



National Aeronautics and  
Space Administration  
Langley Research Center  
Scientific and Technical  
Information Program Office

# Scientific and Technical Aerospace Reports

# STAR

**Volume 41**

**Issue 2**

**January 24, 2003**

## WHAT'S INSIDE

---

- **NASA STI Program Overview**
- **Introduction**
- **NASA STI Availability Information**
- **Table of Contents**
- **Subject Term Index**
- **Personal Author Index**

# NASA STI Program ... in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA Scientific and Technical Information (STI) Program plays a key part in helping NASA maintain this important role.

The NASA STI Program provides access to the NASA STI Database, the largest collection of aeronautical and space science in the world. The STI Program is also NASA's institutional mechanism for disseminating the results of its research and development activities. These results are published by NASA in the NASA STI Report Series, which includes the following report types:

- **TECHNICAL PUBLICATION.** Reports of completed research or major significant phases of research that present the results of NASA programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but has less stringent limitations on manuscript length and extent of graphic presentations.
- **TECHNICAL MEMORANDUM.** Scientific and technical findings that are of preliminary or specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.
- **CONTRACTOR REPORT.** Scientific and technical findings by NASA-sponsored contractors and grantees.
- **CONFERENCE PUBLICATION.** Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.

- **SPECIAL PUBLICATION.** Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.
- **TECHNICAL TRANSLATION.** English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services that help round out the STI Program's diverse offerings include creating custom thesauri, building customized databases, organizing and publishing research results ... even providing videos.

The NASA STI Program is managed by the NASA STI Program Office (STIPO). STIPO is the administrative office at Langley Research Center for the NASA STI Program.

For more information about the NASA STI Program, you can:

- Access the NASA STI Program Home Page at <http://www.sti.nasa.gov>
- E-mail your question via the Internet to [help@sti.nasa.gov](mailto:help@sti.nasa.gov)
- Fax your question to the NASA STI Help Desk at (301) 621-0134
- Telephone the NASA STI Help Desk at (301) 621-0390
- Write to:  
NASA STI Help Desk  
NASA Center for AeroSpace Information  
7121 Standard Drive  
Hanover, MD 21076-1320

# Introduction

*Scientific and Technical Aerospace Reports (STAR)* is an online information resource listing citations and abstracts of NASA and world wide aerospace-related STI. Updated biweekly, *STAR* highlights the most recent additions to the NASA STI Database. Through this resource, the NASA STI Program provides timely access to the most current aerospace-related Research & Development (R&D) results.

*STAR* subject coverage includes all aspects of aeronautics and space research and development, supporting basic and applied research, and application, as well as aerospace aspects of Earth resources, energy development, conservation, oceanography, environmental protection, urban transportation and other topics of high national priority. The listing is arranged first by 11 broad subject divisions, then within these divisions by 76 subject categories and includes two indexes: subject and author.

*STAR* includes citations to Research & Development (R&D) results reported in:

- NASA, NASA contractor, and NASA grantee reports
- Reports issued by other U.S. Government agencies, domestic and foreign institution, universities, and private firms
- Translations
- NASA-owned patents and patent applications
- Other U.S. Government agency and foreign patents and patent applications
- Domestic and foreign dissertations and theses

## The NASA STI Program

The NASA Scientific and Technical Information (STI) Program was established to support the objectives of NASA's missions and research to advance aeronautics and space science. By sharing information, the NASA STI Program ensures that the U.S. maintains its preeminence in aerospace-related industries and education, minimizes duplication of research, and increases research productivity.

Through the NASA Center for AeroSpace Information (CASI), the NASA STI Program acquires, processes, archives, announces and disseminates both NASA's internal STI and world-wide STI. The results of 20th and 21<sup>st</sup> century aeronautics and aerospace research and development, a worldwide investment totaling billions of dollars, have been captured, organized, and stored in the NASA STI Database. New information is continually announced and made available as it is acquired, making this a dynamic and historical collection of value to business, industry, academia, federal institutions, and the general public.

The STI Program offers products and tools that allow efficient access to the wealth of information derived from global R&D efforts. In addition, customized services are available to help tailor this valuable resource to meet your specific needs.

For more information on the most up to date NASA STI, visit the STI Program's website at <http://www.sti.nasa.gov>.

# NASA STI Availability Information

## NASA Center for AeroSpace Information (CASI)

Through NASA CASI, the NASA STI Program offers many information products and services to the aerospace community and to the public, including access to a selection of full text of the NASA STI. Free registration with the program is available to NASA, U.S. Government agencies and contractors. To register, contact CASI at [help@sti.nasa.gov](mailto:help@sti.nasa.gov). Others should visit the program at [www.sti.nasa.gov](http://www.sti.nasa.gov). The 'search selected databases' button provides access to the CASI TRS – the publicly available contents of the NASA STI Database.

Each citation in *STAR* indicates a 'Source of Availability'. When CASI is indicated, the user can order this information directly from CASI using the [STI Online Order Form](#) or contact [help@sti.nasa.gov](mailto:help@sti.nasa.gov) or telephone the CASI Help Desk at 301-621-0390. Before ordering you may access price code tables for STI [documents](#) and [videos](#). When information is not available from CASI, the source of the information is indicated when known.

NASA STI is also available to the public through federal information organizations. NASA CASI disseminates publicly available NASA STI to the National Technical Information Service (NTIS) and to the Federal Depository Library Program (FDLP) through the Government Printing Office (GPO). In addition, NASA patents are available online from the U.S. Patent and Trademark Office.

## National Technical Information Service (NTIS)

The National Technical Information Service serves the American public as a central resource for unlimited, unclassified U.S. Government scientific, technical, engineering, and business related information. For more than 50 years NTIS has provided businesses, universities, and the public timely access to well over 2 million publications covering over 350 subject areas. Visit NTIS at <http://www.ntis.gov>.

## The Federal Depository Library Program (FDLP)

The U.S. Congress established the **Federal Depository Library Program** (FDLP) to ensure access by the American public to U.S. Government information. The program acquires and disseminates information products from all three branches of the U.S. Government to nearly 1,300 Federal depository libraries nationwide. The libraries maintain these information products as part of their existing collections and are responsible for assuring that the public has free access to the information. Locate the Federal Depository Libraries [http://www.access.gpo.gov/su\\_docs](http://www.access.gpo.gov/su_docs).

## The U.S. Patent and Trademark Office (USPTO)

The U.S. Patent and Trademark Office provides online access to full text patents and patent applications. The database includes patents back to 1976 plus some pre-1975 patents. Visit the USPTO at <http://www.uspto.gov/patft/>.

# Table of Contents

## Subject Divisions/Categories

Document citations are grouped by division and then by category, according to the NASA Scope and Coverage Category Guide.

### Aeronautics

01	Aeronautics (General)	1
02	Aerodynamics	2
03	Air Transportation and Safety	5
04	Aircraft Communications and Navigation	7
05	Aircraft Design, Testing and Performance	9
06	Avionics and Aircraft Instrumentation	16
07	Aircraft Propulsion and Power	16
08	Aircraft Stability and Control	20
09	Research and Support Facilities (Air)	20

### Astronautics

12	Astronautics (General)	21
14	Ground Support Systems and Facilities (Space)	23
15	Launch Vehicles and Launch Operations	23
16	Space Transportation and Safety	24

17	Space Communications, Spacecraft Communications, Command and Tracking	26
18	Spacecraft Design, Testing and Performance	26
19	Spacecraft Instrumentation and Astrionics	30
20	Spacecraft Propulsion and Power	31

## **Chemistry and Materials**

23	Chemistry and Materials (General)	36
24	Composite Materials	38
25	Inorganic, Organic, and Physical Chemistry	40
26	Metals and Metallic Materials	44
27	Nonmetallic Materials	47
28	Propellants and Fuels	52
29	Space Processing	54

## **Engineering**

31	Engineering (General)	57
32	Communications and Radar	59
33	Electronics and Electrical Engineering	63
34	Fluid Mechanics and Thermodynamics	67
35	Instrumentation and Photography	88
36	Lasers and Masers	91
37	Mechanical Engineering	94
38	Quality Assurance and Reliability	97
39	Structural Mechanics	98

## **Geosciences**

42	Geosciences (General)	101
43	Earth Resources and Remote Sensing	105
44	Energy Production and Conversion	108
45	Environment Pollution	111
46	Geophysics	126
47	Meteorology and Climatology	131
48	Oceanography	134

## **Life Sciences**

51	Life Sciences (General)	135
52	Aerospace Medicine	152
53	Behavioral Sciences	157
54	Man/System Technology and Life Support	159
55	Exobiology	164

## **Mathematical and Computer Sciences**

60	Computer Operations and Hardware	164
61	Computer Programming and Software	165
62	Computer Systems	176
63	Cybernetics, Artificial Intelligence and Robotics	178
64	Numerical Analysis	179

65	Statistics and Probability	182
66	Systems Analysis and Operations Research	183
67	Theoretical Mathematics	183

## **Physics**

70	Physics (General)	184
71	Acoustics	185
72	Atomic and Molecular Physics	190
73	Nuclear Physics	195
74	Optics	198
75	Plasma Physics	202
76	Solid-State Physics	204
77	Physics of Elementary Particles and Fields	208

## **Social and Information Sciences**

80	Social and Information Sciences (General)	211
81	Administration and Management	211
82	Documentation and Information Science	212

## Space Sciences

89	<a href="#">Astronomy</a>	215
90	<a href="#">Astrophysics</a>	219
91	<a href="#">Lunar and Planetary Science and Exploration</a>	223
92	<a href="#">Solar Physics</a>	227
93	<a href="#">Space Radiation</a>	228

## General

99	<a href="#">General</a>	229
----	-------------------------	-----

## Indexes

Two indexes are available. You may use the find command under the tools menu while viewing the PDF file for direct match searching on any text string. You may also select either of the two indexes provided for searching on *NASA Thesaurus* subject terms and personal author names.

[Subject Term Index](#)

[Personal Author Index](#)

---

# SCIENTIFIC AND TECHNICAL AEROSPACE REPORTS

*A Biweekly Publication of the National Aeronautics and Space Administration*

---

VOLUME 41, JANUARY 24, 2003

## 01 AERONAUTICS (GENERAL)

*Includes general research topics related to manned and unmanned aircraft and the problems of flight within the Earth's atmosphere. Also includes manufacturing, maintenance, and repair of aircraft. For specific topics in aeronautics see categories 02 through 09. For information related to space vehicles see 12 Astronautics.*

**20030004233** NASA Langley Research Center, Hampton, VA USA

### **The Contributions of Vincent Justus Burnelli**

Wood, Richard M., NASA Langley Research Center, USA; [2003]; 14p; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2003-0292; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A review of the contributions and the professional life of Vincent Justus Burnelli are presented. Burnelli was an inventor, aircraft designer and a leading pioneer in early aviation within the USA. A discussion of many of his leading accomplishments are discussed, including hid design of the first commercial twin engine transport, invent of the lifting-body/lifting-fuselage aircraft. He was one of the first to put into practice retractable landing gear, variable area and camber wings, winglets, and full span flaps for twin engine aircraft. A review of a number of his sixty patents is presented and discussed as they relate to his eleven aircraft designs that were produced. A brief discussion of his accomplishments and contributions, as they relate to present aircraft design trends is also presented.

Author

*Biography; Aircraft Design; Aeronautics*

**20030004285** NASA, Washington, DC USA

### **Celebrating a Century of Flight**

O'Keefe, Sean O., NASA, USA; Jumper, John P., Department of the Air Force, USA; Dailey, J. R., USA Centennial of Flight Commission, USA; 2002; 32p; In English; Orginal contains color illustrations

Report No.(s): NASA/SP-2002-09-511-HQ; NAS 1.21:2002-09-511-HQ; ISBN 0-16-067541-3; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Since 1915, the National Advisory Committee for Aeronautics (NACA), transformed into NASA in 1958, has performed cutting-edge research to solve the problems of flight. Using a Grumman F4F-3 Wildcat during World War II, NACA engineers at the Langley Aeronautical Laboratory (now Langley Research Center) in Hampton, Virginia, used this aircraft to investigate the cuffs on the propeller blades to determine their efficiency. While not built to the full production standard of other Grumman Wildcats, research on this aircraft, the second F4F-3, proved most successful in advancing knowledge of the aerodynamics of this engine and propeller system. A close-up of the propeller blades with Curtiss Electric Propellers' logo is shown.

Derived from text

*Aeronautical Engineering; Aircraft Design; Space Flight; Aerospace Sciences; Military Helicopters; NASA Space Programs*

## 02 AERODYNAMICS

*Includes aerodynamics of flight vehicles, test bodies, airframe components and combinations, wings, and control surfaces. Also includes aerodynamics of rotors, stators, fans and other elements of turbomachinery. For related information, see also 34 Fluid Mechanics and Heat Transfer.*

**20030002240** NASA Langley Research Center, Hampton, VA USA

### **Computational Analysis of Towed Ballute Interactions**

Gnoffo, Peter A., NASA Langley Research Center, USA; Anderson, Brian P., George Washington Univ., USA; [2002]; 18p; In English; 8th AIAA/ASME Joint Thermophysics and Heat Transfer Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2997; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A ballute (balloon-parachute) is an inflatable, aerodynamic drag device for application to planetary entry vehicles. Ballutes may be directly attached to a vehicle, increasing its cross-sectional area upon inflation, or towed behind the vehicle as a semi-independent device that can be quickly cut free when the requisite change in velocity is achieved. The aerothermodynamics of spherical and toroidal towed ballutes are considered in the present study. A limiting case of zero towline length (clamped system) is also considered. A toroidal system can be designed (ignoring influence of the tethers) such that all flow processed by the bow shock of the towing spacecraft passes through the hole in the toroid. For a spherical ballute, towline length is a critical parameter that affects aeroheating on the ballute being towed through the spacecraft wake. In both cases, complex and often unsteady interactions ensue in which the spacecraft and its wake resemble an aero spike situated in front of the ballute. The strength of the interactions depends upon system geometry and Reynolds number. We show how interactions may envelope the base of the towing spacecraft or impinge on the ballute surface with adverse consequences to its thermal protection system. Geometric constraints to minimize or eliminate such adverse interactions are discussed. The towed, toroidal system and the clamped, spherical system show greatest potential for a baseline design approach.

Author

*Atmospheric Entry; Ballutes; Spacecraft Control; Flight Control; Towed Bodies; Computerized Simulation*

**20030002253** NASA Langley Research Center, Hampton, VA USA

### **Computational Simulations of a Three-Dimensional High-Lift Wing**

Khorrami, M. R., NASA Langley Research Center, USA; Berkman, M. E., High Technology Corp., USA; Li, F., High Technology Corp., USA; Singer, B. A., NASA Langley Research Center, USA; [2002]; 12p; In English; 20th AIAA Applied Aerodynamics Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS1-00088; RT46324

Report No.(s): AIAA Paper 2002-2804; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Highly resolved computational simulations of a three-dimensional high-lift wing are presented. The steady Reynolds Averaged Navier-Stokes computations are geared towards understanding the flow intricacies associated with inboard and outboard flap side edges. Both moderate and high flap deflections are simulated. Computed surface pressure fields accurately capture the footprint of vortices at flap side edges and are in excellent agreement with pressure sensitive paint measurements. The computations reveal that the outboard vortex possesses higher rotational velocities and lower core pressure than the inboard vortex and therefore is susceptible to severe vortex breakdown.

Author

*Vortices; Wings; Computerized Simulation; Three Dimensional Models; Lift; Computational Fluid Dynamics*

**20030002383** Air Force Research Lab., Air Vehicles Directorate, Wright-Patterson AFB, OH USA

### **An Algorithm for Computing the Range of Trimable Angle of Attack for Aircraft Experiencing Effector Failures**

Kaloust, Joseph; Doman, Dave; Oct. 2002; 14p; In English; Prepared in collaboration with Hope College, Dept. of Engineering, Holland, MI

Report No.(s): AD-A407685; AFRL-VA-WP-TP-2002-324; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a method for computing the range of angle of attack for which an air vehicle can be rotationally trimmed when experiencing control effector failures. The algorithms are applied to an unpowered reentry vehicle as an example. Types of failures considered include floating effectors that do not contribute to the aerodynamic forces and moments or effectors that

are locked at a given position within the effector displacement range. The algorithm can provide critical information to online trajectory generators or path planners for autonomous air vehicles.

DTIC

*Algorithms; Angle of Attack; Effectors; Aerodynamic Forces; Reentry Vehicles; Failure Analysis*

**20030003696** NASA Dryden Flight Research Center, Edwards, CA USA

**Aerodynamic Assessment of Flight-Determined Subsonic Lift and Drag Characteristics of Seven Lifting-Body and Wing-Body Reentry Vehicle Configurations**

Saltzman, Edwin J., Analytical Services and Materials, Inc., USA; Wang, K. Charles, Aerospace Corp., USA; Iliff, Kenneth W., NASA Dryden Flight Research Center, USA; November 2002; 160p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 529-50-04-00-RR

Report No.(s): NASA/TP-2002-209032; NAS 1.60:209032; H-2397; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This report examines subsonic flight-measured lift and drag characteristics of seven lifting-body and wing-body reentry vehicle configurations with truncated bases. The seven vehicles are the full-scale M2-F1, M2-F2, HL-10, X-24A, X-24B, and X-15 vehicles and the Space Shuttle Enterprise. Subsonic flight lift and drag data of the various vehicles are assembled under aerodynamic performance parameters and presented in several analytical and graphical formats. These formats are intended to unify the data and allow a greater understanding than individually studying the vehicles allows. Lift-curve slope data are studied with respect to aspect ratio and related to generic wind-tunnel model data and to theory for low-aspect-ratio platforms. The definition of reference area is critical for understanding and comparing the lift data. The drag components studied include minimum drag coefficient, lift-related drag, maximum lift-to drag ratio, and, where available, base pressure coefficients. The influence of forebody drag on afterbody and base drag at low lift is shown to be related to Hoerner's compilation for body, airfoil, nacelle, and canopy drag. This feature may result in a reduced need of surface smoothness for vehicles with a large ratio of base area to wetted area. These analyses are intended to provide a useful analytical framework with which to compare and evaluate new vehicle configurations of the same generic family.

Author

*Lifting Bodies; Aerodynamic Characteristics; Reentry Vehicles; Aerodynamic Drag; Lift Drag Ratio; Minimum Drag; Body-Wing Configurations*

**20030003705** NASA Glenn Research Center, Cleveland, OH USA

**Computing Axisymmetric Jet Screech Tones Using Unstructured Grids**

Jorgenson, Philip C. E., NASA Glenn Research Center, USA; Loh, Ching Y., Taitech, Inc., USA; August 2002; 16p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 708-90-43

Report No.(s): NASA/TM-2002-211799; E-13494; NAS 1.15:211799; AIAA Paper 2002-3889; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The space-time conservation element and solution element (CE/SE) method is used to solve the conservation law form of the compressible axisymmetric Navier-Stokes equations. The equations are time marched to predict the unsteady flow and the near-field screech tone noise issuing from an underexpanded circular jet. The CE/SE method uses an unstructured grid based data structure. The unstructured grids for these calculations are generated based on the method of Delaunay triangulation. The purpose of this paper is to show that an acoustics solution with a feedback loop can be obtained using truly unstructured grid technology. Numerical results are presented for two different nozzle geometries. The first is considered to have a thin nozzle lip and the second has a thick nozzle lip. Comparisons with available experimental data are shown for flows corresponding to several different jet Mach numbers. Generally good agreement is obtained in terms of flow physics, screech tone frequency, and sound pressure level.

Author

*Symmetry; Screech Tones; Space-Time Ce/Se Method; Conservation Laws; Navier-Stokes Equation; Unstructured Grids (Mathematics)*

**20030003815** NASA Langley Research Center, Hampton, VA USA

**Investigation of Transonic Reynolds Number Scaling on a Twin-Engine Transport**

Curtin, M. M., Boeing Commercial Airplane Co., USA; Bogue, D. R., Boeing Commercial Airplane Co., USA; Om, D., Boeing Commercial Airplane Co., USA; Rivers, S. M. B., NASA Langley Research Center, USA; Pendergraft, O. C., Jr., NASA Langley Research Center, USA; Wahls, R. A., NASA Langley Research Center, USA; [2002]; 14p; In English; 40th AIAA Aerospace

Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0420; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper discusses Reynolds number scaling for aerodynamic parameters including force and wing pressure measurements. A full-span model of the Boeing 777 configuration was tested at transonic conditions in the National Transonic Facility (NTF) at Reynolds numbers (based on mean aerodynamic chord) from 3.0 to 40.0 million. Data was obtained for a tail-off configuration both with and without wing vortex generators and flap support fairings. The effects of aeroelastics were separated from Reynolds number effects by varying total pressure and temperature independently. Data from the NTF at flight Reynolds number are compared with flight data to establish the wind tunnel/flight correlation. The importance of high Reynolds number testing and the need for developing a process for transonic Reynolds number scaling is discussed. This paper also identifies issues that need to be worked for Boeing Commercial to continue to conduct future high Reynolds number testing in the NTF.

Author

*Reynolds Number; Wind Tunnel Tests; Flight Tests; Boeing 777 Aircraft; Airfoil Profiles; Aircraft Configurations*

**20030003914** NASA Dryden Flight Research Center, Edwards, CA USA

**A Ground-Based Research Vehicle for Base Drag Studies at Subsonic Speeds**

Diebler, Corey, NASA Dryden Flight Research Center, USA; Smith, Mark, NASA Dryden Flight Research Center, USA; November 2002; 20p; In English; United Engineering Foundation Conference on the Aerodynamics of Heavy Vehicles, Trucks, Buses, and Trains, 2-6 Dec. 2002, Monterey-Pacific Grove, CA, USA; Sponsored by United Engineering Foundation, Inc., USA Contract(s)/Grant(s): RTOP 953-50-00-SE-RR

Report No.(s): NASA/TM-2002-210737; NAS 1.15:210737; H-2513; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A ground research vehicle (GRV) has been developed to study the base drag on large-scale vehicles at subsonic speeds. Existing models suggest that base drag is dependent upon vehicle forebody drag, and for certain configurations, the total drag of a vehicle can be reduced by increasing its forebody drag. Although these models work well for small projectile shapes, studies have shown that they do not provide accurate predictions when applied to large-scale vehicles. Experiments are underway at the NASA Dryden Flight Research Center to collect data at Reynolds numbers to a maximum of  $3 \times 10^{(exp 7)}$ , and to formulate a new model for predicting the base drag of trucks, buses, motor homes, reentry vehicles, and other large-scale vehicles. Preliminary tests have shown errors as great as 70 percent compared to Hoerner's two-dimensional base drag prediction. This report describes the GRV and its capabilities, details the studies currently underway at NASA Dryden, and presents preliminary results of both the effort to formulate a new base drag model and the investigation into a method of reducing total drag by manipulating forebody drag.

Author

*Research Vehicles; Aerodynamic Drag; Base Flow; Subsonic Speed; Surface Vehicles*

**20030004232** NASA Langley Research Center, Hampton, VA USA

**Aerodynamic Drag and Drag Reduction: Energy and Energy Savings (Invited)**

Wood, Richard M., NASA Langley Research Center, USA; [2003]; 42p; In English; 41st AIAA Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2003-0209; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An assessment of the role of fluid dynamic resistance and/or aerodynamic drag and the relationship to energy use in the USA is presented. Existing data indicates that up to 25% of the total energy consumed in the USA is used to overcome aerodynamic drag, 27% of the total energy used in the USA is consumed by transportation systems, and 60% of the transportation energy or 16% of the total energy consumed in the USA is used to overcome aerodynamic drag in transportation systems. Drag reduction goals of 50% are proposed and discussed which if realized would produce a 7.85% total energy savings. This energy savings correlates to a yearly cost savings in the \$30Billion dollar range.

Author

*Aerodynamic Drag; Drag Reduction; Cost Reduction*

**20030004240** NASA Langley Research Center, Hampton, VA USA

**Investigation of an Oscillating Surface Plasma for Turbulent Drag Reduction**

Wilkinson, Stephen P., NASA Langley Research Center, USA; [2003]; 22p; In English; 41st Aerospace Sciences Meeting and Exhibit, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains

color illustrations

Report No.(s): AIAA Paper 2003-1023; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An oscillating, weakly ionized surface plasma has been investigated for use in turbulent boundary layer viscous drag reduction. The study was based on reports showing that mechanical spanwise oscillations of a wall can reduce viscous drag due to a turbulent boundary layer by up to 40%. It was hypothesized that the plasma induced body force in high electric field gradients of a surface plasma along strip electrodes could also be configured to oscillate the flow. Thin dielectric panels with millimeter-scale, flush-mounted, triad electrode arrays with one and two-phase high voltage excitation were tested. Results showed that while a small oscillation could be obtained, the effect was lost at a low frequency (less than 100Hz). Furthermore, a mean flow was generated during the oscillation that complicates the effect. Hot-wire and pitot probe diagnostics are presented along with phase-averaged images revealing plasma structure.

Author

*Oscillations; Plasmas (Physics); Drag Reduction; Turbulent Boundary Layer; Viscous Drag; Aerodynamic Drag*

### 03

## AIR TRANSPORTATION AND SAFETY

*Includes passenger and cargo air transport operations; aircraft ground operations; flight safety and hazards; and aircraft accidents. Systems and hardware specific to ground operations of aircraft and to airport construction are covered in 09 Research and Support Facilities (Air). Air traffic control is covered in 04 Aircraft Communications and Navigation. For related information see also 16 Space Transportation and Safety; and 85 Technology Utilization and Surface Transportation.*

**20030002645** RAND Corp., Santa Monica, CA USA

### **Safer Skies: Baggage Screening and Beyond**

Kauvar, Gary; Rostker, Bernard; Shaver, Russell; Jan. 2002; 12p; In English

Report No.(s): AD-A407979; RAND-WP-131-RC/NSRD; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper is the result of an examination of plans for implementing explosive detection systems for checked baggage at all U.S. airports, and it contains suggested changes to the existing plans for implementation of the systems. The work was funded by RAND's independent research and development funds. It should be of interest to those concerned about whether the Federal Aviation Administration's (FAA's) plans (now part of the Aviation and Transportation Security Act) appropriately respond to the security threats against our air transportation system. It should also interest those who wish to better understand how to address the natural tension between unfettered access to our commercial aircraft and enhanced transportation security.

DTIC

*Explosives Detection; Civil Aviation*

**20030002662** Civil Aeromedical Inst., Civil Aeromedical Inst., Oklahoma City, OK USA

### **Access-to-Egress I: Interactive Effects of Factors That Control the Emergency Evacuation of Naive Passengers Through the Transport Airplane Type-III Overwing Exit Final Report**

McLean, Garnet A.; Corbett, Cynthia L.; Larcher, Kenneth G.; McDown, Jerry R.; Palmerton, David A.; Aug. 2002; 40p; In English; Prepared in cooperation with Advancia Corp., Oklahoma City, OK

Report No.(s): AD-A408009; DOT/FAA/AM-02/16; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Simulated emergency evacuations were conducted from a narrow-body transport airplane simulator through a Type-III overwing exit. The independent variables were passageway configuration, hatch disposal location, subject group size, and subject group motivation level. Additional variables of interest included individual subject characteristics, i.e., gender, age, waist size, and height, all of which had been shown in previous studies to significantly affect emergency egress. Participants were restricted to those who had no previous emergency evacuation (research) history. The dependent variables of interest included hatch operation time and the time for individual subjects to egress. Evacuation trials were conducted with 48 groups of either 30, 50, or 70 subjects per group, for a total of 2,544 subject participants. Each subject group completed 4 evacuation trials, totaling 192 evacuations. Results reported for hatch operation time include data from all trials, since each trial had a different, naive hatch operator. The egress time results include data only from each group's first evacuation trial in which every subject was naive. Significant main effects of hatch disposal location on both Exit-Ready-to-Use Time (p less than .004) and First-Person- Out Time (p less than .008) were revealed, without effects of the other variables. Significant main effects on individual subject egress time were found for waist size (p less than .0001), gender (p less than .0001), and age (p less than .0001). A small, but significant, main effect was also found for passageway configuration (p less than .001), which was confounded by improper hatch disposal and a between-groups imbalance in individual subject characteristics. This situation produced a significant (4-way) passageway

configuration by hatch disposal location by subject group density by subject group motivation level interaction effect (p less than .008).

DTIC

*Transport Aircraft; Evacuating (Transportation); Emergency Landing; Egress; Passengers*

**20030002700** Federal Aviation Administration, Office of Aviation Medicine, Washington, DC USA

**Risk Perception and Risk Tolerance in Aircraft Pilots *Final Report***

Hunter, David R.; Sep. 2002; 26p; In English

Report No.(s): AD-A407997; DOT/FAA/AM-02/17; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Poor pilot decision-making has been identified as a factor in a large percentage of fatal aviation accidents. Risk perception and risk tolerance are two factors that can significantly impact pilot decision-making. Inaccurate risk perception can lead pilots to ignore or misinterpret external cues that demand immediate and effective decisions to avoid hazards. High risk tolerance can lead pilots to choose courses of action that unnecessarily expose them to hazards and increased likelihood of accident. Risk perception and risk tolerance are related and often confounded constructs. This study sought to separate these two constructs and to develop and evaluate measures that could be used to compare individual pilots on the constructs. A large sample of pilots visiting a government web site completed two risk perception, and three risk tolerance measures. They also completed a short scale assessing their involvement in hazardous aviation events and provided demographic information. Analysis of the data showed that the five new measures demonstrated acceptable internal consistency, The measures of risk perception were only mildly related to risk tolerance, suggesting that these are separate constructs. As hypothesized, pilot perception of risk was negatively related to risk tolerance. In addition, risk perception demonstrated a small, but significant, correlation with self-reported involvement in hazardous aviation events. However, contrary to expectations, risk tolerance was not significantly related to hazardous events. The results suggest that it is differences in cognitive skills required for accurate risk perception that place pilots at greater likelihood of accident involvement, rather than differences in underlying personality traits related to risk tolerance. The implications of the findings are discussed, along with limitations on the generalizability of the results, and suggestions for future research to improve the measurement scales are given.

DTIC

*Safety; Aircraft Pilots; Aircraft Accidents; Risk; Tolerances (Mechanics)*

**20030003819** Civil Aerospace Medical Inst., Oklahoma City, OK USA

**General Aviation Maintenance- Related Accidents: A Review of Ten Years of NTSB Data *Final Report***

Goldman, Scott M., Civil Aerospace Medical Inst., USA; Fiedler, Edna R., Civil Aerospace Medical Inst., USA; King, Raymond E., Civil Aerospace Medical Inst., USA; December 2002; 14p; In English

Contract(s)/Grant(s): FAA-AM-E-01-AAM-182

Report No.(s): DOT/FAA/AM-02/23; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

NTSB accident investigation reports for general aviation accidents occurring between 1988 and 1997 were analyzed in order to provide a descriptive look at ten years worth of accident data. This sample included 1,503 reports, all of which indicated at least one maintenance-related issue as a cause or factor in the accident. Initial analyses describe the frequency of occurrence for type of maintenance task and type of aircraft. Accidents were compared on frequency of occurrence, number of fatalities, and number of serious injuries. Odds for each variable resulting in a fatality or injury are reported. Results indicated that installation errors were the leading maintenance-related cause or factor involved with the accidents. Since installation errors were most common further analyses focused on a more detailed description of installation error. Type of installation error, type of aircraft system involved in the installation, whether or not the installation was inspected, credentials of the mechanic performing the installation, and the operational impact of the installation error were investigated. Results indicate that reversed installation and wrong part were the two installation errors most likely to cause death or injury in GA aircraft accident.

Author

*Aircraft Accident Investigation; Aircraft Accidents; Aircraft Maintenance; Installing*

**20030003995** Bureau of Transportation Statistics, Washington, DC USA

**U.S. International Travel and Transportation Trends**

2002; 54p; In English

Report No.(s): PB2003-100977; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Today, security is one of the most important issues in U.S. international passenger travel and transportation. The terrorist attacks of September 11, 2001, had an immediate impact on international travel and transportation, and are expected to continue to influence not only the aviation industry but all passenger travel to and from the USA. Following the attacks, for example,

overseas travel to the USA declined by 39 percent in October 2001 compared with October 2000, and overseas travel from the USA fell 29 percent.

NTIS

*Airport Security; Terrorism; Travel; Air Transportation*

## 04

### AIRCRAFT COMMUNICATIONS AND NAVIGATION

*Includes all modes of communication with and between aircraft; air navigation systems (satellite and ground based); and air traffic control. For related information see also 06 Avionics and Aircraft Instrumentation; 17 Space Communications; Spacecraft Communications, Command and Tracking, and 32 Communications and Radar.*

**20030002221** NASA Langley Research Center, Hampton, VA USA

#### **Use of Traffic Intent Information by Autonomous Aircraft in Constrained Operations**

Wing, David J., NASA Langley Research Center, USA; Barmore, Bryan E., Titan Systems, Inc., USA; Krishnamurthy, Karthik, Titan Systems, Inc., USA; [2002]; 14p; In English; AIAA Guidance, Navigation, and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4555; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper presents findings of a research study designed to provide insight into the issue of intent information exchange in constrained en-route air-traffic operations and its effect on pilot decision-making and flight performance. The piloted simulation was conducted in the Air Traffic Operations Laboratory at the NASA Langley Research Center. Two operational modes for autonomous flight management were compared under conditions of low and high operational complexity (traffic and airspace hazard density). The tactical mode was characterized primarily by the use of traffic state data for conflict detection and resolution and a manual approach to meeting operational constraints. The strategic mode involved the combined use of traffic state and intent information, provided the pilot an additional level of alerting, and allowed an automated approach to meeting operational constraints. Operational constraints applied in the experiment included separation assurance, schedule adherence, airspace hazard avoidance, flight efficiency, and passenger comfort. The strategic operational mode was found to be effective in reducing unnecessary maneuvering in conflict situations where the intruder's intended maneuvers would resolve the conflict. Conditions of high operational complexity and vertical maneuvering resulted in increased proliferation of conflicts, but both operational modes exhibited characteristics of stability based on observed conflict proliferation rates of less than 30 percent. Scenario case studies illustrated the need for maneuver flight restrictions to prevent the creation of new conflicts through maneuvering and the need for an improved user interface design that appropriately focuses the pilot's attention on conflict prevention information. Pilot real-time assessment of maximum workload indicated minimal sensitivity to operational complexity, providing further evidence that pilot workload is not the limiting factor for feasibility of an en-route distributed traffic management system, even under highly constrained conditions.

Author

*Air Traffic; Flight Management Systems; Automatic Control; Pilot Support Systems; Situational Awareness; Pilot Performance*

**20030002227** NASA Langley Research Center, Hampton, VA USA

#### **Newly Enacted Intent Changes to ADS-B MASPS: Emphasis on Operations, Compatibility, and Integrity**

Barhydt, Richard, NASA Langley Research Center, USA; Warren, Anthony W., Boeing Air Traffic Management, USA; [2002]; 8p; In English; AIAA Guidance, Navigation and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4932; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Significant changes to the intent reporting structure in the Minimum Aviation System Performance Standards (MASPS) for Automatic Dependent Surveillance Broadcast (ADS-B) have recently been approved by RTCA Special Committee 186. The re-structured intent formats incorporate two major changes to the current MASPS (DO-242): addition of a Target State (TS) report that provides information on the horizontal and vertical targets for the current flight segment and replacement of the current Trajectory Change Point (TCP) and TCP+1 reports with Trajectory Change (TC) reports. TC reports include expanded information about TCPs and their connecting flight segments, in addition to making provisions for trajectory conformance elements. New intent elements are designed to accommodate a greater range of intent information, better reflect operational use and capabilities of existing and future aircraft avionics, and aid trajectory synthesis and conformance monitoring systems. These

elements are expected to benefit near-term and future Air Traffic Management (ATM) applications, including separation assurance, local traffic flow management, and conformance monitoring. The current MASPS revision (DO-242A) implements those intent elements that are supported by current avionics standards and data buses. Additional elements are provisioned for inclusion in future MASPS revisions (beyond DO-242A) as avionics systems are evolved.

Author

*Air Traffic Control; Flight Management Systems; Architecture (Computers); Software Engineering; Trajectory Planning; Trajectory Analysis*

**20030002683** Civil Aeromedical Inst., Civil Aeromedical Inst., Oklahoma City, OK USA

**The Moderator Effects of Taskload on the Interplay Between en Route Intra-Sector Team Communications, Situation Awareness, and Mental Workload *Final Report***

Bailey, Larry L.; Willems, Ben F.; Oct. 2002; 19p; In English; Prepared in cooperation with FAA William J. Hughes Technical Center, Atlantic City, NJ

Report No.(s): AD-A408021; DOT/FAA/AM-02/18; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Recently, the Federal Aviation Administration (FAA) began a program of research to investigate the role that intra-team communication plays in helping radar air traffic control teams coordinate their individual efforts. Based on the literature of controller and pilot communications, it was hypothesized that as taskload increased, communications would increase in order to maintain situational awareness. Furthermore, it was hypothesized that there would be an inverse relationship between taskload and situational awareness. Using a high-fidelity air traffic control (ATC) simulator, ten 2-person teams, consisting of certified ATC specialists, performed routine ATC tasks within a single factor (low and high workload) repeated measure design. Performance was videotaped and the frequency of intra-team communications was counted. Post scenario perceptions of taskload and situational awareness were assessed using a version of the NASA Taskload Index (TLX) and a 4-item scale developed at the William J. Hughes Technical Center, respectively. Bivariate correlations of intra-team communications (c), taskload (t) and situational awareness (s) were separately analyzed for low and high workload. Because the sign of the correlations were established a priori, a one tailed test of significance was used with  $p < .10$  as a test of significance. Results for the low workload condition were  $r = -.14$  (ns),  $r = .38$  (ns), and  $r = -.62^{**}$ . Correlations for the high workload conditions were  $r = .51^*$ ,  $r = .63^*$ ,  $r = -.30$  (ns). Under high workload conditions, as perceptions of taskload increased, there was a corresponding increase in the frequency of intra-team communications. The data suggest that the increase in communications is used to maintain situational awareness. This conclusion supports the a priori hypotheses.

DTIC

*Air Traffic Control; Telecommunication; Air Traffic Controllers (Personnel); Teams*

**20030002830** Oklahoma Univ., Norman, OK USA

**Aiding Planning in Air Traffic Control: An Experimental Investigation of the Effects of Perceptual Information Integration *Final Report***

Moertl, Peter M., Oklahoma Univ., USA; Gronlund, Scott D., Oklahoma Univ., USA; Dougherty, Michael R. P., Maryland Univ., USA; Mills, Scott H., Technology Resources, Inc., USA; Canning, John M., White Oak Technologies, Inc., USA; Johansson, Joakim, Ericsson, Inc., Sweden; December 2002; 14p; In English

Contract(s)/Grant(s): FAA-97-G-037; AM-A-00-HRR-522

Report No.(s): DOT/FAA/AM-02/22; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Prior research examined how controllers plan in their traditional environment and identified various information uncertainty by perceptually representing important constraints. This included integrating spatial information on the radar screen with discrete information (planned sequences of air traffic). Improved planning performance and decreased workload in the planning aid condition have been reported. The purpose of this paper was to determine the source of these performance improvements. Analysis of computer interactions using loglinear modeling showed that the planning interface led to less repetitive, but more integrated, information retrieval gave rise to the performance improvements. Potential applications of this research include the design and evaluation of interface automation that keeps users in active control by modification of perceptual task characteristics.

Author

*Air Traffic Control; Information Management; Performance; Planning*

**20030004097** Civil Aerospace Medical Inst., Oklahoma City, OK USA

**The Effects of Practice and Coaching on the Air Traffic Selection and Training Test Battery *Final Report***

Heil, Michael C., Civil Aerospace Medical Inst., USA; Detwiler, Cristy A., Civil Aerospace Medical Inst., USA; Agen, Rebecca, Civil Aerospace Medical Inst., USA; Williams, Clara A., Civil Aerospace Medical Inst., USA; Agnew, Brandy O., Civil

Aerospace Medical Inst., USA; King, Raymond E., Civil Aerospace Medical Inst., USA; December 2002; 14p; In English  
Contract(s)/Grant(s): FAA-HRR-521

Report No.(s): DOT/FAA/AM-02-24; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Air Traffic Selection and Training (AT-SAT) test battery is the Federal Aviation Administration's (FAA's) recently developed computerized selection test for Air Traffic Control Specialists (ATCSs). Only one form of the AT-SAT battery was developed as part of the initial development and validation effort, meaning that all people who take the test receive the exact same items. The goals of the current study were to: 1) determine if repeated test taking improves performance; 2) determine if coaching improves performance; 3) identify specific tests within the AT-SAT battery that are most susceptible to practice and coaching effects; and, 4) determine the extent to which practice and coaching effects potentially impact hiring decisions. Study participants were not ATCSs; however, they had to meet basic requirements for the ATC occupation to be eligible for participation. They were recruited through a contractor and randomly assigned to one of three experimental groups. Group 1 received a one-day coaching intervention before taking the first administration of AT-SAT. Group 2 took the first administration of AT-SAT, and then received the coaching intervention before the second administration. Group 3, the control group, took AT-SAT three times without coaching. Test scores were compared both between and within each group using ANOVA with repeated measures. The results suggest that performance on the AT-SAT battery may indeed be influenced by both practice and coaching effects. More specifically, the results demonstrate that the composite AT-SAT score that is used for hiring decisions increases with repeated administrations, although the greatest increase occurs following coaching. In terms of selection decisions, it is conceivable that coaching could move an individual from a failing status into a passing status and even from the qualified category into the well-qualified category, without improving their ability to perform on the job.

Author

*Air Traffic Control; Air Traffic Controllers (Personnel); Education; Students; Training Evaluation*

**20030004223** Federal Aviation Administration, Cambridge, MA USA

**Vulnerability Assessment of the Transportation Infrastructure Relying on the Global Positioning System *Final Report***

Volpe, J. A.; Aug. 29, 2001; 118p; In English

Report No.(s): PB2003-101435; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

In October 1997, the Commission recommended an assessment of the vulnerability of the transportation infrastructure relying on the use of global positioning system (GPS). Specifically, the report recommended a three-part assessment: fully evaluate actual and potential sources of interference to, and vulnerabilities of, GPS before a final decision is reached to eliminate other radionavigation and aircraft landing guidance systems; sponsor an independent, integrated assessment of risks to civilians users of GPS-based systems, projected through the year 2010; and base decisions regarding the proper federal navigation systems mix and the final architecture of the modernized National Airspace System (NAS) on the results of that assessment.

NTIS

*Global Positioning System; Vulnerability; Air Transportation*

## 05

### AIRCRAFT DESIGN, TESTING AND PERFORMANCE

*Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.*

**20030002248** Marine Corps Development and Education Command, Quantico, VA USA

**V/STOL Shipboard Recovery: 'It's Not Just Another Carrier Landing'**

Shorter, Andrew G.; Apr. 12, 2002; 55p; In English

Report No.(s): AD-A407726; AY-01-02; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The USA Marine Corps operates the only vertical/short take-off and landing (V/STOL) jet aircraft in the USA, the AV-8B Harrier. This aircraft provides the USMC with a unique basing flexibility not found in conventional jet aircraft. The Harrier is the only aircraft that can accomplish shipboard operations (take-offs and landings) using routine procedures that are the same as those for shorebased launch and recovery operations. The USMC harrier force trains and operates at less than its full potential because of the tendency to unnecessarily apply conventional aircraft carrier training and operating procedures to the Harrier. The current V/STOL shipboard training and currency requirements do not maximize the use of limited manpower and operational flying time with respect to the highly technical, mission oriented, tactical core skills training There are historical elements that

contribute to this situation as well as adherence to perceptions that either were or are now invalid for the current conditions. However logical and sensible these measures may have been or seemed to be up to this point, the current standards can and should be changed to more closely reflect the modern capabilities and requirements of today's V/STOL force.

DTIC

*Aircraft Carriers; Vertical Takeoff Aircraft; Jet Aircraft*

**20030002250** Department of Defense, Office of the Inspector General, Arlington, VA USA

**Acquisition: Fuel Cells of the V-22 Osprey Joint Advanced Vertical Aircraft**

Ugone, Mary L.; Meling, John E.; Snider, Jack D.; Gause, Neal J.; Carey, Alice F.; Oct. 24, 2002; 76p; In English  
Report No.(s): AD-A407722; IG/DOD-D-2003-013; No Copyright; Avail: Defense Technical Information Center (DTIC)

This audit resulted from allegations referred to the Office of the Inspector General of the Department of Defense by the Commandant of the Marine Corps on December 27, 2001. Of those allegations, four concerned the crashworthiness of the fuel cells or tanks installed on the V-22. Specifically, it was alleged by a Marine aviator that: the fuel cell installed in the V-22 was not able to withstand the required 10g (gravitational acceleration) impact; a fuel cell that could withstand the impact was developed but not installed because of structural issues affecting the weight of the aircraft; the V-22 design could have incorporated breakaway fuel cells, which break away on impact to prevent fires and explosions, but, instead, incorporated fuel cells that will burst and flood the cabin with fuel; and because the V-22 fuel cells did not pass the drop test, the V-22 fuel cell standards were lowered to incorporate a cell design that would work and still maintain a weight savings. Appendix B of this report covers those four allegations. The Office of the Inspector General of the Department of Defense addressed the other allegations in a separate report, dated August 19, 2002.

DTIC

*Fuel Cells; Crashworthiness; Vertical Takeoff Aircraft*

**20030002280** NASA Langley Research Center, Hampton, VA USA

**Constrained Aerothermodynamic Design of Hypersonic Vehicles**

Gally, Tom, Embry-Riddle Aeronautical Univ., USA; Campbell, Dick, NASA Langley Research Center, USA; [2002]; 7p; In English; 20th Applied Aerodynamics Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3139; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An investigation was conducted into possible methods of incorporating a hypersonic design capability with aerothermodynamic constraints into the CDISC aerodynamic design tool. The work was divided into two distinct phases: develop relations between surface curvature and hypersonic pressure coefficient which are compatible with CDISC's direct-iterative design method; and explore and implement possible methods of constraining the heat transfer rate over all or portions of the design surface. The main problem in implementing this method has been the weak relationship between surface shape and pressure coefficient at the stagnation point and the need to design around the surface blunt leading edge where there is a slope singularity. The final results show that some success has been achieved, but further improvements are needed.

Author

*Aerothermodynamics; Hypersonic Vehicles; Spacecraft Design*

**20030002376** NASA Langley Research Center, Hampton, VA USA

**Energy Absorbing Seat System for an Agricultural Aircraft**

Kellas, Sotiris, Lockheed Martin Corp., USA; December 2002; 31p; In English

Contract(s)/Grant(s): NAS1-96014; RTOP 728-50-10-01

Report No.(s): NASA/CR-2002-212132; NAS 1.26:212132; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A task was initiated to improve the energy absorption capability of an existing aircraft seat through cost-effective retrofitting, while keeping seat-weight increase to a minimum. This task was undertaken as an extension of NASA ongoing safety research and commitment to general aviation customer needs. Only vertical crash scenarios have been considered in this task which required the energy absorbing system to protect the seat occupant in a range of crash speeds up to 31 ft/sec. It was anticipated that, the forward and/or side crash accelerations could be attenuated with the aid of airbags, the technology of which is currently available in automobiles and military helicopters. Steps which were followed include, preliminary crush load determination, conceptual design of cost effective energy absorbers, fabrication and testing (static and dynamic) of energy absorbers, system analysis, design and fabrication of dummy seat/rail assembly, dynamic testing of dummy seat/rail assembly, and finally, testing

of actual modified seat system with a dummy occupant. A total of ten full scale tests have been performed including three of the actual aircraft seat. Results from full-scale tests indicated that occupant loads were attenuated successfully to survivable levels.  
Author

*Agricultural Aircraft; Full Scale Tests; Seats; Systems Engineering; Energy Absorption; Fabrication*

**20030002379** Air Command and Staff Coll., Maxwell AFB, AL USA

**UAVS and ISR Sensor Technology**

Butler, Jeffrey T.; Apr. 2001; 59p; In English; Original contains color images

Report No.(s): AD-A407741; AU/ACSC/033/2001-04; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This paper examines the Air Force's need to aggressively pursue development of unmanned aerial vehicles (UAVs) and sensors for airborne intelligence, surveillance, and reconnaissance (ISR) data collection. Additionally, recommendations for optimizing the employment and development of ISR UAVs and sensors are addressed. The transformation of the US military from a Cold War conventional force towards a global expeditionary force has created a growing demand for air power including deployable, long endurance ISR assets. UAVs equipped with advanced sensors were superb ISR performers in the 1990's and possess the potential to provide a long-term, air power alternative for enhancing the nation's ISR capability. The Air Force must embrace emerging sensor and information technologies to maintain the pace of innovation. Technological advances are redefining old paradigms on how to best conduct the ISR mission. In the near term, the Air Force should continue efforts to integrate UAVs with other manned and spaceborne ISR assets. The horizontal integration of these assets into a tightly coupled system of systems will provide a great leap forward. For the long-term, the Air Force must address its shortfalls in R&D funding. A healthy technology base is required for revolutionary technologies such as micro-electro-mechanical systems (MEMS), micro air vehicles, and hyper-spectral imaging. Finally, the Air Force should establish a unifying vision for ISR UAVs to focus development while also providing a platform to advocate the unique merits of air power in the form of airborne ISR.

DTIC

*Aerial Reconnaissance; Drone Aircraft*

**20030002503** Alabama Univ., Dept. of Mechanical and Aerospace Engineering, Huntsville, AL USA

**Unmanned Hybrid Vehicle. Volume 1: Summary Final Report, 1 Mar.-30 Sep. 2002**

Frederick, Robert A., Jr.; Quick, Dana M.; Morris, Geof F.; Pierce, Jennifer C.; Sep. 27, 2002; 78p; In English

Contract(s)/Grant(s): DAAH01-01-C-R160

Report No.(s): AD-A407956; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Aviation and ground systems must increase use of emerging and advanced technologies to remain viable in complex, future battlefield environments. Unmanned vehicles will become part of future military operations due to: the demand for immediate intelligence on the battlefield, decreasing defense budgets, increasing operational tempos, and the low tolerance for casualties by the public. This work develops and evaluates system level concepts that fulfill these overall requirements using an unmanned hybrid vehicle. The unmanned hybrid vehicle combines the attributes of an autonomous vertical takeoff and landing air vehicle and an autonomous ground vehicle. This allows fast, flexible deployment and quiet, longer duration ground missions. The assumed time of deployment is the year 2012. The study included requirements definition, concept synthesis, and down selection to three final configurations. Engineering students from the University of Alabama in Huntsville and Ecole Superieure des Techniques Aemnautiques et de Construction Automobile participated on three competing design teams. Team I developed a basic system with coaxial rotors and a fuel cell drive system. The system is one unit that can both fly and operate on the ground. Team 2 developed a separate air and ground vehicle with intermeshing rotors. The integrated ground unit is deployed and retrieved by the air system. Team 3 also developed a separate air and ground vehicle but with a single rotor system that also requires a tail rotor.

DTIC

*Drone Aircraft; Military Operations; Pilotless Aircraft*

**20030002644** Alabama Univ., Huntsville, AL USA

**Unmanned Hybrid Vehicle. Volume III Final Report, 1 Mar.-30 Sep. 2002**

Quick, Dana M.; Morris, Geof F.; Pierce, Jennifer C.; Frederick, Robert A.; Sep. 27, 2002; 117p; In English

Contract(s)/Grant(s): DAAH01-01-C-160

Report No.(s): AD-A407976; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Aviation and ground systems must increase use of emerging and advanced technologies to remain viable in complex, future battlefield environments. Unmanned vehicles will become part of future military operations due to: the demand for immediate intelligence on the battlefield, decreasing defense budgets, increasing operational tempos, and the low tolerance for casualties by the public. This work develops and evaluates system level concepts that fulfill these overall requirements using an unmanned

hybrid vehicle. The unmanned hybrid vehicle combines the attributes of an autonomous vertical takeoff and landing air vehicle and an autonomous ground vehicle. This allows fast, flexible deployment and quiet, longer duration ground missions. The assumed time of deployment is the year 2012. The study included requirements definition, concept synthesis, and down selection to three final configurations. Engineering students from the University of Alabama in Huntsville and Ecole Superieure des Techniques Aeronautiques et de Construction Automobile participated on three competing design teams. Team I developed a basic system with coaxial rotors and a fuel cell drive system. The system is one unit that can both fly and operate on the ground. Team 2 developed a separate air and ground vehicle with intermeshing rotors. The integrated ground unit is deployed and retrieved by the air system. Team 3 also developed a separate air and ground vehicle but with a single rotor system that also requires a tail rotor.

DTIC

*Aircraft; Configurations; Surface Vehicles*

**20030002650** Defence Science and Technology Organisation, Information Technology Div., Canberra Australia

**The Incorporation of Pitting Corrosion Damage into F-111 Fatigue Life Modelling**

Mills, T.; Sharp, P. K.; Loader, C.; Jun. 2002; 177p; In English

Report No.(s): AD-A408004; DSTO-RR-0237; DODA-AR-012-354; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

In this report, an Equivalent Crack Size (ECS) approach is assessed and implemented for corrosion pitting in D6ac steel. Relationships between physical corrosion morphology and fatigue life of laboratory coupons were established that allowed corrosion pits to be described as cracks to provide input for durability and damage tolerance analyses. Using the ECS relationship, fatigue lives were accurately predicted in complex coupons tested under spectrum loading. Details are provided on all the corrosion procedures, the developmental testing program, and the validation testing program. So far, the ECS model for corrosion pitting is only valid for areas of the structure that do not experience yielding. Examination of the application of ECS to cases that experience compressive and tensile yield, awaits final development of the appropriate analysis software. The impact of this research on F-111 fleet management can be quite positive by helping avoid unnecessary maintenance and helping to reach a life-of-type goal of 2020.

DTIC

*F-111 Aircraft; Fatigue Life; Wings; Corrosion Tests; Damage*

**20030002679** Aircraft Owners and Pilots Association, Frederick, MD USA

**General Aviation Pilot Performance Following Unannounced In-Flight Loss of Vacuum System and Associated Instruments in Simulated Instrument Meteorological Conditions Final Report**

Roy, Kathleen M.; Beringer, Dennis B.; Oct. 2002; 13p; In English; Prepared in cooperation with FAA Civil Aerospace Medical Institute, Oklahoma City, OK

Report No.(s): AD-A408027; DOT/FAA/AM-02/19; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Forty-one instrument-rated pilots were exposed to an unannounced failure of attitude and heading instrumentation during flight in single-engine general aviation aircraft: 25 in a Piper Archer PA-28 and 16 in a Beechcraft Bonanza A36. The PA-28 flights consisted of three groups: (1) Group A - a failure of the attitude indicator (AI) and directional gyro (DG), (2) Group B - same as Group A but received 30 minutes of partial-panel instruction in a personal-computer-based aviation training device (PCATD) prior to the flight, and (3) Group C - same as group A but had a failure-annunciator light (vacuum) on the panel. The A36 flights consisted of two groups: (1) Group A - a failure of the AI only, (2) Group B - a failure of the AI and the horizontal situation indicator (HSI). All of the PA-28 pilots maintained control of the aircraft, and 68 percent of them flew successful partial-panel approaches, and likely would have survived if it had been an actual emergency. However, 25 percent of the Bonanza pilots could not maintain control, and the evaluator had to assume control of the aircraft. Use of the PCATD prior to the data flight reduced the time required to recognize a failure while airborne (mean A&C = 7.6 min., mean for B = 4.9 min.), but there were no other observed differences in performance between the Archer groups. Recommendations are presented regarding both training and instrumentation.

DTIC

*Flight Instruments; Vacuum Systems; Pilot Performance*

**20030002772** NASA Ames Research Center, Moffett Field, CA USA

**Progress Toward Generation of a Navier-Stokes Database for a Harrier in Ground Effect**

Chaderjian, Neal M., NASA Ames Research Center, USA; Ahmad, Jasim U., Eloret Corp., USA; Pandya, Shishir A., NASA Ames Research Center, USA; Murman, Scott A., Eloret Corp., USA; [2002]; 4p; In English; International Powered Lift Conference (IPLC), 5-7 Nov. 2002, Williamsburg, VA, USA; Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The Harrier YAV-8B aircraft is capable of vertical and short-field take-off and landing (V/STOL) by directing its four exhaust nozzles toward the ground, or conventional flight by rotating its nozzles into a horizontal position. The British Royal Air Force and the USA Marine Corps have used this aircraft for more than 30 years to provide a quick reaction time for troop support, and reduce the need for long runways. The success of this powered-lift (PL) vehicle has also prompted the more recent design of the Joint Strike Fighter (JSF). However there are significant safety issues that must be addressed when operating a PL vehicle in close proximity to the ground. Hot Gas Ingestion (HGI) by the inlets can result in a rapid loss of powered lift; and high-speed jet flows along the ground plane can induce low pressures underneath the vehicle, causing a 'suck-down' effect. Under these conditions, departure from controlled flight may occur. Moreover, unsteady ground vortices and jet fountains can affect the aircraft's controllability and its proximity to ground troops. The viscous, time-dependent flow fields of PL vehicles are difficult to accurately and efficiently predict using Computational Fluid Dynamics (CFD). A number of researchers have used the time-dependent Reynolds-averaged Navier-Stokes (RANS) equations to compute flows for single and multiple jets in a cross-flow. A few have added some geometric complexity to the problem by computing flows for jet-augmented delta wings near a ground plane. Smith et.al. computed for the first time a single RANS solution about a simplified Harrier. This geometry included a fuselage, wing, leading edge root extension (LERX), inlets, and exhaust nozzles. All of these investigations cite two practical problems with computing these flows: 1) the need for improved solution accuracy; and, 2) the need for faster solution methods. We view the need for faster solution methods as key to improving the solution accuracy and making this class of computation more routine. One can hardly refine grids, explore the use of advanced turbulence models, and generate databases when it takes weeks of dedicated computer time for a single solution. Chaderjian, Ahmad, Pandya, and Murman have focused on reducing the time-to-solution for this very difficult and complex problem through process automation and exploitation of parallel computing. They began with the Harrier geometry reported, and added a deflected wing flap and empennage for greater realism. to date more than 80 solutions have been carried out. This paper will describe this process and progress made in reducing the time required to generate a simple longitudinal force and moment database for a Harrier in ground effect. It shows a typical snap-shot from an unsteady streakline animation, where fluid particles are colored by temperature. The ground vortex and a jet-fountain vortex are highlighted. It also shows a similar streakline image, where HGI occurs due to the vehicle in close proximity to the ground. It shows the mean lift coefficient as a function of angle of attack and height. The angle of attack range was 4 deg less than or = alpha less than or = 10 deg with an increment of 1 degree, and the height range was 10 ft less than or = h less than or = 30ft with an increment of 5 feet. This 35 solution database was extended to over 2500 cases using a monotone cubic-spline interpolation procedure. The suck-down effect (reduction of lift near the ground) is highlighted in the figure. The "cushion effect," the conventional reduction of lift as the vehicle moves out of ground effect, is also indicated. All 35 RANS solutions were obtained using 952 Silicon Graphics Origin 2000 and 3000 processors in dedicated mode for one week. Typically, 112 processors were assigned to each case. Some other cases used fewer processors to utilize all available CPUS. The final paper will report on the automation of the solution process, including: grid generation, job monitoring, solution completion criteria, and post processing. Moreover, improvements in parallel efficiency for a dual time-step algorithm for the RANS equations will also be presented. Results will be discussed in detail using unsteady streakline flow visualization to correlate unsteady flow structures with dominant aerodynamic frequencies. The stability derivatives, CL, and CL, will also be presented.

Author

*Aerodynamic Coefficients; Computational Fluid Dynamics; Data Bases; Deflection; Delta Wings; Exhaust Nozzles; Turbulence Models; V/STOL Aircraft*

**20030003700** NASA Ames Research Center, Ames Research Center, Moffett Field, CA USA

**Measurements of the Early Development of Trailing Vorticity from a Rotor**

McAlister, Kenneth W.; Heineck, James T.; Jul. 2002; 67p; In English; Original contains color images

Contract(s)/Grant(s): RTOP 712-92-43

Report No.(s): AD-A406980; A-0208212; NASA/TP-2002-211848; NAS 1.60:211848; AFDD-TR-02-A-001; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The wake behind a two-bladed model rotor in light climb was measured using particle image velocimetry, with particular emphasis on the development of the trailing vortex during the first revolution of the rotor. The distribution of vorticity was distinguished from the slightly elliptical swirl pattern. Peculiar dynamics within the "void" region may explain why the peak vorticity appeared to shift away from the center as the vortex aged, suggesting the onset of instability. The swirl and axial velocities (which reached 44% and 12% of the rotor tip speed, respectively) were found to be asymmetric relative to the vortex center. In particular, the axial flow was composed of two concentrated zones moving in opposite directions. The radial distribution of the circulation rapidly increased in magnitude until reaching a point just beyond the core radius, after which the rate of growth decreased significantly. The core-radius circulation increased slightly with wake age, but the large-radius circulation appeared to remain relatively constant. The radial distributions of swirl velocity and vorticity exhibit self-similar behaviors, especially

within the core. The diameter of the vortex core was initially about 10% of the rotor-blade chord, but more than doubled its size after one revolution of the rotor.

DTIC

*Measurement; Vorticity; Rotary Wings; Wakes; Particle Image Velocimetry; Tip Speed*

**20030003701** NASA Ames Research Center, Ames Research Center, Moffett Field, CA USA

**A Model Rotor in Axial Flight**

McAlister, K. W.; Huang, S. S.; Abrego, A. I.; Jun. 2001; 68p; In English; Original contains color images

Contract(s)/Grant(s): RTOP 712-10-12

Report No.(s): AD-A406985; A-00V0045; NASA/TM-2001-210925; NAS 1.15:210925; AFDD-TR-01-A-004; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

A model rotor was mounted horizontally in the settling chamber of a wind tunnel to obtain performance and wake structure data under low climb conditions. The immediate wake of the rotor was carefully surveyed using 3-component particle image velocimetry to define the velocity and vortical content of the flow, and used in a subsequent study to validate a theory for the separate determination of induced and profile drag. Measurements were obtained for two collective pitch angles intended to render a predominately induced drag state and another with a marked increase in profile drag. A majority of the azimuthally directed vorticity in the wake was found to be concentrated in the tip vortices. However, adjacent layers of inboard vorticity with opposite sense were clearly present. At low collective, the close proximity of the tip vortex from the previous blade caused the wake from the most recent blade passage to be distorted. The deficit velocity component that was directed along the azimuth of the rotor blade was never more than 15 percent of the rotor tip speed, and except for the region of the tip vortex, appeared to have totally disappeared from the wake left by the previous blade.

DTIC

*Rotor Dynamics; Rotor Blades (Turbomachinery); Helicopter Wakes; Wind Tunnel Tests; Aircraft Models; Climbing Flight*

**20030003783** NASA Langley Research Center, Hampton, VA USA

**Development of Pneumatic Channel Wing Powered-Lift Advanced Super-STOL Aircraft *Progress Report, 1 Mar. 1999 - 28 Feb. 2002***

Englar, Robert J., Georgia Tech Research Inst., USA; Campbell, Bryan A., NASA Langley Research Center, USA; [2002]; 11p; In English; 20th AIAA Applied Aerodynamics Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAG1-2169; GTRI Proj. A-5942

Report No.(s): AIAA Paper 2002-2929; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The powered-lift Channel Wing concept has been combined with pneumatic Circulation Control aerodynamic and propulsive technology to generate a Pneumatic Channel Wing configuration intended to have Super-STOL or VSTOL capability while eliminating many of the operational problem areas of the original Channel Wing vehicle. A preliminary design study of this pneumatic vehicle based on previous wind-tunnel and flight-test data for the two technologies integrated into a simple Pneumatic Channel Wing (PCW) configuration showed very strong Super-STOL potential. Wind-tunnel development and evaluations of a PCW powered model conducted at Georgia Tech Research Institute (GTRI) have shown substantial lift capabilities for the blown configuration ( $C_{sub L}$ ) values of 8.5 to 9.0). Variation in blowing of the channel was shown to be more efficient than variation in propeller thrust. Also revealed was the ability to operate unstalled at very high angles of attack of 40 deg-45 deg, or to achieve very high lift at much lower angle of attack to increase visibility and controllability. In order to provide greater flexibility in Super-STOL takeoffs and landings, the blown model also displayed the ability to interchange thrust and drag by varying blowing without any moving parts. This paper presents these experimental results, discusses variations in the configuration geometry under development, and extends this integrated technology to advanced design studies of PCW-type vehicles.

Author

*Aerodynamic Configurations; Channel Wings; Short Takeoff Aircraft; Powered Lift Aircraft; Pneumatic Control; Wind Tunnel Tests*

**20030003826** NASA Dryden Flight Research Center, Edwards, CA USA

**The Aircraft Simulation Role in Improving Flight Safety Through Control Room Training**

Shy, Karla S., NASA Dryden Flight Research Center, USA; Hageman, Jacob J., NASA Dryden Flight Research Center, USA; Le, Jeanette H., NASA Dryden Flight Research Center, USA; August 2002; 21p; In English; AIAA Modeling and Simulation Technologies Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics,

USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 706-51-54-T4-56

Report No.(s): NASA/TM-2002-210731; H-2501; NAS 1.15:210731; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution under U.S. Government purpose rights; Distribution under U.S. Government purpose rights

NASA Dryden Flight Research Center uses its six-degrees-of-freedom (6-DOF) fixed-base simulations for mission control room training to improve flight safety and operations. This concept is applied to numerous flight projects such as the F-18 High Alpha Research Vehicle (HARV), the F-15 Intelligent Flight Control System (IFCS), the X-38 Actuator Control Test (XACT), and X-43A (Hyper-X). The Dryden 6-DOF simulations are typically used through various stages of a project, from design to ground tests. The roles of these simulations have expanded to support control room training, reinforcing flight safety by building control room staff proficiency. Real-time telemetry, radar, and video data are generated from flight vehicle simulation models. These data are used to drive the control room displays. Nominal static values are used to complete information where appropriate. Audio communication is also an integral part of training sessions. This simulation capability is used to train control room personnel and flight crew for nominal missions and emergency situations. Such training sessions are also opportunities to refine flight cards and control room display pages, exercise emergency procedures, and practice control room setup for the day of flight. This paper describes this technology as it is used in the X-43A and F-15 IFCS and XACT projects.

Author

*Flight Safety; Flight Control; Flight Training; Technology Utilization; Computerized Simulation; Research Vehicles*

**20030003828** NASA Langley Research Center, Hampton, VA USA

**Probabilistic Methods for Uncertainty Propagation Applied to Aircraft Design**

Green, Lawrence L., NASA Langley Research Center, USA; Lin, Hong-Zong, PredictionProbe, Inc., USA; Khalessi, Mohammad R., PredictionProbe, Inc., USA; [2002]; 22p; In English; 20th AIAA Applied Aerodynamics Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3140; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Three methods of probabilistic uncertainty propagation and quantification (the method of moments, Monte Carlo simulation, and a nongradient simulation search method) are applied to an aircraft analysis and conceptual design program to demonstrate design under uncertainty. The chosen example problems appear to have discontinuous design spaces and thus these examples pose difficulties for many popular methods of uncertainty propagation and quantification. However, specific implementation features of the first and third methods chosen for use in this study enable successful propagation of small uncertainties through the program. Input uncertainties in two configuration design variables are considered. Uncertainties in aircraft weight are computed. The effects of specifying required levels of constraint satisfaction with specified levels of input uncertainty are also demonstrated. The results show, as expected, that the designs under uncertainty are typically heavier and more conservative than those in which no input uncertainties exist.

Author

*Aircraft Design; Design Analysis; Structural Weight; Probability Theory*

**20030004235** Veridian Systems Div., Yorktown, VA USA

**Design, Fabrication, and Testing of Composite Energy-Absorbing Keel Beams for General Aviation Type Aircraft**

Kellas, Sotiris, Veridian Systems Div., USA; Knight, Norman F., Jr., Veridian Systems Div., USA; December 2002; 28p; In English; Original contains color illustrations

Contract(s)/Grant(s): GSA-GS-35F-4503G; RTOP 728-50-10-01

Report No.(s): NASA/CR-2002-212133; NAS 1.26:212133; L-9045; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A lightweight energy-absorbing keel-beam concept was developed and retrofitted in a general aviation type aircraft to improve crashworthiness performance. The energy-absorbing beam consisted of a foam-filled cellular structure with glass fiber and hybrid glass/kevlar cell walls. Design, analysis, fabrication and testing of the keel beams prior to installation and subsequent full-scale crash testing of the aircraft are described. Factors such as material and fabrication constraints, damage tolerance, crush stress/strain response, seat-rail loading, and post crush integrity, which influenced the course of the design process are also presented. A theory similar to the one often used for ductile metal box structures was employed with appropriate modifications to estimate the sustained crush loads for the beams. This, analytical tool, coupled with dynamic finite element simulation using MSC.Dytran were the prime design and analysis tools. The validity of the theory as a reliable design tool was examined against

test data from static crush tests of beam sections while the overall performance of the energy-absorbing subfloor was assessed through dynamic testing of 24 in long subfloor assemblies.

Author

*General Aviation Aircraft; Composite Structures; Keels; Foams; Glass Fibers; Kevlar (Trademark)*

## 06

### AVIONICS AND AIRCRAFT INSTRUMENTATION

*Includes all stages of design of aircraft and aircraft structures and systems. Also includes aircraft testing, performance, and evaluation, and aircraft and flight simulation technology. For related information, see also 18 Spacecraft Design, Testing and Performance and 39 Structural Mechanics. For land transportation vehicles, see 85 Technology Utilization and Surface Transportation.*

**20030002837** Civil Aerospace Medical Inst., Oklahoma City, OK USA

**Assessment of Advanced Cockpit Displays for General Aviation Aircraft: The Capstone Program Final Report**

Williams, Kevin W., Civil Aerospace Medical Inst., USA; Yost, Alan, Department of Transportation, USA; Holland, Jeff, Federal Aviation Administration, USA; Tyler, Robert R., Trios Associates, Inc., USA; December 2002; 40p; In English

Contract(s)/Grant(s): FAA-AHRR-521

Report No.(s): DOT/FAA/AM-02/21; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Since the inception of the Capstone Program, approximately 150 aircraft in the area of Bethel, Alaska have received a suite of ADS-B displays. Despite the opportunity provided by the large number of ADS-B-capable aircraft in the Bethel area, very little information has been collected from the owner/operators and pilots of these aircraft that might help in transitioning the technology to the rest of the country. To remedy this situation, a team of human factors experts was tasked with travelling to Bethel in March 2002 to collect data regarding the use of these displays in day-to-day flight activities. A total of 41 pilots participated in the interview process, representing nine different flight companies in the Bethel area. All of the pilots were male. The average age was 37, ranging from 21 to 58. The average number of flight hours for the pilots was 4,962 hours, ranging from 950 hours to 30,000 hours. The median number of total flight hours was 3,250. Over 95% (39) of the pilots were instrument rated. Results from the pilot interviews and self-administered questionnaires revealed a number of human factors design, safety, and training issues. Discussion of these results will focus on display design and training recommendations for ADS-B displays that will ease the training burden, mitigate safety hazards, and accentuate safety improvements.

Author

*General Aviation Aircraft; Display Devices; Aircraft Pilots; Human Factors Engineering*

## 07

### AIRCRAFT PROPULSION AND POWER

*Includes prime propulsion systems and systems components, e.g., gas turbine engines and compressors; and onboard auxiliary power plants for aircraft. For related information see also 20 Spacecraft Propulsion and Power, 28 Propellants and Fuels, and 44 Energy Production and Conversion.*

**20030002252** NASA Langley Research Center, Hampton, VA USA

**Application of Modern Design of Experiments to CARS Thermometry in a Model Scramjet Engine**

Danehy, P. M., NASA Langley Research Center, USA; DeLoach, R., NASA Langley Research Center, USA; Cutler, A. D., George Washington Univ., USA; [2002]; 18p; In English; 22nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2914; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

We have applied formal experiment design and analysis to optimize the measurement of temperature in a supersonic combustor at NASA Langley Research Center. We used the coherent anti-Stokes Raman spectroscopy (CARS) technique to map the temperature distribution in the flowfield downstream of an 1160 K, Mach 2 freestream into which supersonic hydrogen fuel is injected at an angle of 30 degrees. CARS thermometry is inherently a single-point measurement technique; it was used to map the flow by translating the measurement volume through the flowfield. The method known as "Modern Design of Experiments" (MDOE) was used to estimate the data volume required, design the test matrix, perform the experiment and analyze the resulting

data. MDOE allowed us to match the volume of data acquired to the precision requirements of the customer. Furthermore, one aspect of MDOE, known as response surface methodology, allowed us to develop precise maps of the flowfield temperature, allowing interpolation between measurement points. An analytic function in two spatial variables was fit to the data from a single measurement plane. Fitting with a Cosine Series Bivariate Function allowed the mean temperature to be mapped with 95% confidence interval half-widths of +/- 30 Kelvin, comfortably meeting the confidence of +/- 50 Kelvin specified prior to performing the experiments. We estimate that applying MDOE to the present experiment saved a factor of 5 in data volume acquired, compared to experiments executed in the traditional manner. Furthermore, the precision requirements could have been met with less than half the data acquired.

Author

*Experiment Design; Supersonic Combustion Ramjet Engines; Temperature Distribution; Temperature Measurement; Thermal Mapping; Combustion Chambers*

**20030002653** NASA Langley Research Center, Hampton, VA USA

**Hypersonic Airbreathing Propulsion: An Aerodynamics, Aerothermodynamics, and Acoustics Competency White Paper**

Drummond, J. Philip, NASA Langley Research Center, USA; Cockrell, Charles E., Jr., NASA Langley Research Center, USA; Pellett, Gerald L., NASA Langley Research Center, USA; Diskin, Glenn S., NASA Langley Research Center, USA; Auslender, Aaron H., NASA Langley Research Center, USA; Exton, Reginald J., NASA Langley Research Center, USA; Guy, R. Wayne, NASA Langley Research Center, USA; Hoppe, John C., NASA Langley Research Center, USA; Puster, Richard L., NASA Langley Research Center, USA; Rogers, R. Clayton, NASA Langley Research Center, USA; November 2002; 44p; In English  
Contract(s)/Grant(s): RTOP 708-72-44-02

Report No.(s): NASA/TM-2002-211951; L-18110; NAS 1.15:211951; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This White Paper examines the current state of Hypersonic Airbreathing Propulsion at the NASA Langley Research Center and the factors influencing this area of work and its personnel. Using this knowledge, the paper explores beyond the present day and suggests future directions and strategies for the field. Broad views are first taken regarding potential missions and applications of hypersonic propulsion. Then, candidate propulsion systems that may be applicable to these missions are suggested and discussed. Design tools and experimental techniques for developing these propulsion systems are then described, and approaches for applying them in the design process are considered. In each case, current strategies are reviewed and future approaches that may improve the techniques are considered. Finally, the paper concentrates on the needs to be addressed in each of these areas to take advantage of the opportunities that lay ahead for both the NASA Langley Research Center and the Aerodynamic Aerothermodynamic, and Aeroacoustics Competency. Recommendations are then provided so that the goals set forth in the paper may be achieved.

Author

*Air Breathing Engines; Hypersonic Flight; Aeroacoustics; Aerodynamics; Aerothermodynamics; Technology Assessment*

**20030002821** NASA Glenn Research Center, Cleveland, OH USA

**Unsteady Ejector Performance: An Experimental Investigation using a Pulsejet Driver**

Paxson, Daniel E., NASA Glenn Research Center, USA; Wilson, Jack, QSS Group, Inc., USA; Dougherty, Kevin T., QSS Group, Inc., USA; June 2002; 20p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Meeting and Exhibit, 7-10 Jul 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-48-13

Report No.(s): NASA/TM-2002-211711; NAS 1.15:211711; E-13462; AIAA Paper 2002-3915; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An experimental investigation is described in which thrust augmentation and mass entrainment were measured for a variety of simple cylindrical ejectors driven by a gasoline-fueled pulsejet. The ejectors were of varying length, diameter, and inlet radius. Measurements were also taken to determine the effect on performance of the distance between pulsejet exit and ejector inlet. Limited tests were also conducted to determine the effect of driver cross-sectional shape. Optimal values were found for all three ejector parameters with respect to thrust augmentation. This was not the case with mass entrainment, which increased monotonically with ejector diameter. Thus, it was found that thrust augmentation is not necessarily directly related to mass entrainment, as is often supposed for ejectors. Peak thrust augmentation values of 1.8 were obtained. Peak mass entrainment values of 30 times the driver mass flow were also observed. Details of the experimental setup and results are presented. Preliminary

analysis of the results indicates that the enhanced performance obtained with an unsteady jet (primary source) over comparably sized ejectors driven with steady jets is due primarily to the structure of the starting vortex-type flow associated with the former.

Author

*Ejectors; Pulsejet Engines; Thrust Augmentation; Intake Systems; Propulsion System Performance; Unsteady Flow*

**20030003722** NASA Glenn Research Center, Cleveland, OH USA

**Unsteady Ejector Performance: An Experimental Investigation Using a Resonance Tube Driver**

Wilson, Jack, QSS Group, Inc., USA; Paxson, Daniel E., NASA Glenn Research Center, USA; July 2002; 19p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-48-13

Report No.(s): NASA/TM-2002-211474; E-13239; NAS 1.15:211474; AIAA Paper 2002-3632; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A statistically designed experiment to characterize thrust augmentation for unsteady ejectors has been conducted at the NASA Glenn Research Center. The variable parameters included ejector diameter, length, and nose radius. The pulsed jet driving the ejectors was produced by a shrouded resonance (or Hartmann-Sprenger) tube. In contrast to steady ejectors, an optimum ejector diameter was found, which coincided with the diameter of the vortex ring created at the pulsed jet exit. Measurements of ejector exit velocity using a hot-wire permitted evaluation of the mass augmentation ratio, which was found to correlate to thrust augmentation following a formula derived for steady ejectors.

Author

*Thrust Augmentation; Ejectors; Resonance*

**20030003724** NASA Glenn Research Center, Cleveland, OH USA

**High-Speed, High-Temperature Finger Seal Test Results**

Proctor, Margaret P., NASA Glenn Research Center, USA; Kumar, Arun, Honeywell Engines, Systems and Services, USA; Delgado, Irebert R., Army Research Lab., USA; July 2002; 18p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 722-90-A5; DA Proj. 1L1-61102-AH-45

Report No.(s): NASA/TM-2002-211589; E-13374; NAS 1.15:211589; ARL-TR-2781; AIAA Paper 2002-3793; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Finger seals have significantly lower leakage rates than conventional labyrinth seals used in gas turbine engines and are expected to decrease specific fuel consumption by over 1 percent and to decrease direct operating cost by over 0.5 percent. Their compliant design accommodates shaft growth and motion due to thermal and dynamic loads with minimal wear. The cost to fabricate these finger seals is estimated to be about half the cost to fabricate brush seals. A finger seal has been tested in NASA's High Temperature, High Speed Turbine Seal Test Rig at operating conditions up to 1200 F, 1200 ft/s, and 75 psid. Static, performance and endurance test results are presented. While seal leakage and wear performance are acceptable, further design improvements are needed to reduce the seal power loss.

Author

*Seals (Stoppers); High Temperature Tests; Performance Tests*

**20030003726** NASA Glenn Research Center, Cleveland, OH USA

**Thermodynamic Cycle and CFD Analyses for Hydrogen Fueled Air-Breathing Pulse Detonation Engines**

Povinelli, Louis A., NASA Glenn Research Center, USA; Yungster, Shaye, NASA Lewis Research Center, USA; June 2002; 13p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-21-33

Report No.(s): NASA/TM-2002-211698; NAS 1.15:211698; E-13431; ICOMP-2002-03; AIAA Paper 2002-3629; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper presents the results of a thermodynamic cycle analysis of a pulse detonation engine (PDE) using a hydrogen-air mixture at static conditions. The cycle performance results, namely the specific thrust, fuel consumption and impulse are

compared to a single cycle CFD analysis for a detonation tube which considers finite rate chemistry. The differences in the impulse values were indicative of the additional performance potential attainable in a PDE.

Author

*Thermodynamic Cycles; Computational Fluid Dynamics; Air Breathing Engines; Pulse Detonation Engines*

**20030003791** National Coordination Office for Computing, Information and Communications, President's Information Technology Advisory Committee, Arlington, VA USA

**Numerical Predictions and Experimental Results of Air Flow in a Smooth Quarter-Scale Nacelle**

Black, A. R.; Sue-Antilla, J. M.; Gritzo, L. A.; Disimile, P. J.; Tucker, J. R.; Jun. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800965; SANDIA2002-1319; No Copyright; Avail: National Technical Information Service (NTIS)

Fires in aircraft engine nacelles must be rapidly suppressed to avoid loss of life and property. The design of new and retrofit suppression systems has become significantly more challenging due to the ban on production of Halon 1301 for environmental concerns. Since fire dynamics and the transport of suppressants within the nacelle are both largely determined by the available air flow, efforts to define systems using less effective suppressants greatly benefit from characterization of nacelle air flow fields. A combined experimental and computational study of nacelle air flow therefore has been initiated.

NTIS

*Air Flow; Nacelles; Aircraft Engines; Flow Distribution*

**20030003812** NASA Marshall Space Flight Center, Huntsville, AL USA

**Effects of Endwall Geometry and Stacking on Two-Stage Supersonic Turbine Performance**

Dorney, Daniel J., NASA Marshall Space Flight Center, USA; Griffin, Lisa W., NASA Marshall Space Flight Center, USA; Huber, Frank W., Riverbend Design Services, USA; Sondak, Douglas L., Boston Univ., USA; [2002]; 18p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-0078; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The drive towards high-work turbines has led to designs which can be compact, transonic, supersonic, counter rotating, or use a dense drive gas. These aggressive designs can lead to strong secondary flows and airfoil flow separation. In many cases the secondary and separated flows can be minimized by contouring the hub/shroud endwalls and/or modifying the airfoil stacking. In this study, three-dimensional unsteady Navier-Stokes simulations were performed to study three different endwall shapes between the first-stage vanes and rotors, as well as two different stackings for the first-stage vanes. The predicted results indicate that changing the stacking of the first-stage vanes can significantly impact endwall separation (and turbine performance) in regions where the endwall profile changes.

Author

*Supersonic Turbines; Performance; Three Dimensional Models; Navier-Stokes Equation; Unsteady Flow; Two Stage Turbines*

**20030003827** NASA Langley Research Center, Hampton, VA USA

**Thrust Augmentation with Mixer/Ejector Systems**

Presz, Walter M., Jr., College of Western New England, USA; Reynolds, Gary, Stage III Technologies, L. C., USA; Hunter, Craig, NASA Langley Research Center, USA; [2002]; 11p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA

Report No.(s): AIAA Paper 2002-0230; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Older commercial aircraft often exceed FAA (Federal Aviation Administration) sideline noise regulations. The major problem is the jet noise associated with the high exhaust velocities of the low bypass ratio engines on such aircraft. Mixer/ejector exhaust systems can provide a simple means of reducing the jet noise on these aircraft by mixing cool ambient air with the high velocity engine gases before they are exhausted to ambient. This paper presents new information on thrust performance predictions, and thrust augmentation capabilities of mixer/ejectors. Results are presented from the recent development program of the patented Alternating Lobe Mixer Ejector Concept (ALMEC) suppressor system for the Gulfstream GII, GIIB and GIII aircraft. Mixer/ejector performance procedures are presented which include classical control volume analyses, compound compressible flow theory, lobed nozzle loss correlations and state of the art computational fluid dynamic predictions. The mixer/ejector thrust predictions are compared to subscale wind tunnel test model data and actual aircraft flight test measurements. The results demonstrate that a properly designed mixer/ejector noise suppressor can increase effective engine bypass ratio and

generate large thrust gains at takeoff conditions with little or no thrust loss at cruise conditions. The cruise performance obtained for such noise suppressor systems is shown to be a strong function of installation effects on the aircraft.

Author

*Jet Aircraft Noise; Thrust Augmentation; Commercial Aircraft; Exhaust Systems; Noise Reduction; Performance Prediction*

## 08

### AIRCRAFT STABILITY AND CONTROL

*Includes flight dynamics, aircraft handling qualities; piloting; flight controls; and autopilots. For related information, see also 05 Aircraft Design, Testing and Performance and 06 Avionics and Aircraft Instrumentation.*

**20030002767** NASA Ames Research Center, Moffett Field, CA USA

#### **Cartesian-Grid Simulations of a Canard-Controlled Missile with a Free-Spinning Tail**

Murman, Scott M., Eloret Corp., USA; Aftosmis, Michael J., NASA Ames Research Center, USA; Oct. 18, 2002; 15p; In English; 41st AIAA Applied Aerodynamics Conference, Jun. 2002, Orlando, FL, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 704-40-21; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The proposed paper presents a series of simulations of a geometrically complex, canard-controlled, supersonic missile with free-spinning tail fins. Time-dependent simulations were performed using an inviscid Cartesian-grid-based method with results compared to both experimental data and high-resolution Navier-Stokes computations. At fixed free stream conditions and canard deflections, the tail spin rate was iteratively determined such that the net rolling moment on the empennage is zero. This rate corresponds to the time-asymptotic rate of the free-to-spin fin system. After obtaining spin-averaged aerodynamic coefficients for the missile, the investigation seeks a fixed-tail approximation to the spin-averaged aerodynamic coefficients, and examines the validity of this approximation over a variety of freestream conditions.

Author

*Grid Generation (Mathematics); Cartesian Coordinates; Aerodynamic Characteristics; Canard Configurations; Missiles; Rolling Moments*

## 09

### RESEARCH AND SUPPORT FACILITIES (AIR)

*Includes airports, runways, hangars, and aircraft repair and overhaul facilities; wind tunnels, water tunnels, and shock tubes; flight simulators; and aircraft engine test stands. Also includes airport ground equipment and systems. For airport ground operations see 03 Air Transportation and Safety. For astronomical facilities see 14 Ground Support Systems and Facilities (Space).*

**20030002510** Federal Aviation Administration, Technical Center, Atlantic City, NJ USA

#### **Communication and Coordination Between Airway Facilities Sites: Implications for Operations Control Centers**

Ingurgio, Victor J.; Aug. 2002; 79p; In English

Report No.(s): AD-A407966; DOT/FAA/CT-TN02/15; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

This report examined the communications and coordination patterns between Airway Facilities centers, specifically between the Operations Control Centers (OCCs), General National Air Space Maintenance Control Centers, and Air Route Traffic Control Center Maintenance Control Centers. Data were collected from a representative sample of facilities, broken out by region, via the Communication and Coordination Questionnaire. This questionnaire enabled Human Factors Engineers to provide a baseline for the frequency of communications, the modes of communications used for coordinating management and maintenance events between these facilities, as well as a measure of task cohesiveness within and between facilities. The findings showed that: the most frequently used communication modality for a number of events were telephone communications. Task cohesion between facilities was above average, but task cohesion declines as the distance from a facility to its regional OCC increases. The results provide direct suggestions for the transition team responsible for the new OCC conversion regarding the standardization of the OCCs.

DTIC

*Air Traffic Control; Ground Based Control*

**20030003719** NASA Langley Research Center, Hampton, VA USA

**Joint Winter Runway Friction Program Accomplishments**

Yager, Thomas J., NASA Langley Research Center, USA; Wambold, James C., CDRM, Inc., USA; Henry, John J., CDRM, Inc., USA; Andresen, Arild, Mobility Friction Technology, Norway; Bastian, Matthew, National Research Council of Canada, Canada; [2002]; 17p; In English; Virginia Department of Transportation and Virginia Tech Pavement Evaluation 2002 Conference, 21-25 Oct. 2002, Roanoke, VA, USA; Sponsored by Virginia Dept. of Transportation, USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The major program objectives are: (1) harmonize ground vehicle friction measurements to report consistent friction value or index for similar contaminated runway conditions, for example, compacted snow, and (2) establish reliable correlation between ground vehicle friction measurements and aircraft braking performance. Accomplishing these objectives would give airport operators better procedures for evaluating runway friction and maintaining acceptable operating conditions, providing pilots information to base go/no go decisions, and would contribute to reducing traction-related aircraft accidents.

Derived from text

*Aircraft Accidents; Friction Measurement; Runway Conditions; Traction; Braking*

**20030004229** Rhode Island Univ., Transportation Center, Kingston, RI USA

**Development of an Advanced Pavement Deicing System Final Report**

Taggart, D. G.; Ibrahim, O.; Huston, M.; Kim, T.; May 2002; 46p; In English  
Report No.(s): PB2003-101668; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Current methods for winter maintenance of pavement surfaces consist of plowing and application of corrosive deicing agents. These chemicals are hazardous to the environment and hence, their use needs to be minimized. Over 20 years ago, the Connecticut Department of Transportation investigated the use of 300 psi pressurized salt brine jets to enhance the deicing performance. Despite promising results from several field trials, technical difficulties led to abandonment of this technology in the early 80s. Recent advances in high pressure jetting technology suggest that the use of high pressure jets in conjunction with improved chemical agents for pavement deicing may now be practical. In this study, the application of modern high pressure jetting technology as a means of pavement deicing is explored. The proposed system removes ice and snow through the combined action of mechanical jetting forces and controlled use of deicing chemicals. Appropriate operating parameters and consumption rates are identified and compared to the ConnDOT system developed in the 1970s.

NTIS

*Pavements; Deicing; Hydraulic Jets*

**12**

**ASTRONAUTICS (GENERAL)**

*Includes general research topics related to space flight and manned and unmanned space vehicles, platforms or objects launched into, or assembled in, outer space; and related components and equipment. Also includes manufacturing and maintenance of such vehicles or platforms. For specific topics in astronautics see categories 13 through 20. For extraterrestrial exploration, see 91 Lunar and Planetary Science and Exploration.*

**20030002474** NASA Marshall Space Flight Center, Huntsville, AL USA

**Space Ops 2002: Bringing Space Operations into the 21st Century. Track 3: Operations, Mission Planning and Control. 2nd Generation Reusable Launch Vehicle-Concepts for Flight Operations**

Hagopian, Jeff, NASA Marshall Space Flight Center, USA; [2002]; 8p; In English; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

With the successful implementation of the International Space Station (ISS), the National Aeronautics and Space Administration (NASA) enters a new era of opportunity for scientific research. The ISS provides a working laboratory in space, with tremendous capabilities for scientific research. Utilization of these capabilities requires a launch system capable of routinely transporting crew and logistics to/from the ISS, as well as supporting ISS assembly and maintenance tasks. The Space Shuttle serves as NASA's launch system for performing these functions. The Space Shuttle also serves as NASA's launch system for supporting other science and servicing missions that require a human presence in space. The Space Shuttle provides proof that reusable launch vehicles are technically and physically implementable. However, a couple of problems faced by NASA are the prohibitive cost of operating and maintaining the Space Shuttle and its relative inability to support high launch rates. The 2nd Generation Reusable Launch Vehicle (2nd Gen RLV) is NASA's solution to this problem. The 2nd Gen RLV will provide a robust

launch system with increased safety, improved reliability and performance, and less cost. The improved performance and reduced costs of the 2nd Gen RLV will free up resources currently spent on launch services. These resource savings can then be applied to scientific research, which in turn can be supported by the higher launch rate capability of the 2nd Gen RLV. The result is a win - win situation for science and NASA. While meeting NASA's needs, the 2nd Gen RLV also provides the United States aerospace industry with a commercially viable launch capability. One of the keys to achieving the goals of the 2nd Gen RLV is to develop and implement new technologies and processes in the area of flight operations. NASA's experience in operating the Space Shuttle and the ISS has brought to light several areas where automation can be used to augment or eliminate functions performed by crew and ground controllers. This experience has also identified the need for new approaches to staffing and training for both crew and ground controllers. This paper provides a brief overview of the mission capabilities provided by the 2nd Gen RLV, a description of NASA's approach to developing the 2nd Gen RLV, a discussion of operations concepts, and a list of challenges to implementing those concepts.

Author

*Flight Operations; Reusable Launch Vehicles; Space Shuttles; International Space Station; NASA Programs*

**20030003835** NASA Langley Research Center, Hampton, VA USA

**Deep Space Design Environments for Human Exploration**

Wilson, J. W., NASA Langley Research Center, USA; Cloudsley, M. S., National Academy of Sciences - National Research Council, USA; Cucinotta, F. A., NASA Johnson Space Center, USA; Tripathi, R. K., NASA Langley Research Center, USA; Nealy, J. E., Old Dominion Univ., USA; DeAngelis, G., Old Dominion Univ., USA; [2002]; 7p; In English; World Space Congress 2002, 10-19 Oct. 2002, Houston, TX, USA; Original contains color illustrations; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Mission scenarios outside the Earth's protective magnetic shield are being studied. Included are high usage assets in the near-Earth environment for casual trips, for research, and for commercial/operational platforms, in which career exposures will be multi-mission determined over the astronaut's lifetime. The operational platforms will serve as launching points for deep space exploration missions, characterized by a single long-duration mission during the astronaut's career. The exploration beyond these operational platforms will include missions to planets, asteroids, and planetary satellites. The interplanetary environment is evaluated using convective diffusion theory. Local environments for each celestial body are modeled by using results from the most recent targeted spacecraft, and integrated into the design environments. Design scenarios are then evaluated for these missions. The underlying assumptions in arriving at the model environments and their impact on mission exposures within various shield materials will be discussed.

Author

*Space Exploration; Deep Space; Planetary Environments; Manned Space Flight; Mathematical Models*

**20030004224** NASA, Washington, DC USA

**Guidelines and Capabilities for Designing Human Missions**

Mar. 2002; 104p; In English

Report No.(s): PB2003-101438; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The human element is likely the most complex and difficult one of mission design; it significantly influences every aspect of mission planning, from the basic parameters like duration to the more complex tradeoffs between mass, volume, power, risk, and cost. For engineers who rely on precise specifications in data books and other such technical references, dealing with the uncertainty and the variability of designing for human beings can be frustrating. When designing for the human element, questions arise more often than definitive answers. Nonetheless, we do not doubt that the most captivating discoveries in future space missions will necessitate human explorers. These guidelines and capabilities are meant to identify the points of intersection between humans and mission considerations such as architecture, vehicle design, technologies, operations, and science requirements. We seek to provide clear, top-level guidelines for human-related exploration studies and technology research that address common questions and requirements. As a result, we hope that ongoing mission trade studies consider common, standard, and practical criteria for human interfaces.

NTIS

*Astronauts; Human Factors Engineering; Mission Planning*

## GROUND SUPPORT SYSTEMS AND FACILITIES (SPACE)

*Includes launch complexes, research and production facilities; ground support equipment, e.g., mobile transporters; and test chambers and simulators. Also includes extraterrestrial bases and supporting equipment. For related information see also 09 Research and Support Facilities (Air).*

**20030002521** Florida International Univ., Industrial and Systems Engineering Dept., Miami, FL USA

### **Process Engineering Technology Center Initiative**

Centeno, Martha A., Florida International Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

NASA's Kennedy Space Center (KSC) is developing as a world-class Spaceport Technology Center (STC). From a process engineering (PE) perspective, the facilities used for flight hardware processing at KSC are NASA's premier factories. The products of these factories are safe, successful shuttle and expendable vehicle launches carrying state-of-the-art payloads. PE is devoted to process design, process management, and process improvement, rather than product design. PE also emphasizes the relationships of workers with systems and processes. Thus, it is difficult to speak of having a laboratory for PE at K.S.C. because the entire facility is practically a laboratory when observed from a macro level perspective. However, it becomes necessary, at times, to show and display how K.S.C. has benefited from PE and how K.S.C. has contributed to the development of PE; hence, it has been proposed that a Process Engineering Technology Center (PETC) be developed to offer a place with a centralized focus on PE projects, and a place where K.S.C.'s PE capabilities can be showcased, and a venue where new Process Engineering technologies can be investigated and tested. Graphics for showcasing PE capabilities have been designed, and two initial test beds for PE technology research have been identified. Specifically, one test bed will look into the use of wearable computers with head mounted displays to deliver work instructions; the other test bed will look into developing simulation models that can be assembled into one to create a hierarchical model.

Author

*Display Devices; Graphic Arts; Industrial Plants; Research Facilities*

## LAUNCH VEHICLES AND LAUNCH OPERATIONS

*Includes all classes of launch vehicles, launch/space vehicle systems, and boosters; and launch operations. For related information see also 18 Spacecraft Design, Testing, and Performance; and 20 Spacecraft Propulsion and Power.*

**20030002800** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Launch Vehicle Sizing Benefits Utilizing Main Propulsion System Crossfeed and Project Status**

Chandler, Frank, Boeing Co., USA; Scheiern, M., Boeing Co., USA; Champion, R., NASA Marshall Space Flight Center, USA; Mazurkivich, P., NASA Marshall Space Flight Center, USA; Jul. 09, 2002; 10p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS8-01099

Report No.(s): AIAA Paper 2002-3900; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

To meet the goals for a next generation Reusable Launch Vehicle (RLV), a unique propulsion feed system concept was identified using crossfeed between the booster and orbiter stages that could reduce the Two-Stage-to-Orbit (TSTO) vehicle weight and Design, Development, Test and Evaluation (DDT&E) costs by approximately 25%, while increasing safety and reliability. The Main Propulsion System (MPS) crossfeed water demonstration test program addresses all activities required to reduce the risks for the MPS crossfeed system from a Technology Readiness Level (TRL) of 2 to 4 by the completion of testing and analysis by June 2003. During the initial period, that ended in March 2002, a subscale water flow test article was defined. Procurement of a subscale crossfeed check valve was initiated and the specifications for the various components were developed. The fluid transient and pressurization analytical models were developed separately and successfully integrated. The test matrix for the water flow test was developed to correlate the integrated model. A computational fluid dynamics (CFD) model of the crossfeed check valve was developed to assess flow disturbances and internal flow dynamics. Based on the results, the passive crossfeed system concept was very feasible and offered a safe system to be used in an RLV architecture. A water flow test article was designed to accommodate a wide range of flows simulating a number of different types of propellant systems. During the follow-on period,

the crossfeed system model will be further refined, the test article will be completed, the water flow test will be performed, and finally the crossfeed system model will be correlated with the test data. This validated computer model will be used to predict the full-scale vehicle crossfeed system performance.

Author

*Computational Fluid Dynamics; Feed Systems; Mathematical Models; Reusable Launch Vehicles; Computerized Simulation; Technology Assessment; Propulsion System Performance*

**20030003735** NASA Glenn Research Center, Cleveland, OH USA

**Modeling International Space Station (ISS) Floating Potentials**

Ferguson, Dale C., NASA Glenn Research Center, USA; Gardner, Barbara, Science Applications International Corp., USA; May 2002; 14p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-A4-05

Report No.(s): NASA/TM-2002-211487; NAS 1.15:211487; AIAA Paper 2002-0933; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The floating potential of the International Space Station (ISS) as a function of the electron current collection of its high voltage solar array panels is derived analytically. Based on Floating Potential Probe (FPP) measurements of the ISS potential and ambient plasma characteristics, it is shown that the ISS floating potential is a strong function of the electron temperature of the surrounding plasma. While the ISS floating potential has so far not attained the pre-flight predicted highly negative values, it is shown that for future mission builds, ISS must continue to provide two-fault tolerant arc-hazard protection for astronauts on EVA.

Author

*International Space Station; Spacecraft Charging; Plasma Potentials; Electron Energy; Plasma Temperature; Space Plasmas*

**20030003757** Georgia Inst. of Tech., Space Systems Design Lab., Atlanta, GA USA

**Bifrost: A 4th Generation Launch Architecture Concept**

Rohrschneider, R. R., Georgia Inst. of Tech., USA; Young, D., Georgia Inst. of Tech., USA; St.Germain, B., Georgia Inst. of Tech., USA; Brown, N., Georgia Inst. of Tech., USA; Crowley, J., Georgia Inst. of Tech., USA; Maatsch, J., Georgia Inst. of Tech., USA; Olds, J. R., Georgia Inst. of Tech., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 39-54; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

A 4th generation launch architecture is studied for the purpose of drastically reducing launch costs and hence enabling new large mass missions such as space solar power and human exploration of other planets. The architecture consists of a magnetic levitation launch tube placed on the equator with the exit end elevated to approximately 20 km. Several modules exist for sending manned and unmanned payloads into Earth orbit. Analysis of the launch tube operations, launch trajectories, module aerodynamics, propulsion modules, and system costs are presented. Using the hybrid logistics module, it is possible to place payloads into low Earth orbit for just over \$100 per lb.

Author

*Spacecraft Launching; Spacecraft Design; Magnetic Suspension; Aerospace Engineering; Spacecraft Modules; Trajectories*

## 16

### SPACE TRANSPORTATION AND SAFETY

*Includes passenger and cargo space transportation, e.g., shuttle operations; and space rescue techniques. For related information, see also 03 Air Transportation and Safety and 15 Launch Vehicles and Launch Vehicles, and 18 Spacecraft Design, Testing and Performance. For space suits, see 54 Man/System Technology and Life Support.*

**20030002472** Florida Inst. of Tech., Aerospace Engineering Dept., FL USA

**Outline of a Twenty-Five Year Plan for Development and Deployment of A Catapult for A Third Generation Space Shuttle**

Russell, John M., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

This report reviews the rationale for catapult assist in the launching a third generation space shuttle. It then furnishes lists of early design decisions, questions whose answers are prerequisite to later design decisions, preliminary inventories of carriage

levitation and carriage propulsion concepts, phases of the project and major milestones, and some sources of expertise to support the project.

Author

*Catapults; Deployment; Propulsion*

**20030002497** NASA Marshall Space Flight Center, Huntsville, AL USA

**Expedite the Processing of Unpressurized Payloads to the International Space Station Using the ExPRESS Pallet**

Bacskay, Allen S., NASA Marshall Space Flight Center, USA; Jan. 08, 2002; 1p; In English; 53rd International Astronautical Congress (IAF) 2002 World Space Congress, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Expedite the Processing of Experiments to Space Station (ExPRESS) Pallet will be used as an experiment platform for external/unpressurized payloads to be flown aboard the International Space Station (ISS). The purpose of the ExPRESS Pallet is to provide an easy access to the ISS for Scientific Investigators that require an external platform for their experiment hardware. As the name of the ExPRESS Pallet implies, the objective of the ExPRESS program is to provide a simplified integration process in a short time period (24 months) for payloads to be flown on the ISS. The ExPRESS Pallet provides unique opportunities for research across many science disciplines, including earth observation, communications, solar and deep space viewing, and long-term exposure. The ExPRESS Pallet provides access to Ram, Wake, Nadir, Zenith and Earth Limb for viewing and exposure to the space environment. The ExPRESS Pallet will provide standard physical payload interfaces, and a standard integration template. The ExPS consists of the Pallet structure, payload Adapters, a subsystem assembly that includes data controller, power distribution and conversion, and Extra Vehicular Robotics compatibility. The ExPRESS Pallet provides the capability to changeout payloads on-orbit via the ExPRESS Pallet Adapter (ExPA). The following paragraphs will describe the Services and Accommodations available to the Payload developers by the ExPRESS Pallet and a brief description of the Integration process. More detailed information on the ExPRESS Pallet can be found in the ExPRESS Pallet Payload Accommodations Handbook, SSP 52000-PAH-EPP.

Author

*International Space Station; Payloads; Controllers; Systems Integration*

**20030002516** La Salle Univ., Management Dept., Philadelphia, PA USA

**Space Transportation Operations: Assessment of Methodologies and Models**

Joglekar, Prafulla, La Salle Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

The systems design process for future space transportation involves understanding multiple variables and their effect on lifecycle metrics. Variables such as technology readiness or potential environmental impact are qualitative, while variables such as reliability, operations costs or flight rates are quantitative. In deciding what new design concepts to fund, NASA needs a methodology that would assess the sum total of all relevant qualitative and quantitative lifecycle metrics resulting from each proposed concept. The objective of this research was to review the state of operations assessment methodologies and models used to evaluate proposed space transportation systems and to develop recommendations for improving them. It was found that, compared to the models available from other sources, the operations assessment methodology recently developed at Kennedy Space Center has the potential to produce a decision support tool that will serve as the industry standard. Towards that goal, a number of areas of improvement in the Kennedy Space Center's methodology are identified.

Author

*Environmental Surveys; Models; Reliability; Space Transportation System; Technology Assessment*

**20030002833** NASA Johnson Space Center, Houston, TX USA

**STS-112 Post Flight Presentation**

Nov. 26, 2002; In English; 18 min., 10 sec. playing time, in color, with sound

Report No.(s): JSC-1941; NONP-NASA-VT-2002160012; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

The STS-112 post flight presentation begins with a shot of the moonrise over the Earth's Limb. A photograph of the STS-112 crew is shown. The crew consists of Mission Specialists Sandy Magnus, David Wolf, Piers Sellers and Fodor Yurchikhin, Pilot Pam Melroy and Commander Jeff Ashby. The crew departs from the Operations and Control Building to the launch pad at

Kennedy Space Center in Florida. Sandy Magnus is shown preparing to board the Space Shuttle Atlantis. The actual STS-112 launch with flight deck activity during rendezvous with the International Space Station is also presented.

CASI

*Space Transportation System; Atlantis (Orbiter); Extravehicular Activity; International Space Station; Flyby Missions*

**20030004016** NASA Johnson Space Center, Houston, TX USA

**STS-113 Flight Day 9 Highlights**

Dec. 01, 2002; In English; 18 min., 49 sec. playing time, in color, with sound

Report No.(s): BRF-1436I; NONP-NASA-VT-2002153313; No Copyright; Avail: CASI; B02, Videotape-Beta; V02, Videotape-VHS

This video shows the activities of the STS-113 (Jim Wetherbee, Commander; Paul Lockhart, Pilot; Michael Lopez-Alegria, John Herrington, Mission Specialists) crew during flight day 9. Also seen are the outgoing Expedition 5 (Valeri Korzun, Commander; Peggy Whitsun, ISS Science Officer/Flight Engineer; Sergei Treschev, Flight Engineer) and incoming Expedition 6 (Kenneth Bowersox, Commander; Donald Pettit, Nikolai Budarin, Flight Engineers) crews of the ISS (International Space Station). Flight day 9 is a relatively inactive day, with some off-time scheduled for crew bonding and enjoying views. Seven of the joint crew members, including Lopez-Alegria, Wetherbee, Herrington, and Whitsun, pose together and answer questions. Footage shows ISS Science Officers Whitsun and Pettit troubleshooting equipment. The video also contains a clear view of southern South America, a cloudy view of the South Pacific, and external footage of the ISS including the Canadarm robotic arm. The payload bay of the shuttle Endeavour is also shown.

CASI

*Endeavour (Orbiter); International Space Station; Spacecrews; Spacecrew Transfer*

## 17

### SPACE COMMUNICATIONS, SPACECRAFT COMMUNICATIONS, COMMAND AND TRACKING

*Includes space systems telemetry; space communications networks; astronavigation and guidance; and spacecraft radio blackout. For related information, see also 04 Aircraft Communications and Navigation and 32 Communications and Radar.*

**20030002493** Florida Inst. of Tech., Electrical and Computer Science and Engineering Div., FL USA

**Space-Based Encoded Telemetry for Range Safety**

Kozaitis, Samuel P., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

This work involves the analysis of a communication system that uses the NASA Tracking and Data Relay Satellite/space Network (TDRSS/SN) to provide range safety and flight termination system support for expendable launch vehicles and the space shuttle. We examined the high-alphabet scheme for flight termination, and considered an analogous digital system. We also considered the bit-rate needed for a flight termination system using the TDRSS system based on the received signal-to-noise ratio, and link margin. We found that a TDRSS spread-spectrum communication system operating in the vicinity of 150 bits/second could satisfy the requirements for flight termination.

Author

*Telemetry; Safety Management; Signal to Noise Ratios; Satellite Networks; Range Safety; Telecommunication*

## 18

### SPACECRAFT DESIGN, TESTING AND PERFORMANCE

*Includes satellites; space platforms; space stations; spacecraft systems and components such as thermal and environmental controls; and spacecraft control and stability characteristics. For life support systems, see 54 Man/System Technology and Life Support. For related information, see also 05 Aircraft Design, Testing and Performance, 39 Structural Mechanics, and 16 Space Transportation and Safety.*

**20030002216** NASA Marshall Space Flight Center, Huntsville, AL USA

**QMI: Rising to the Space Station Design Challenge**

Carswell, W. E., National Space Science and Technology Center, USA; Farmer, J., NASA Marshall Space Flight Center, USA; Coppens, C., NASA Marshall Space Flight Center, USA; Breeding, S., NASA Marshall Space Flight Center, USA; Rose, F., Pace

and Waite, Inc., USA; [2002]; 1p; In English; International Space Station Utilization Conference/World Space Congress, 19 Oct. 2002, Houston, TX, USA

Contract(s)/Grant(s): NCC8-66; No Copyright; Avail: Issuing Activity; Abstract Only

The Quench Module Insert (QMI) materials processing furnace is being designed to operate for 8000 hours over four years on the International Space Station (ISS) as part of the first Materials Science Research Rack (MSRR-1) of the Materials Science Research Facility (MSRF). The Bridgman-type furnace is being built for the directional solidification processing of metals and alloys in the microgravity environment of space. Most notably it will be used for processing aluminum and related alloys. Designing for the space station environment presents intriguing design challenges in the form of a ten-year life requirement coupled with both limited opportunities for maintenance and resource constraints in the form of limited power and space. The long life requirement has driven the design of several features in the furnace, including the design of the heater core, the selection and placement of the thermocouples, overall performance monitoring, and the design of the chill block. The power and space limitations have been addressed through a compact furnace design using efficient vacuum insulation. Details on these design features, as well as development test performance results to date, are presented.

Author

*Aluminum; Directional Solidification (Crystals); Furnaces; Maintenance; Vacuum; Heating Equipment*

**20030002318** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

**Mean Performance Optimization of an Orbiting Distributed Aperture by Warped Aperture Image Plane Comparisons**

Parker, Timothy W.; Sep. 2002; 156p; In English; Original contains color images

Report No.(s): AD-A407746; AFIT/DS/ENY/02-3; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This work models the aggregate performance of satellite receiver formations functioning as orbiting interferometers as compared to filled apertures of similar geometries. These models facilitate selecting initial conditions for formations such that their control-free dynamics yield interferometry performance with minimal errors as compared to the filled apertures. The solution method draws on the dynamic models of an orbiting planar satellite formation to define the size and shape of a reference aperture and to define the degrees of freedom for the formation members. The paths of formation elements yield geometries for which the aggregate performance of the array of discrete receivers may be calculated. The objective of the optimization process is therefore minimizing the time-average square of the difference between the filled aperture's intensity map and that generated by the discrete receiver array. This yields a formation whose configuration offers minimum errors for imaging processes beginning at any arbitrary start time. The problem as posed is non-convex, and requires implementation of a global search method. Genetic algorithms are used. The solution method includes a new analytic solution for the intensity map of an elliptical aperture and a technique for generalizing this solution to include the effect of non-ideal viewing geometries.

DTIC

*Orbits; Optimization; Receivers; Apertures*

**20030002457** Louisiana Tech Univ., Mechanical Engineering Dept., Ruston, LA USA

**Thermal Analysis of the NASA Integrated Vehicle Health Monitoring Experiment Technology for X-Vehicles (NITEX)**

Hegab, Hisham E., Louisiana Tech Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

The purpose of this project was to perform a thermal analysis for the NASA Integrated Vehicle Health Monitoring (IVHM) Technology Experiment for X-vehicles (NITEX). This electronics package monitors vehicle sensor information in flight and downlinks vehicle health summary information via telemetry. The experiment will be tested on the X-34 in an unpressurized compartment, in the vicinity of one of the vehicle's liquid oxygen tanks. The transient temperature profile for the electronics package has been determined using finite element analysis for possible mission profiles that will most likely expose the package to the most extreme hot and cold environmental conditions. From the analyses, it was determined that temperature limits for the electronics would be exceeded for the worst case cold environment mission profile. The finite element model used for the analyses was modified to examine the use of insulation to address this problem. Recommendations for insulating the experiment for the cold environment are presented, and were analyzed to determine their effect on a nominal mission profile.

Author

*Thermal Analysis; Health; High Temperature Environments; Mathematical Models; Monitors*

**20030002459** Stanford Univ., Dept. of Aeronautics and Astronautics, Stanford, CA USA

**Distributed Space System Technology Demonstrations with the Emerald Nanosatellite *Final Report, 1 Apr. 2000 - 30 Jun. 2002***

Twiggs, Robert, Stanford Univ., USA; [2002]; 96p; In English

Contract(s)/Grant(s): NAG5-9737

Report No.(s): SPO-23620; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

A viewgraph presentation of Distributed Space System Technologies utilizing the Emerald Nanosatellite is shown. The topics include: 1) Structure Assembly; 2) Emerald Mission; 3) Payload and Mission Operations; 4) System and Subsystem Description; and 5) Safety Integration and Testing.

CASI

*Aerospace Engineering; Nanosatellites; Technology Utilization; Systems Engineering; Mechanical Engineering*

**20030002499** NASA Marshall Space Flight Center, Huntsville, AL USA

**Thermal Orbital Environmental Parameter Study on the Propulsive Small Expendable Deployer System (ProSEDS) Using Earth Radiation Budget Experiment (ERBE) Data**

Sharp, John R., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; Thermal and Fluids Analysis Workshop 2002, 12-16 Aug. 2002, Clear Lake, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The natural thermal environmental parameters used on the Space Station Program (SSP 30425) were generated by the Space Environmental Effects Branch at NASA's Marshall Space Flight Center (MSFC) utilizing extensive data from the Earth Radiation Budget Experiment (ERBE), a series of satellites which measured low earth orbit (LEO) albedo and outgoing long-wave radiation. Later, this temporal data was presented as a function of averaging times and orbital inclination for use by thermal engineers in NASA Technical Memorandum TM 4527. The data was not presented in a fashion readily usable by thermal engineering modeling tools and required knowledge of the thermal time constants and infrared versus solar spectrum sensitivity of the hardware being analyzed to be used properly. Another TM was recently issued as a guideline for utilizing these environments (NASA/TM-2001-211221) with more insight into the utilization by thermal analysts. This paper gives a top-level overview of the environmental parameters presented in the TM and a study of the effects of implementing these environments on an ongoing MSFC project, the Propulsive Small Expendable Deployer System (ProSEDS), compared to conventional orbital parameters that had been historically used.

Author

*Trajectory Planning; Trajectory Analysis; Preflight Analysis; Orbits; Parameter Identification; Models*

**20030002504** Air Force Research Lab., Space Vehicles Directorate, Kirkland AFB, NM USA

**Intelligent Optical Polarimetry Development for Space Surveillance Missions**

McMakin, Lenore; Zetocha, Paul; Sparkman, Clint; McIntire, Harold; Fetrow, Matthew; Jan. 1999; 6p; In English; Presented at Int. Symposium on AI, Robotics and Automation in Space (5th). Held in Noordwijk, Netherlands, 1-3 Jun. 1999. Prepared in collaboration with Applied Technology Associates, Inc., Albuquerque, NM

Contract(s)/Grant(s): Proj-8809

Report No.(s): AD-A407957; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The rapidly increasing numbers and complexity of earth-orbiting satellites in recent decades has placed heavy demands upon telemetry and ground support equipment and personnel to maintain and control the systems. A major thrust of current space program developments is the reduction of dependence upon ground control for normal satellite operations. This paper describes one such experiment currently under development at the Air Force Research Laboratory (AFRL), which addresses these needs. The experiment combines an optical polarimeter for measurement of multi-spectral polarization signals of orbiting objects and a system of intelligent software agents, which will provide automated payload and bus control. We discuss the development of the optical system hardware, software agent development, and aspects of the processing and control of information from on-board data.

DTIC

*Artificial Satellites; Polarimetry; Adaptive Control*

**20030002643** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

**Microdot - A Four-Bit Microcontroller Designed for Distributed Low-End Computing in Satellites**

Mar. 2002; 143p; In English; Original contains color images

Report No.(s): AD-A407973; AFIT/GE/ENG/02M-28; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Many satellites are an integrated collection of sensors and actuators that require dedicated real-time control. For single processor systems, additional sensors require an increase in computing power and speed to provide the multi-tasking capability needed to service each sensor. Faster processors cost more and consume more power, which taxes a satellite's power resources and may lead to shorter satellite lifetimes. An alternative design approach is a distributed network of small and low power microcontrollers designed for space that handle the computing requirements of each individual sensor and actuator. The design of microdot, a four-bit microcontroller for distributed low-end computing, is presented. The design is based on previous research completed at the Space Electronics Branch, Air Force Research Laboratory (AFRL/VSSE) at Kirtland AFB, NM, and the Air Force Institute of Technology at Wright-Patterson AFB, OH. The Microdot has 29 instructions and a 1K x 4 instruction memory. The distributed computing architecture is based on the Philips Semiconductor I2C Serial Bus Protocol. A prototype was implemented and tested using an Altera Field Programmable Gate Array (FPGA). The prototype was operable to 9.1 MHz. The design was targeted for fabrication in a radiation-hardened-by-design gate-array cell library for the TSMC 0.35 micrometer CMOS process.

DTIC

*Microprocessors; Artificial Satellites; Microelectronics*

**20030002684** NASA Johnson Space Center, Houston, TX USA

**Computer Modeling of Real-Time Dynamic Lighting**

Maida, James C., NASA Johnson Space Center, USA; Pace, J., Johnson Engineering Corp., USA; Novak, J., National Space Biomedical Research Inst., USA; [2000]; 1p; In English; Bioastronautics Investigators' Workshop 2001, 2001, Galveston, TX, USA; Sponsored by Universities Space Research Association, USA

Contract(s)/Grant(s): NRA-98-HEDS-01; No Copyright; Avail: Issuing Activity; Abstract Only

Space Station tasks involve procedures that are very complex and highly dependent on the availability of visual information. In many situations, cameras are used as tools to help overcome the visual and physical restrictions associated with space flight. However, these cameras are effected by the dynamic lighting conditions of space. Training for these is conditions is necessary. The current project builds on the findings of an earlier NRA funded project, which revealed improved performance by humans when trained with computer graphics and lighting effects such as shadows and glare.

Author

*Spacecraft Cabin Atmospheres; Lighting Equipment; Astronaut Training; Computerized Simulation; Visual Perception; Human Performance*

**20030002756** NASA Langley Research Center, Hampton, VA USA

**Solar Sail Loads, Dynamics, and Membrane Studies**

Slade, K. N., NASA Langley Research Center, USA; Belvin, W. K., NASA Langley Research Center, USA; Behun, V., Swales Aerospace, USA; [2002]; 12p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Conference on Structures, Structural Dynamics, and Materials, 22-25 Apr. 2002, Denver, CO, Denver, CO, USA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-1265; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

While a number of solar sail missions have been proposed recently, these missions have not been selected for flight validation. Although the reasons for non-selection are varied, principal among them is the lack of subsystem integration and ground testing. This paper presents some early results from a large-scale ground testing program for integrated solar sail systems. In this series of tests, a 10 meter solar sail tested is subjected to dynamic excitation both in ambient atmospheric and vacuum conditions. Laser vibrometry is used to determine resonant frequencies and deformation shapes. The results include some low-order sail modes which only can be seen in vacuum, pointing to the necessity of testing in that environment.

Author

*Loads (Forces); Solar Sails; Dynamic Structural Analysis; Space Missions; Membrane Structures*

**20030003702** NASA Langley Research Center, Hampton, VA USA

**A Fabrication and Deployment Approach for a Miura-Ori Solar Sail Model**

Horner, Garnett C., NASA Langley Research Center, USA; Elliott, M. Dustin, Kentucky Univ., USA; [2002]; 7p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1708; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper discusses the detailed construction technique of the Miura-Ori solar sail model and outlines the various possible methods for its deployment. An experimental solar sail model has been constructed using the Miura-Ori folding pattern. Additionally, four inflatable struts were deployed to open the Miura-Ori membrane. The objective for the construction and testing of this model was the study of the deployment characteristics of such a structure from a macroscopic perspective.

Author

*Solar Sails; Fabrication; Struts; Membrane Structures; Ground Tests; Feasibility Analysis*

## SPACECRAFT INSTRUMENTATION AND ASTRIONICS

*Includes the design, manufacture, or use of devices for the purpose of measuring, detecting, controlling, computing, recording, or processing data related to the operation of space vehicles or platforms. For related information, see also 06 Aircraft Instrumentation and Avionics; For spaceborne instruments not integral to the vehicle itself see 35 Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy, Instrumentation and Photography; For spaceborne telescopes and other astronomical instruments see 89 Astronomy.*

**20030002255** AZ Technology, Inc., Huntsville, AL USA

### **Novel Advancements in Internet-Based Real Time Data Technologies**

Myers, Gerry, AZ Technology, Inc., USA; [2002]; 2p; In English; Space Ops 2002 Conference, 9-12 Oct. 2002, Houston, TX, USA  
Contract(s)/Grant(s): NAS8-01163; No Copyright; Avail: Issuing Activity; Abstract Only

AZ Technology has been working with MSFC Ground Systems Department to find ways to make it easier for remote experimenters (RPI's) to monitor their International Space Station (ISS) payloads in real-time from anywhere using standard/familiar devices. AZ Technology was awarded an SBIR Phase I grant to research the technologies behind and advancements of distributing live ISS data across the Internet. That research resulted in a product called "EZStream" which is in use on several ISS-related projects. Although the initial implementation is geared toward ISS, the architecture and lessons learned are applicable to other space-related programs. This paper presents the high-level architecture and components that make up EZStream. A combination of commercial-off-the-shelf (COTS) and custom components were used and their interaction will be discussed. The server is powered by Apache's Jakarta-Tomcat web server/servlet engine. User accounts are maintained in a My SQL database. Both Tomcat and MySQL are Open Source products. When used for ISS, EZStream pulls the live data directly from NASA's Telescience Resource Kit (TReK) API. TReK parses the ISS data stream into individual measurement parameters and performs on-the-fly engineering unit conversion and range checking before passing the data to EZStream for distribution. TReK is provided by NASA at no charge to ISS experimenters. By using a combination of well established Open Source, NASA-supplied, and AZ Technology-developed components, operations using EZStream are robust and economical. Security over the Internet is a major concern on most space programs. This paper describes how EZStream provides for secure connection to and transmission of space-related data over the public Internet. Display pages that show sensitive data can be placed under access control by EZStream. Users are required to login before being allowed to pull up those web pages. To enhance security, the EZStream client/server data transmissions can be encrypted to preclude interception. EZStream was developed to make use of a host of standard platforms and protocols. Each are discussed in detail in this paper. The EZStream server is written as Java Servlets. This allows different platforms (i.e. Windows, UNIX, Linux, Mac) to host the server portion. The EZStream client component is written in two different flavors: JavaBean and ActiveX. The JavaBean component is used to develop Java Applet displays. The ActiveX component is used for developing ActiveX-based displays. Remote user devices will be covered including web browsers on PC's and scaled-down displays for PDA's and smart cell phones. As mentioned, the interaction between EZStream (web/data server) and TReK (data source) will be covered as related to ISS. EZStream is being enhanced to receive and parse binary data stream directly. This makes EZStream beneficial to both the ISS International Partners and non-NASA applications (i.e. factory floor monitoring). The options for developing client-side display web pages will be addressed along with the development of tools to allow creation of display web pages by non-programmers.

Author

*Applications Programs (Computers); Communication Networks; Data Bases; Data Flow Analysis; Display Devices*

**20030002528** NASA Marshall Space Flight Center, Huntsville, AL USA

### **The Extension of ISS Resources for Multi-Discipline Subrack Payloads**

Sledd, Annette M., NASA Marshall Space Flight Center, USA; Jan. 08, 2002; 1p; In English; 53rd International Astronautical Congress (IAF) 2002 World Space Congress, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The EXPedite the processing of Experiments to Space Station or EXPRESS Rack System was developed to provide Space Station accommodations for subrack payloads. The EXPRESS Rack accepts Space Shuttle middeck locker type payloads and International Subrack Interface Standard (ISIS) Drawer payloads, allowing previously flown payloads an opportunity to transition to the International Space Station. The EXPRESS Rack provides power, data command and control, video, water cooling, air cooling, vacuum exhaust, and Nitrogen supply to payloads. The EXPRESS Rack system also includes transportation racks to transport payloads to and from the Space Station, Suitcase Simulators to allow a payload developer to verify data interfaces at the development site, Functional Checkout Units to allow payload checkout at KSC prior to launch, and trainer racks for the astronauts to learn how to operate the EXPRESS Racks prior to flight. Standard hardware and software interfaces provided by the EXPRESS Rack simplify the integration processes, and facilitate simpler ISS payload development. Whereas most ISS Payload facilities are designed to accommodate one specific type of science, the EXPRESS Rack is designed to accommodate multi-discipline research within the same rack allowing for the independent operation of each subrack payload. On-orbit operations began with the EXPRESS Rack Project on April 24, 2001, with one rack operating continuously to support long-running payloads. The other on-orbit EXPRESS Racks operate based on payload need and resource availability. Sustaining Engineering and Logistics and Maintenance functions are in place to maintain operations and to provide software upgrades.

Author

*International Space Station; Logistics; Systems Engineering; Space Shuttle Payloads; Multidisciplinary Research*

## 20

### SPACECRAFT PROPULSION AND POWER

*Includes main propulsion systems and components, e.g., rocket engines; and spacecraft auxiliary power sources. For related information, see also 07 Aircraft Propulsion and Power; 28 Propellants and Fuels; 15 Launch Vehicles and Launch Operations; and 44 Energy Production and Conversion.*

**20030002230** NASA Langley Research Center, Hampton, VA USA

#### **Propulsion Simulations with the Unstructured-Grid CFD Tool TetrUSS**

Deere, Karen A., NASA Langley Research Center, USA; Pandya, Mohagna J., Swales Aerospace, USA; [2002]; 14p; In English; 32nd AIAA Fluid Dynamics Conference and Exhibit, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2980; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A computational investigation has been completed to assess the capability of the NASA Tetrahedral Unstructured Software System (TetrUSS) for simulation of exhaust nozzle flows. Three configurations were chosen for this study: (1) a fluidic jet effects model, (2) an isolated nacelle with a supersonic cruise nozzle, and (3) a fluidic pitchthrust- vectoring nozzle. These configurations were chosen because existing data provided a means for measuring the ability of the TetrUSS flow solver USM3D for simulating complex nozzle flows. Fluidic jet effects model simulations were compared with structured-grid CFD (computational fluid dynamics) data at Mach numbers from 0.3 to 1.2 at nozzle pressure ratios up to 7.2. Simulations of an isolated nacelle with a supersonic cruise nozzle were compared with wind tunnel experimental data and structured-grid CFD data at Mach numbers of 0.9 and 1.2, with a nozzle pressure ratio of 5. Fluidic pitch-thrust-vectoring nozzle simulations were compared with static experimental data and structured-grid CFD data at static freestream conditions and nozzle pressure ratios from 3 to 10. A fluidic injection case was computed with the third configuration at a nozzle pressure ratio of 4.6 and a secondary pressure ratio of 0.7. Results indicate that USM3D with the S-A turbulence model provides accurate exhaust nozzle simulations at on-design conditions, but does not predict internal shock location at overexpanded conditions or pressure recovery along a boattail at transonic conditions.

Author

*Computational Fluid Dynamics; Computerized Simulation; Exhaust Nozzles; Fluidics; Nozzle Flow; Unstructured Grids (Mathematics)*

**20030002239** Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

#### **Micropropulsion Research at AFRL**

Gulczynski, Frank s., III; Spanjers, Gregory G.; May 03, 2000; 13p; In English

Report No.(s): AD-A407732; AFRL-PR-ED-TP-2000-101; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

There is an increased requirement for microsatellites to support such future missions as formation-flying space-based surveillance, space control, and on-orbit satellite servicing. Devices that can provide precise impulse bits in the 10-micro newton

range may be enabling for a new fleet of 25-kg class spacecraft supporting these missions. In response to this need the Air Force Research Laboratory is developing a miniaturized propulsion unit: the Micro-Pulsed Plasma Thruster (Micro-PPT). Like a standard PPT, the Micro-PPT uses a surface discharge across the face of a solid Teflon(TM) propellant to create and accelerate a combination of plasma and neutral vapor. The Micro-PPT substantially differs from the standard design by using a self-igniting discharge and eliminating the separate igniter circuit from the thruster. This simplification enables the order-of-magnitude reductions in the thruster size and operational power level required to meet microsatellite propulsion requirements.

DTIC

*Artificial Satellites; Propulsion; Thrusters*

**20030002244** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Small and Microthruster Propulsion Research at the Air Force Research Laboratory, Edwards AFB**

Dulligan, Michael; Gulczinski, Frank; Spanjers, Greg; Mar. 2000; 2p; In English

Report No.(s): AD-A407731; AFRL-PR-ED-AB-2000-053; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Clusters of satellites flying in cooperative formation require small and precise thruster operations to maintain formation integrity. Satellites in the 100-kg size class benefit from small thrusters for primary propulsion and micropropulsion for precision positioning and attitude control. A review of the research and development of small and micropropulsion thrusters at the Air Force Research Laboratory, Edwards AFB is presented with an emphasis on the propulsion package in development for the Air Force Research Laboratory TechSat21 flight in 2003.

DTIC

*Thrusters; Military Technology; Research and Development*

**20030002245** Air Force Research Lab., Space and Missile Propulsion Div., Edwards AFB, CA USA

**The Micro Pulsed Plasma Thruster**

Spanjers, Gregory G.; Schilling, John H.; Engelman, Scott; Spores, Ronald A.; May 11, 1999; 18p; In English

Report No.(s): AD-A407730; AFRL-JPR-ED-TP-FY99-0050; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

There is an increased requirement for microsatellites to support such future missions as formation-flying space-based radar, space control, and on-orbit satellite servicing. Devices that can provide precise impulse bit in the 10 micro Newton range may be enabling for a new fleet of 25-kg class spacecraft supporting these missions. In response to this need the Air Force Research Laboratory is developing a miniaturized propulsion unit: the Micro Pulsed Plasma Thruster (Micro-PPT). Like a standard PPT, The Micro-PPT uses a surface discharge across the face of a solid Teflon(TM) propellant to create and accelerate a combination of plasma and neutral vapor. However the Micro-PPT substantially differs from the standard design by using a self-igniting discharge and eliminating the separate igniter and trigger circuit from the thruster. This simplification enables the order-of-magnitude reductions in the thruster size and operational power level required to meet the microsatellite propulsion requirement.

DTIC

*Plasma Engines; Propulsion; Thrusters*

**20030002262** NASA Langley Research Center, Hampton, VA USA

**Nonintrusive Temperature and Velocity Measurements in a Hypersonic Nozzle Flow**

OByrne, S., NASA Langley Research Center, USA; Danehy, P. M., NASA Langley Research Center, USA; Houwing, A. F. P., Australian National Univ., Australia; [2002]; 14p; In English; 22nd AIAA Aerodynamic Measurement Technology and Ground Testing Conference, 24-26 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2917; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Distributions of nitric oxide vibrational temperature, rotational temperature and velocity have been measured in the hypersonic freestream at the exit of a conical nozzle, using planar laser-induced fluorescence. Particular attention has been devoted to reducing the major sources of systematic error that can affect fluorescence temperature measurements, including beam attenuation, transition saturation effects, laser mode fluctuations and transition choice. Visualization experiments have been performed to improve the uniformity of the nozzle flow. Comparisons of measured quantities with a simple one-dimensional computation are made, showing good agreement between measurements and theory given the uncertainty of the nozzle reservoir conditions and the vibrational relaxation rate.

Author

*Temperature Measurement; Velocity Measurement; Hypersonic Nozzles; Flow Distribution; Wind Tunnel Tests; Computational Fluid Dynamics; Nitric Oxide; Nozzle Flow*

**20030002282** NASA Marshall Space Flight Center, Huntsville, AL USA

**Space Solar Power Demonstrations: Challenges and Progress**

Howell, Joe T., NASA Marshall Space Flight Center, USA; Mankins, John C., NASA, USA; [2002]; 1p; In English; 53rd International Astro. Congress, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The prospects of using electrical power beamed from space are coming closer to reality with the continued pursuit and improvements in the supporting space solar research and technology. Space Solar Power (SSP) has been explored off and on for approximately three decades as a viable alternative and clean energy source. Results produced through the more recent Space Solar Power Exploratory Research and Technology (SERT) program involving extensive participation by industry, universities, and government has provided a sound technical basis for believing that technology can be improved to the extent that SSP systems can be built, economically feasible, and successfully deployed in space. Considerable advancements have been made in conceptual designs and supporting technologies including solar power generation, wireless power transmission, power management distribution, thermal management and materials, and the integrated systems engineering assessments. Basic technologies have progressed to the point where the next logical step is to formulate and conduct sophisticated demonstrations involving prototype hardware as final proof of concepts and identify high end technology readiness levels in preparation for full scale SSP systems designs. In addition to continued technical development issues, environmental and safety issues must be addressed and appropriate actions taken to reassure the public and prepare them for the future use of this alternative renewable energy resource. Accomplishing these objectives will allow informed future decisions regarding further SSP and related R&D investments by both NASA management and prospective external partners. In particular, accomplishing these objectives will also guide further definition of SSP and related technology roadmaps including performance objectives, resources and schedules; including 'multi-purpose' applications (terrestrial markets, science, commercial development of space, and other government missions).

Author

*Solar Generators; Experimentation; Market Research; Prototypes; Technology Assessment; Temperature Control*

**20030002283** NASA Marshall Space Flight Center, Huntsville, AL USA

**Space Solar Power Concepts: Demonstrations to Pilot Plants**

Carrington, Connie K., NASA Marshall Space Flight Center, USA; Feingold, Harvey, Science Applications International Corp., USA; [2002]; 1p; In English; 53rd IAF, 10-19 Oct. 2002, Houston, TX, USA; Sponsored by International Astronautical Federation, Switzerland; No Copyright; Avail: Issuing Activity; Abstract Only

The availability of abundant, affordable power where needed is a key to the future exploration and development of space as well as future sources of clean terrestrial power. One innovative approach to providing such power is the use of wireless power transmission (WPT). There are at least two possible WPT methods that appear feasible; microwave and laser. Microwave concepts have been generated, analyzed and demonstrated. Technologies required to provide an end-to-end system have been identified and roadmaps generated to guide technology development requirements. Recently, laser W T approaches have gained an increased interest. These approaches appear to be very promising and will possibly solve some of the major challenges that exist with the microwave option. Therefore, emphasis is currently being placed on the laser WPT activity. This paper will discuss the technology requirements, technology roadmaps and technology flight experiments demonstrations required to lead toward a pilot plant demonstration. Concepts will be discussed along with the modeling techniques that are used in developing them. Feasibility will be addressed along with the technology needs, issues and capabilities for particular concepts. Flight experiments and demonstrations will be identified that will pave the road from demonstrations to pilot plants and beyond.

Author

*Solar Cells; Solar Generators; Feasibility*

**20030002402** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Analyses of Teflon™ Surface Charring and Near Field Plume of a Micro-Pulsed Plasma Thruster**

Keidar, Michael; Boyd, Iain D.; Gulczinski, Frank S., III; Antoneen, Erik L.; Spanjers, Gregory G.; Jul. 18, 2002; 12p; In English; Prepared in cooperation with the Dept. of Aerospace Engineering, Univ. of Michigan, Ann Arbor, MI

Contract(s)/Grant(s): F49620-99-1-0040

Report No.(s): AD-A407805; AFRL-PR-ED-TP-2002-185; IEPC-01-155; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Teflon(TM) ablation in a micro-Pulsed Plasma Thruster is studied with an aim to understand the charring phenomena. Microscopic analysis of the charred areas shows that it contains mainly carbon. It is concluded that the carbon char is formed as result of carbon flux returned from the plasma. A simplified model of the current layer near the Teflon(TM) surface is developed. The current density and the Teflon(TM) surface temperature have peaks near the electrodes that explain preferential ablation of

these areas as was observed experimentally. The comparison of the temperature field and the ablation rate distribution with photographs of the Teflon(TM) surface shows that the area with minimum surface temperature and ablation rate corresponds to the charring area. This suggests that the charring may be related to a temperature effect. Electron densities predicted by the plume model are compared with near field measurements.

DTIC

*Surface Temperature; Charring; Temperature Distribution; Plasmas (Physics); Pulsed Plasma Thrusters; Temperature Effects*

**20030002646** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**The USAF Electric Propulsion Program**

Spores, R. A.; Birkan, M.; Jul. 1998; 14p; In English; Pres: 34th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 12-15 Jul, Cleveland, OH

Report No.(s): AD-A407980; AFRL-PR-ED-TP-1998-163; AIAA-98-3181; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An overview of the current state of electric propulsion technology development efforts within the USA Air Force is presented. Air Force Mission Needs Statements which call for electric propulsion are likewise discussed. Two groups within the Air Force Research Laboratory contribute to the electric propulsion program: Propulsion Directorate and Air Force Office of Scientific Research (AFOSR). The Propulsion Directorate is conducting electric propulsion efforts in basic research, engineering development as well as an Advanced Technology Development effort that will result in a space flight experiment of a 30 kilowatt arcjet system. AFOSR funds basic research in electric propulsion throughout the country in both academia and industry.

DTIC

*Electric Propulsion; Artificial Satellites*

**20030002663** Boeing North American, Inc., Rocketdyne Div., Canoga Park, CA USA

**Covering Achievements of the US Air Force Thrust Cell Technologies Program and Light Weight Thrust Chamber Assembly Program**

Farner, Bruce; Wherley, Brian; Ulmer, Don; Claflin, Scott; Ferrell, Suzanne; Jun. 1999; 26p; In English; Presented at the ASM Aerospace Materials Technology Conference Held in Wright Patterson, AFB, Ohio on June 21-24, 1999. Aeromat99. Contains viewgraphs only

Contract(s)/Grant(s): F04611-97-C-0034

Report No.(s): AD-A408008; AFRL-PR-ED-TP-FY99-0143; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

No abstract available.

Author

*Copper Alloys; Liquid Propellant Rocket Engines; Brazing; Thrust Chambers*

**20030002826** NASA Marshall Space Flight Center, Huntsville, AL USA

**2-D Magnetohydrodynamic Modeling of A Pulsed Plasma Thruster**

Thio, Y. C. Francis, NASA Marshall Space Flight Center, USA; Cassibry, J. T., Alabama Univ., USA; Wu, S. T., Alabama Univ., USA; [2002]; 12p; In English; 33rd AIAA Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-2194; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Experiments are being performed on the NASA Marshall Space Flight Center (MSFC) MK-1 pulsed plasma thruster. Data produced from the experiments provide an opportunity to further understand the plasma dynamics in these thrusters via detailed computational modeling. The detailed and accurate understanding of the plasma dynamics in these devices holds the key towards extending their capabilities in a number of applications, including their applications as high power (greater than 1 MW) thrusters, and their use for producing high-velocity, uniform plasma jets for experimental purposes. For this study, the 2-D MHD modeling code, MACH2, is used to provide detailed interpretation of the experimental data. At the same time, a 0-D physics model of the plasma initial phase is developed to guide our 2-D modeling studies.

Author

*Magnetohydrodynamics; Pulsed Plasma Thrusters; Two Dimensional Models; Fluid Flow; Computerized Simulation*

**20030002829** NASA Marshall Space Flight Center, Huntsville, AL USA

**Engine System Loads Analysis Compared to Hot-Fire Data**

Fraday, Gregory P., NASA Marshall Space Flight Center, USA; Jennings, John M., NASA Marshall Space Flight Center, USA;

Mims, Katherine, NASA Marshall Space Flight Center, USA; Brunty, Joseph, NASA Marshall Space Flight Center, USA; Christensen, Eric R., Science Applications International Corp., USA; [2002]; 13p; In English; 43rd AIAA Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1510; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Early implementation of structural dynamics finite element analyses for calculation of design loads is considered common design practice for high volume manufacturing industries such as automotive and aeronautical industries. However with the rarity of rocket engine development programs starts, these tools are relatively new to the design of rocket engines. In the NASA MC-1 engine program, the focus was to reduce the cost-to-weight ratio. The techniques for structural dynamics analysis practices, were tailored in this program to meet both production and structural design goals. Perturbation of rocket engine design parameters resulted in a number of MC-1 load cycles necessary to characterize the impact due to mass and stiffness changes. Evolution of loads and load extraction methodologies, parametric considerations and a discussion of load path sensitivities are important during the design and integration of a new engine system. During the final stages of development, it is important to verify the results of an engine system model to determine the validity of the results. During the final stages of the MC-1 program, hot-fire test results were obtained and compared to the structural design loads calculated by the engine system model. These comparisons are presented in this paper.

Author

*Dynamic Structural Analysis; Loads (Forces); Design Analysis; Parameter Identification; Rocket Engine Design; Engine Tests; Scale Models; Performance Prediction*

**20030003703** NASA Glenn Research Center, Cleveland, OH USA

**High Performance Power Module for Hall Effect Thrusters**

Pinero, Luis R., NASA Glenn Research Center, USA; Peterson, Peter Y., QSS Group, Inc., USA; Bowers, Glen E., Akima Corp., USA; September 2002; 14p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 755-B4-05

Report No.(s): NASA/TM-2002-211874; E-13556; NAS 1.15:211874; AIAA Paper 2002-3947; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Previous efforts to develop power electronics for Hall thruster systems have targeted the 1 to 5 kW power range and an output voltage of approximately 300 V. New Hall thrusters are being developed for higher power, higher specific impulse, and multi-mode operation. These thrusters require up to 50 kW of power and a discharge voltage in excess of 600 V. Modular power supplies can process more power with higher efficiency at the expense of complexity. A 1 kW discharge power module was designed, built and integrated with a Hall thruster. The breadboard module has a power conversion efficiency in excess of 96 percent and weighs only 0.765 kg. This module will be used to develop a kW, multi-kW, and high voltage power processors.

Author

*Hall Thrusters; Breadboard Models; Electronic Modules*

**20030003737** NASA Glenn Research Center, Cleveland, OH USA

**NASA's Hall Thruster Program 2002**

Jankovsky, Robert S., NASA Glenn Research Center, USA; Jacobson, David T., NASA Glenn Research Center, USA; Pinero, Luis R., NASA Glenn Research Center, USA; Manzella, David H., NASA Glenn Research Center, USA; Hofer, Richard R., QSS Group, Inc., USA; Peterson, Peter Y., QSS Group, Inc., USA; September 2002; 14p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-B4-05

Report No.(s): NASA/TM-2002-211880; E-13562; NAS 1.15:211880; AIAA Paper 2002-3675; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The NASA Hall thruster program currently supports a number of tasks related to high power thruster development for a number of customers including the Energetics Program (formerly called the Space-based Program), the Space Solar Power Program, and the In-space Propulsion Program. In program year 2002, two tasks were central to the NASA Hall thruster program: 1) the development of a laboratory Hall thruster capable of providing high thrust at high power-, and 2) investigations into operation of Hall thrusters at high specific impulse. In addition to these two primary thruster development activities, there are a number of other on-going activities supported by the NASA Hall thruster program. These additional activities are related to issues such as high-power power processor architecture, thruster lifetime, and spacecraft integration.

Author

*Hall Thrusters; High Thrust; Spacecraft Propulsion*

**20030003756** Embry-Riddle Aeronautical Univ., Dept. of Physical Sciences, USA

**PARTS: (Plasma Accelerated Reusable Transport System)**

Aherne, Michael, Embry-Riddle Aeronautical Univ., USA; Davis, Phil, Embry-Riddle Aeronautical Univ., USA; England, Matt, Embry-Riddle Aeronautical Univ., USA; Gustavsson, Jake, Embry-Riddle Aeronautical Univ., USA; Pankow, Steve, Embry-Riddle Aeronautical Univ., USA; Sampaio, Chere, Embry-Riddle Aeronautical Univ., USA; Savella, Phil, Embry-Riddle Aeronautical Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 23-38; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The Plasma Accelerated Reusable Transport System (PARTS) is an unmanned cargo shuttle intended to ferry large payloads to and from Martian orbit using a highly efficient VARIABLE Specific Impulse Magnetoplasma Rocket (VASIMR). The design of PARTS focuses on balancing cost and minimizing transit time for a chosen payload consisting of vehicles, satellites, and other components provided by interested parties.

Author

*Mars (Planet); Cargo; Vasimr (Propulsion System); Reusable Spacecraft; Spacecraft Design; Plasma Propulsion*

**20030003786** NASA Glenn Research Center, Cleveland, OH USA

**Experimental Evaluation of a Subscale Gaseous Hydrogen/Gaseous Oxygen Coaxial Rocket Injector**

Smith, Timothy D., NASA Glenn Research Center, USA; Klem, Mark D., NASA Glenn Research Center, USA; Breisacher, Kevin J., NASA Glenn Research Center, USA; Farhangi, Shahram, Boeing Co., USA; Sutton, Robert, Boeing Co., USA; November 2002; 20p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 708-73-10

Report No.(s): NASA/TM-2002-211982; E-13652; NAS 1.15:211982; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The next generation reusable launch vehicle may utilize a Full-Flow Stage Combustion (FFSC) rocket engine cycle. One of the key technologies required is the development of an injector that uses gaseous oxygen and gaseous hydrogen as propellants. Gas-gas propellant injection provides an engine with increased stability margin over a range of throttle set points. This paper summarizes an injector design and testing effort that evaluated a coaxial rocket injector for use with gaseous oxygen and gaseous hydrogen propellants. A total of 19 hot-fire tests were conducted up to a chamber pressure of 1030 psia, over a range of 3.3 to 6.7 for injector element mixture ratio. Post-test condition of the hardware was also used to assess injector face cooling. Results show that high combustion performance levels could be achieved with gas-gas propellants and there were no problems with excessive face heating for the conditions tested.

Author

*Injectors; Test Facilities; Coaxial Flow; Hydrogen; Oxygen; Gaseous Rocket Propellants; Rocket Engine Design*

## 23

### CHEMISTRY AND MATERIALS (GENERAL)

*Includes general research topics related to the composition, properties, structure, and use of chemical compounds and materials as they relate to aircraft, launch vehicles, and spacecraft. For specific topics in chemistry and materials see categories 24 through 29. For astrochemistry see category 90 Astrophysics.*

**20030002682** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Research in Energetic Ionic Liquids**

Drake, Greg; Hawkins, Tommy; Oct. 2002; 24p; In English; Presented at the AFOSR Workshop Held in Dulles, VA on 9-10 Oct.

2002. Contains viewgraphs only  
Report No.(s): AD-A408022; AFRL-PR-ED-VG-2002-232; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche  
No abstract available.

Author

*Explosives; Propellants; Liquids*

**20030003680** Argonne National Lab., IL USA

**Joining of Melt-Textured YBCO: A Direct Contact Method**

Chen, L.; Claus, H.; Paulikas, A. P.; Zheng, H.; Veal, B. W.; 2002; 18p; In English

Report No.(s): DE2002-799814; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We report a method for making weld joints, capable of transmitting high supercurrent densities, in bulk samples of melt textured YBCO. The joining procedure is carried out in a flowing atmosphere of O<sub>2</sub> to eliminate problems associated with nitrogen gas, which can become trapped in the joint. No filler or fluxing material is used. The method can be used to join large areas (several cm<sup>2</sup>) that are capable of transmitting supercurrent densities exceeding 10<sup>(sup 4)</sup> A/cm<sup>(sup 2)</sup>.

NTIS

*Welded Joints; YBCO Superconductors; Melting; High Current*

**20030003691** Stanford Linear Accelerator Center, Stanford, CA USA

**Structure of pH Dependent Block Copolymer Micelles: Charge and Ionic Strength Dependence**

Lee, A. S.; Gast, A. P.; Buotuen, V.; Armes, S. P.; Pople, J. A.; May 2002; 76p; In English

Report No.(s): DE2002-799988; SLAC-PUB-9346; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We characterize the structures of various polyelectrolyte block copolymer micelles in dilute aqueous solution as a function of pH and ionic strength. The block copolymers carry a common core block 2-(diethylamino) ethyl methacrylate (DEAEMA) and one of three coronal blocks: 2-(dimethylamino) ethyl methacrylate (DMAEMA), polyethylene oxide (PEO), and DMAEMA whose side-chain amine groups are selectively quaternized with benzyl chloride (Q-DMAEMA).

NTIS

*Block Copolymers; pH; Polyethylenes; Oxides*

**20030003739** Stanford Linear Accelerator Center, Stanford, CA USA

**Thermodynamic Interactions in Organometallic Block Copolymers**

Eitouni, H. B.; Balsara, N. P.; Hahn, H.; Pople, J. A.; Hempenius, M. A.; May 2002; 40p; In English

Report No.(s): DE2002-799989; SLAC-PUB-9347; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The thermodynamic interactions in anionically synthesized poly(styrene-block-ferrocenyldimethylsilane) (SF) copolymers were examined using birefringence, small angle X-ray and neutron scattering (SAXS and SANS). We show that birefringence detection of the order-disorder transition is possible in colored samples provided the wavelength of the incident beam is in the tail of the absorption spectrum. The location of the order-disorder transition was confirmed by SAXS.

NTIS

*Polymer Blends; Thermodynamics; Organometallic Compounds; Thermodynamic Properties; Block Copolymers*

**20030003907** Ohio Dept. of Transportation, Columbus, OH USA

**PCC/AC Shoulder Joint Seal Evaluation. Study SD96-10, Executive Summary**

May 1999; 18p; In English

Report No.(s): PB2003-101456; SD96-10-X; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report presents the findings on the evaluation of Crafcro Incorporated Roadsaver 903 SL Silicone Sealant and Dow Corning 890 SL Silicone Sealant. The Research Technical Panel had proposed to use the two self-leveling silicone joint sealants in test sections to seal longitudinal joints between Portland Cement Concrete Pavements (PCCP) and Asphalt Concrete (AC) shoulders.

NTIS

*Sealing; Pavements; Evaluation*

24  
**COMPOSITE MATERIALS**

*Includes physical, chemical, and mechanical properties of laminates and other composite materials.*

**20030002331** Jortner Research and Engineering, Inc., Costa Mesa, CA USA

**Mechanics of Shrinkage During Processing of Carbon-Carbon Composite** *Final Report, 1 Apr. 1993-31 Mar. 1996*

Jortner, Julius; Aug. 24, 2002; 61p; In English

Contract(s)/Grant(s): F49620-93-C-0015

Report No.(s): AD-A407783; JRE02002A; AFRL-SR-AR-TR-02-0344; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This report describes research into the mechanisms of shrinkage of resin-matrix laminates as they are carbonized during the process of making carbon-carbon composites. Activities have included: direct observation of composite samples while heating in the hot stage of a scanning electron microscope; calculation of strain fields from SEM images of fiber bundles; and development of image-analysis methods for characterizing the geometries of fiber arrays, with emphasis on quantifying contacts among neighboring fibers. Fiber-fiber contacts are found to be a major factor determining the shrinkage behavior of composites during carbonization.

DTIC

*Carbon-Carbon Composites; Image Analysis; Shrinkage; Laminates*

**20030002505** North Carolina Agricultural and Technical State Univ., Dept. of Mechanical Engineering, Greensboro, NC USA

**A Pulsed Laser Deposition Facility for the Synthesis of Novel Surface Engineered and Electronic Ceramic Materials** *Final Report, 1 Sep. 2000-31 Aug. 2001*

Sankar, J.; Kumar, D.; Yarmolenko, S.; Lee, Clinton; Pai, D.; Aug. 31, 2002; 13p; In English

Contract(s)/Grant(s): F49620-00-1-0366

Report No.(s): AD-A407959; AFRL-SR-AR-TR-02-0357; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The acquired funding from ARO was efficiently used to set-up a pulsed laser deposition (PLD) facility at the NCAT campus. The PLD technique is one of the most popular and effective techniques used in the present days for the deposition of thin films. In this technique, a pulsed laser (usually an excimer) is directed on a solid target. The PLD facility at NCAT campus has added a new dimension to the various research and educational activities taking place at our campus under the umbrella of NSF Center for Advanced Materials and Smart Structures. We have carried out a number of important experiments using the PLD facility in NOAT campus. These experiments have resulted in several publications in peer reviewed journals. A list of these publications can be seen at [http:// camss.ncat.edu](http://camss.ncat.edu).

DTIC

*Thin Films; Deposition; Pulsed Lasers; Fabrication*

**20030002673** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Dirgantara Terapan, Jakarta, Indonesia

**Modulus Elasticity Change Caused by Composition Variations of CTPB, MAPO, and EPON** *Perubahan Modulus Elastis Akibat Variasi Komposisi CTPB, MAPO dan EPON*

Rosita, Geni, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 11-18; In Malay-Indonesian; Copyright; Avail: Issuing Activity

This research conducted to analyze mechanical properties influenced by composition variation of CTPB, MAPO and EPON. The result showed that highest elasticity modulus reached on ratio of MAPO and CTPB 1,5 : 1. EPON addition even was decreasing the elasticity, with ratio CTPB : MAPO : EPON was 2: 1: 1,4.

Author

*Mechanical Properties; Modulus of Elasticity; Composition (Property); Polymers*

**20030003736** NASA Langley Research Center, Hampton, VA USA

**Nanostructured Composites: Effective Mechanical Property Determination of Nanotube Bundles**

Saether, E., NASA Langley Research Center, USA; Pipes, R. B., Akron Univ., USA; Frankland, S. J. V., Institute for Computer Applications in Science and Engineering, USA; [2002]; 8p; In English; 43rd AIAA/ASME/ASCE/AHS/ACS Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS1-97046

Report No.(s): AIAA Paper 2002-1523; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Carbon nanotubes naturally tend to form crystals in the form of hexagonally packed bundles or ropes that should exhibit a transversely isotropic constitutive behavior. Although the intratube axial stiffness is on the order of 1 TPa due to a strong network of delocalized bonds, the intertube cohesive strength is orders of magnitude less controlled by weak, nonbonding van der Waals interactions. An accurate determination of the effective mechanical properties of nanotube bundles is important to assess potential structural applications such as reinforcement in future composite material systems. A direct method for calculating effective material constants is developed in the present study. The Lennard-Jones potential is used to model the nonbonding cohesive forces. A complete set of transverse moduli are obtained and compared with existing data.

Author

*Carbon Nanotubes; Nanostructure (Characteristics); Lennard-Jones Potential; Molecular Interactions; Computerized Simulation; Elastic Properties; Strain Rate*

**20030004011** Old Dominion Univ., Coll. for Advanced Engineering Environments, Hampton, VA USA

**Nonlinear and Failure Analysis of Composite Structures Final Report, 1 Jan. 2001 - 31 Dec. 2002**

Noor, Ahmed K., Old Dominion Univ., USA; December 2002; 7p; In English

Contract(s)/Grant(s): NAG1-01028; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The overall goal of this research is to assess the effect of discontinuities and uncertainties on the nonlinear response and failure of stiffened composite panels subjected to combined mechanical and thermal loads. The key elements of the study are: (a) study of the effects of stiffener geometry and of transverse stresses on the response, damage initiation and propagation in stiffened composite panels; (b) use of hierarchical sensitivity coefficients to identify the major parameters that affect the response and damage in each of the different levels in the hierarchy (micromechanical, layer, panel, subcomponent and component levels); and, (c) application of fuzzy set techniques to identify the range and variation of possible responses. The computational models developed are used in conjunction with experiments to understand the physical phenomena associated with the nonlinear response and failure of stiffened composite panels. A toolkit is developed for use in conjunction with deterministic analysis programs to help the designer in assessing the effect of uncertainties in the different computational model parameters on the variability of the response quantities.

Author

*Mathematical Models; Loads (Forces); Failure Analysis; Composite Structures; Nonlinearity; Sensitivity Analysis; Coefficients; Parameterization*

**20030004106** NASA Langley Research Center, Hampton, VA USA

**Thermomechanical Response Variability of Stiffened Composite Panels**

Noor, Ahmed K., Old Dominion Univ., USA; Starnes, James H., Jr., NASA Langley Research Center, USA; Peters, Jeanne M., Old Dominion Univ., USA; Journal of Aerospace Engineering; October 2002; ISSN 0893-1321; Volume 15, No. 4, pp. 154-164; In English

Contract(s)/Grant(s): NCC1-01014; NAG1-01028; Copyright; Avail: Issuing Activity

A significant numerical simulation capability now exists for studying the various phenomena associated with the response, failure, and performance of multilayered composite panels and shells subjected to combined pressure, mechanical, and thermal loads. The phenomena involved cover a wide range of length scales from local to global structural response. The modeling approaches used for multilayered panels include micromechanical models, three-dimensional continuum models, quasi-three-dimensional models, and two-dimensional plate and shell models. Within each category a number of models with several levels of sophistication has evolved. The four categories are described in review papers. Despite the extensive literature cited in the afore-mentioned references, only a few studies have been reported on the effects of stiffness discontinuities, such as those associated with an abrupt stiffener termination or dropped plies, on the response of composite panel. Stiffener termination is often necessary in composite aerospace structures to satisfy detailed design requirements, and therefore an understanding and a prediction of its effect on the response and failure of composite panels are desirable. Such a prediction must take into account the fact that current measurement technology does not allow the accurate determination of the material parameters that are used in the analytical models.

Derived from text

*Composite Structures; Stiffness; Loads (Forces); Nonlinear Feedback; Sensitivity Analysis; Thermodynamics*

## INORGANIC, ORGANIC AND PHYSICAL CHEMISTRY

Includes the analysis, synthesis, and use inorganic and organic compounds; combustion theory; electrochemistry; and photochemistry. For related information see also 34 Fluid Dynamics and Thermodynamics, For astrochemistry see category 90 Astrophysics.

**20030002220** NASA Langley Research Center, Hampton, VA USA

### **Fundamental Mixing and Combustion Experiments for Propelled Hypersonic Flight**

Cutler, A. D., George Washington Univ., USA; Diskin, G. S., NASA Langley Research Center, USA; Danehy, P. M., NASA Langley Research Center, USA; Drummond, J. P., NASA Langley Research Center, USA; [2002]; 13p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NCC1-370

Report No.(s): AIAA Paper 2002-3879; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Two experiments have been conducted to acquire data for the validation of computational fluid dynamics (CFD) codes used in the design of supersonic combustors. The first experiment is a study of a supersonic coaxial jet into stagnant air in which the center jet is of a light gas, the coflow jet is of air, and the mixing layer between them is compressible. The jet flow field is characterized using schlieren imaging, surveys with Pitot, total temperature and gas sampling probes, and RELIEF velocimetry. VULCAN, a structured grid CFD code, is used to solve for the nozzle and jet flow. The second experiment is a study of a supersonic combustor consisting of a diverging duct with single downstream-angled wall injector. Entrance Mach number is 2 and enthalpy is nominally that of Mach 7 flight. Coherent anti-Stokes Raman spectroscopy (CARS) has been used to obtain nitrogen temperature in planes of the flow, and surface pressures and temperatures have also been acquired. Modern-design-of-experiment techniques have been used to maximize the quality of the data set.

Author

*Jet Engines; Flow Distribution; Data Acquisition; Evaluation; Nozzle Flow; Mixing Layers (Fluids); Supersonic Jet Flow; Combustion Chambers; Design Analysis*

**20030002382** Navy Experimental Diving Unit, Panama City, FL USA

### **Test Methods for Sodolime Carbon Dioxide Absorbents**

Long, E. T.; Aug. 2002; 29p; In English

Report No.(s): AD-A407711; NEDU-TR-02-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The following are general safety precautions that are not related to any specific procedures; therefore, they do not appear elsewhere in this document. These are recommended precautions that personnel must understand and use during various phases of testing and evaluation. STANDARD SAFETY PRECAUTIONS: Safety precautions for unmanned testing are normal precautions associated with testing at pressures of 5000 psig or less. to minimize safety risks, operating personnel shall adhere to the test procedures as presented in this manual when they conduct UBA testing. Failure to perform the procedures as prescribed may cause injury to personnel or damage to equipment. Operating personnel must observe all applicable safety regulations in compliance with the Navy Occupational Safety and Health (NAVOSH) Program Manual, OPNAVINST 5100.23E with change 1. Carbon dioxide (CO<sub>2</sub>) absorbents currently used in manned hyperbaric chambers and underwater breathing apparatus (UBA) authorized for use in the U.S. Navy primarily consist of calcium hydroxide (Ca(OH)<sub>2</sub>) HYDRATED LIME and sodium hydroxide (NaOH) sodium hydrate, which can cause irritation or burns to the eyes and/or skin. Before conducting the procedures outlined in this technical manual, the operator should review the Material Safety Data Sheet (MSDS) for the product under investigation.

DTIC

*Absorbents; Carbon Dioxide; Hyperbaric Chambers; Calcium Oxides; Performance Tests*

**20030002403** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

### **Characterization of the Optical and Electrical Properties of Proton-Irradiated 4H-Silicon Carbide**

Crockett, Heather C.; Mar. 26, 2002; 85p; In English; Original contains color images

Report No.(s): AD-A407806; AFIT/GNE/ENP/02M-01; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Epitaxial n-type 4H-silicon carbide (SiC) is irradiated with 2 MeV protons to evaluate the dislocation damage effects on the optical and electrical characteristics of the material. The optical properties of the material are investigated using temperature-dependant photoluminescence (PL) and the effects of proton irradiation on the electrical properties are evaluated using current-voltage measurements and constant-voltage deep level transient spectroscopy (CV-DLTS). Subsequent

high-temperature thermal annealing and recovery of the irradiated material is investigated over the temperature range of 900-1500 deg C. Proton-induced irradiation damage is apparent in the 4H-SiC material, affecting both the optical and electrical characteristics of the devices. The radiative behavior of the nitrogen-related near band edge transitions is significantly reduced as a result of the irradiation with partial recovery observed after high-temperature thermal annealing at 1500 deg C. A deeper trapping complex (EC-ET 380 meV) is detected as a result of irradiation and shows signs of activation due to thermal annealing. Initial indications taken from I-V measurements of the Schottky diodes reveal that proton irradiation followed by thermal annealing at 900 deg C may, in fact, enhance the rectifying device characteristics. Increasing the anneal temperature (TA = 1300 deg C) causes the device to fail entirely. Further annealing of the irradiated 4H-SiC at 1500 deg C demonstrates recovery in the rectifying behavior of the material. Significant levels of deep level donor traps are observed, induced by irradiation in n-type material. Three detectable defect pairs emerge with energy levels ranging from 570-730 meV below the conduction band. The trap parameters were determined using curve-fitting algorithms.

DTIC

*Optical Properties; Electrical Properties; Silicon Carbides*

**20030002458** Florida Inst. of Tech., Chemical Engineering Dept., FL USA

**Membrane Separation of Gases from the Martian Atmosphere**

Jennings, Paul A., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

A test bed has been constructed to test membrane modules for separation of gases under temperature and pressure conditions normally encountered on the surface of Mars. The test bed allows independent control of: (1) feed flow rates, (2) feed composition, (3) feed pressure, (4) permeate pressure, and (5) operating temperature. Preliminary data obtained at a nominal feed pressure of 760 torr and permeate pressure of 10 torr has demonstrated the ability of one membrane module to operate at temperatures as low as -70 C. At temperatures below -40 C, however, significant loss of carbon dioxide and argon was observed, probably indicating condensation at the relatively high pressure used. As expected, permeation flow rates decreased with decreasing temperature, the flow at -30 C approximately 37% of the value at +23 C. Values of permeability for individual gas components showed similar decreases with decreasing temperature, but permeability ratios changed significantly. For example, the ratio of the permeabilities of carbon dioxide and nitrogen increased from 2.6 at 23 C to 5.6 at -30 C. Additional data at lower operating pressures and temperatures must be obtained in order to optimize design of a usable separation system.

Author

*Argon; Carbon Dioxide; Mars Atmosphere; Membranes; Nitrogen; Operating Temperature; Separators*

**20030002520** University of Southeastern Louisiana, Chemistry and Physics Dept., Hammond, LA USA

**Developing A New Sampling and Analysis Method for Hydrazine and Monomethyl Hydrazine**

Allen, John R., University of Southeastern Louisiana, USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

Solid phase microextraction (SPME) will be used to develop a method for detecting monomethyl hydrazine (MMH) and hydrazine (Hz). A derivatizing agent, pentafluorobenzoyl chloride (PFBCl), is known to react readily with MMH and Hz. The SPME fiber can either be coated with PFBCl and introduced into a gaseous stream containing MMH, or PFBCl and MMH can react first in a syringe barrel and after a short equilibration period a SPME is used to sample the resulting solution. These methods were optimized and compared. Because Hz and MMH can degrade the SPME, letting the reaction occur first gave better results. Only MMH could be detected using either of these methods. Future research will concentrate on constructing calibration curves and determining the detection limit.

Author

*Technology Assessment; Solid Phases; Hydrazines; Chlorides*

**20030002631** NASA Marshall Space Flight Center, Huntsville, AL USA

**Partial Pressures for Several In-Se Compositions from Optical Absorbance of the Vapor**

Brebrick, R. F., Marquette Univ., USA; Su, Ching-Hua, NASA Marshall Space Flight Center, USA; Journal of Phase Equilibria: Basic and Applied Research (Section I); 2001; Volume 23, No. 5, pp. 397-408; In English; Copyright; Avail: Issuing Activity

The optical absorbance of the vapor phase over various In-Se compositions between 33.3-60.99 at.% Se and 673-1418 K was measured and used to obtain the partial pressures of Se<sub>2</sub>(g) and In<sub>2</sub>Se(g). The results are in agreement with silica Bourdon gauge measurements for compositions between 50-61 at.%, but significantly higher than those from Knudsen cell and simultaneous

Knudsen-torsion cell measurements. It is found that 60.99 at.% Se lies outside the sesquiselenide homogeneity range and 59.98 at.% Se lies inside and is the congruently melting composition. The Gibbs energy of formation of the liquid from its pure liquid elements between 1000-1300 K is essentially independent of temperature and falls between -36 to -38 kJ per g atomic weight for 50 and 56% Se at 1200 and 1300 K.

Author

*Partial Pressure; Vapor Phases; Indium; Selenium; Thermal Analysis; Light (Visible Radiation)*

**20030002648** State Univ. of New York at Buffalo, Dept. of Mechanical and Aerospace Engineering, Amherst, NY USA

**Filtered Mass Density Function for Subgrid Scale Modeling of Turbulent Diffusion Flames** *Final Report, 1 Nov. 1999-31 Aug. 2002*

Givi, Peyman; Jaber, Farhad A.; Oct. 31, 2002; 106p; In English

Contract(s)/Grant(s): F49620-00-1-0035; Proj-2308

Report No.(s): AD-A408007; AFRL-SR-AR-TR-02-0389; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Research concentrated on the following three issues: (1) development of the velocity filtered density function (VFDF); (2) development of the velocity-scalar filtered density function (VSPDF); and (3) implementation of the scalar filtered density function (SFDF) for LES of a turbulent methane jet flame. In efforts pertaining to (1)-(2), modeled transport equations for the VFDF and VSPDF were derived. These equations were solved with a new Lagrangian Monte Carlo scheme. The model predictions were compared with results obtained via conventional LES closures and with direct numerical simulation (DNS) data of a turbulent mixing layer. In efforts pertaining to (3), the LES/SFDF predictions of a methane jet-flame were used to construct the spatial and the compositional structure of the flame. Some preliminary results were obtained and were compared with experimental data obtained at the Sandia National Laboratories.

DTIC

*Combustion; Fluid Mechanics; Models; Propulsion System Configurations*

**20030002810** NASA Ames Research Center, Moffett Field, CA USA

**Theoretical Study of Decomposition Pathways for HArF and HKrF**

Chaban, Galina M., NASA Ames Research Center, USA; Lundell, Jan, Helsinki Univ., Finland; Gerber, R. Benny, Hebrew Univ., Israel; Aug. 15, 2002; 18p; In English

Contract(s)/Grant(s): NSF CHE-01-01199; DFG-SFB450; RTOP 274-50-00-06; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

To provide theoretical insights into the stability and dynamics of the new rare gas compounds HArF and HKrF, reaction paths for decomposition processes  $\text{HRgF} \rightarrow \text{Rg} + \text{HF}$  and  $\text{HRgF} \rightarrow \text{H} + \text{Rg} + \text{F}$  ( $\text{Rg} = \text{Ar}, \text{Kr}$ ) are calculated using ab initio electronic structure methods. The bending channels,  $\text{HRgF} \rightarrow \text{Rg} + \text{HF}$ , are described by single-configurational MP2 and CCSD(T) electronic structure methods, while the linear decomposition paths,  $\text{HRgF} \rightarrow \text{H} + \text{Rg} + \text{F}$ , require the use of multi-configurational wave functions that include dynamic correlation and are size extensive. HArF and HKrF molecules are found to be energetically stable with respect to atomic dissociation products ( $\text{H} + \text{Rg} + \text{F}$ ) and separated by substantial energy barriers from  $\text{Rg} + \text{HF}$  products, which ensure their kinetic stability. The results are compatible with experimental data on these systems.

Author

*Numerical Analysis; Stability; Dynamic Models; Rare Gas Compounds; Wave Functions*

**20030003648** NASA Glenn Research Center, Cleveland, OH USA

**Fluid Dynamics of Bubbly Liquids**

Tsang, Y. H., Cornell Univ., USA; Koch, D. L., Cornell Univ., USA; Zenit, R., Cornell Univ., USA; Sangani, A., Syracuse Univ., USA; Kushch, V. I., Syracuse Univ., USA; Spelt, P. D. M., Syracuse Univ., USA; Hoffman, M., NASA Glenn Research Center, USA; Nahra, H., NASA Glenn Research Center, USA; Fritz, C., NASA Glenn Research Center, USA; Dolesh, R., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 477-514; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Experiments have been performed to study the average flow properties of inertially dominated bubbly liquids which may be described by a novel analysis. Bubbles with high Reynolds number and low Weber number may produce a fluid velocity disturbance that can be approximated by a potential flow. We studied the behavior of suspensions of bubbles of about 1.5 mm diameter in vertical and inclined channels. The suspension was produced using a bank of 900 glass capillaries with inner diameter of about 100 microns in a quasi-steady fashion. In addition, salt was added to the suspension to prevent bubble-bubble coalescence. As a result, a nearly monodisperse suspension of bubble was produced. by increasing the inclination angle, we were able to explore an increasing amount of shear to buoyancy motion. A pipe flow experiment with the liquid being recirculated is under

construction. This will provide an even larger range of shear to buoyancy motion. We are planning a microgravity experiment in which a bubble suspension is subjected to shearing in a couette cell in the absence of a buoyancy-driven relative motion of the two phases. By employing a single-wire, hot film anemometer, we were able to obtain the liquid velocity fluctuations. The shear stress at the wall was measured using a hot film probe flush mounted on the wall. The gas volume fraction, bubble velocity, and bubble velocity fluctuations were measured using a homemade, dual impedance probe. In addition, we also employed a high-speed camera to obtain the bubble size distribution and bubble shape in a dilute suspension. A rapid decrease in bubble velocity for a dilute bubble suspension is attributed to the effects of bubble-wall collisions. The more gradual decrease of bubble velocity as gas volume fraction increases, due to subsequent hindering of bubble motion, is in qualitative agreement with the predictions of Spelt and Sangani for the effects of potential-flow bubble-bubble interactions on the mean velocity. The ratio of the bubble velocity variance to the square of the mean is 0(0.1). For these conditions Spelt and Sangani predicted that the homogeneous suspension would be unstable and clustering into horizontal rafts will take place. Evidence for bubble clustering is obtained by analysis of video images. The liquid velocity variance is larger than would be expected for a homogeneous suspension and the liquid velocity frequency spectrum indicates the presence of velocity fluctuations that are slow compared with the time for the passage of an individual bubble. These observations provide further evidence for bubble clustering.

Author

*Bubbles; Potential Flow; Shear Properties; Fluid Dynamics*

**20030003654** NASA Ames Research Center, Moffett Field, CA USA

**Separation of Carbon Monoxide and Carbon Dioxide for Mars ISRU**

LeVan, M. Douglas, Vanderbilt Univ., USA; Walton, Krista S., Vanderbilt Univ., USA; Finn, John E., NASA Ames Research Center, USA; Sridhar, K. R., Arizona Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 620-635; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Human Exploration and Development of Space will require the use of fundamental process technologies for gas storage and separation. These are enabling technologies. In our research, we are designing, constructing, and testing an innovative, robust, low mass, low power separation device that can recover carbon dioxide and carbon monoxide for Mars ISRU (in-situ resource utilization). The work has broad implications for gas storage and separations for gas-solid systems; these are ideally suited for reduced gravitational environments. The work is also important for robotic sample return missions using ISRU and in lunar oxygen production from regolith using carbothermal reduction. This paper describes our overall effort and highlights our results on adsorption equilibrium determination and process design. A second paper will provide details on adsorption equilibrium measurement and adsorbent selection.

Author

*In Situ Resource Utilization; Mars Exploration; Carbon Dioxide Removal; Carbon Monoxide*

**20030003681** Argonne National Lab., IL USA

**C(2)D(5)I Dissociation and D + CH(3) - - is greater than CH(2)D + H at High Temperature: Implications to the High Pressure Rate Constant for CH(4) Dissociation**

Su, M. C.; Michael, J. V.; Apr. 16, 2002; 30p; In English

Report No.(s): DE2002-799816; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The shock tube technique with H- and D-atom atomic resonance absorption spectrometry (ARAS) detection has been used to study the the  $\text{CH}_3 + \text{D} \rightarrow \text{CH}_2\text{D} + \text{H}$ , over the temperature ranges, 924-1370 K and 1294-1753 K, respectively. First-order rate constants for the thermal decomposition of  $\text{C}_2\text{D}_5\text{I}$  can be expressed by the Arrhenius equation,  $\log k_{\text{C}_2\text{D}_5\text{I}} = (10.397 + \text{or} = 0.297) (7700 + \text{or} = 334 \text{ K})/T$ , giving  $k_{\text{C}_2\text{D}_5\text{I}} = 2.49 \times 10^{10} \exp(-17729 \text{ K}/T) \text{ s}^{-1}$ . The branching ratio between product channels,  $\text{C}_2\text{D}_5 + \text{I}$  and  $\text{C}_2\text{D}_4 + \text{DI}$ , was also determined. These results coupled with fast decomposition of  $\text{C}_2\text{D}_5$  radicals were then used to specify  $(\text{D})_t$  in subsequent kinetics experiments with  $\text{CH}_3$  where  $(\text{CH}_3)\text{O}$  was prepared from the concurrent thermal decomposition of  $\text{CH}_3\text{I}$ .

NTIS

*Dissociation; High Pressure; Reaction Kinetics; Shock Tubes; Spectrometers*

**20030003682** Sandia National Labs., Albuquerque, NM USA

**Theoretical Analysis of the CH(3) + H Reaction: Isotope Effects, the High Pressure Limit, and Transition State Recrossing**

Klippenstein, S. J.; Georgievskii, Y.; Harding, L. B.; 2002; 24p; In English

Report No.(s): DE2002-799817; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The reaction of methyl radicals with hydrogen atoms is studied with a combination of ab initio quantum chemistry, variational transition theory, and classical trajectory simulations. The interaction between the two radicals, including the umbrella mode of the methyl radical, is examined at the CAS+1+2 level using an augmented correlation consistent polarized valence triple zeta basis set. The implementation of an analytic representation of the ab initio data within variable reaction coordinate transition state theory yields predictions for the zero-pressure limit isotopic exchange rate constants that are about 15% greater than the available experimental data.

NTIS

*High Pressure; Hydrogen Atoms; Isotope Effect; Radicals; Chemical Reactions; Quantum Chemistry; Methyl Compounds*

**20030003780** Department of Housing and Urban Development, Washington, DC USA

**Electrochemical Chloride Extraction: Influence of Concrete Surface on Treatment**

Sharp, S. R.; Clemena, G. G.; Virmani, Y. P.; Stoner, G. E.; Kelly, R. G.; Sep. 09, 2002; 56p; In English

Report No.(s): PB2003-101517; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

One bridge restoration technique available for reducing corrosion-induced concrete deterioration, which removes chloride ions while simultaneously realkalizing the concrete adjacent to the steel, is electrochemical chloride extraction (ECE). Studies have shown that ECE is capable of removing, in a single application, a significant portion of the chloride ions from a reinforced concrete structure. Prior research has also shown that the quantity of chloride ions removed is dependent on numerous factors including quantity and spacing of reinforcing steel, applied voltage, initial chloride concentration, etc. In addition, investigations into chloride binding and competition between other ions as current carriers have helped to clarify the probable mechanisms responsible for decreases in current efficiency with time during chloride removal.

NTIS

*Chlorides; Surface Treatment; Electrochemical Corrosion; Concretes*

**20030003785** Navy Experimental Diving Unit, Panama City, FL USA

**The Analysis of Sodalime Granule Size Distributions**

Clarke, J. R.; Aug. 2002; 95p; In English

Report No.(s): AD-A407905; NEDU TR-02-08; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

NEDU has developed a procedure for translating mesh sizes given in sodalime specifications to those sieve sizes used in testing laboratories. This procedure is used to establish model Gaussian and log-normal distributions that are capable of meeting the specifications. The mesh size distribution measured by sieving a sodalime sample is then compared to the best model. A chi-square goodness of fit test is used to determine whether or not the sample distribution meets the best model distribution. Several Mathcad documents are provided to explain the mathematical basis for this procedure.

DTIC

*Granular Materials; Absorbents*

## 26

### METALS AND METALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of metals and metallic materials; and metallurgy.*

**20030002492** California Polytechnic State Univ., Materials Engineering Dept., San Luis Obispo, CA USA

**Corrosion Research and Web Site Activities**

Heidersbach, Robert H., California Polytechnic State Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

This report covers corrosion-related activities at the NASA Kennedy Space Center during the summer of 2000. The NASA Kennedy Space Center's corrosion web site, corrosion.ksc.nasa.gov, was updated with new information based on feedback over the past two years. The methodology for a two-year atmospheric exposure testing program to study the effectiveness of commercial chemicals sold for rinsing aircraft and other equipment was developed and some preliminary laboratory chemical analyses are presented.

Author

*Chemical Analysis; Corrosion; Websites*

**20030002511** Army Engineer Research and Development Center, Champaign, IL USA

**Chrome Plating Controls Enhancement to the 120-mm Plating Facility at Watervliet Arsenal, NY, Fiscal Year 2000 Final Report**

Baird, Joyce C.; Franklin, Dave; Darcy, Phil; Aug. 2002; 32p; In English; Original contains color images

Report No.(s): AD-A407972; ERDC/CBRL-TR-02-19; No Copyright; Avail: Defense Technical Information Center (DTIC)

Watervliet Arsenal's (WVA's) chrome plating controls in its 120-mm plating facility required enhancements and upgrades to improve efficiency and reduce operating costs. A site visit and preliminary investigation determined that system hardware needed modification. New designs were developed for the existing plating tank temperature loops and analog indicators were replaced with digital equipment. Scrubber instrumentation was calibrated, rectifier current loops were simplified, additional hardware was provided, and software was modified. Operating and maintenance manuals were updated and maintenance personnel were provided training. The chrome plating controls enhancement to the 120-mm plating facility reduced the annual operating costs and improved the efficiency of the 120-mm major plating facility at WVA.

DTIC

*Chromium; Plating*

**20030003669** Northwestern Univ., Chicago, IL USA

**Dynamics and Instability of Triple Junctions of Solidifying Eutectics: Flow-Modified Morphologies**

Davis, Stephen H., Northwestern Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 223-239; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Fluid motions impressed upon a eutectic crystal front during directional solidification result in an increase of the lamellar spacing. This flow-induced change of microstructures is analyzed analytically to show the relationship between spacing and the operating conditions. The resulting system is a set of ordinary differential equations which describe the evolution of triple junctions. In a weak-flow regime lamellar widths at the minimum undercooling have a scaling similar to that of Jackson and Hunt, modified by the flows. When the flows are strong, a new scaling law shows that the width is proportional to one-fourth power of the imposed shear rate. Lamellar phases then tilt into the flow. Only at large morphological numbers does the minimum undercooling point corresponds to the marginal stability limit. Simulations show that the flows promote pinching of unstable lamellae.

Author

*Fluid Flow; Directional Solidification (Crystals); Phase Transformations; Microstructure; Crystal Morphology; Eutectics; Computational Fluid Dynamics*

**20030003683** Argonne National Lab., Energy Technology Div., IL USA

**Mechanism of Fatigue Crack Initiation in Austenitic Stainless Steels in LWR Environments**

Chopra, O. K.; 2002; 14p; In English

Report No.(s): DE2002-799837; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This paper examines the mechanism of fatigue crack initiation in austenitic stainless steels (SSs) in light water reactor (LWR) coolant environments. The effects of key material and loading variables, such as strain amplitude, strain rate, temperature, level of dissolved oxygen in water, and material heat treatment on the fatigue lives of wrought and cast austenitic SSs in air and LWR environments have been evaluated.

NTIS

*Austenitic Stainless Steels; Crack Initiation; Fatigue (Materials); Light Water Reactors; Coolants*

**20030003711** Lawrence Livermore National Lab., Livermore, CA USA

**Interfacial Dislocations and Deformation Twinning in Fully Lamellar TiAl**

Hsing, L. M.; Choi, B. W.; Nieh, T. G.; Jul. 13, 2000; 24p; In English

Report No.(s): DE2002-792728; UCRL-JC-137471; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Deformation twinning, which takes place abnormally within lamellar TiAl subjected to creep deformation at strain rates as low as  $10(\text{sup } -7)$ , has been found to be intimately related to the motion, pileup and dissociation of interfacial (Shockley partial) dislocations. In this study, results of in-situ TEM observations are presented to verify the motion and pileup of interfacial dislocations.

NTIS

*Deformation; Mechanical Twinning; Titanium Aluminides; Creep Properties; Lamella (Metallurgy); Interfacial Tension; Dislocations (Materials)*

**20030003745** Argonne National Lab., IL USA

**Metal Dusting Research at Argonne National Laboratory**

Natesan, K.; Zeng, Z.; Maroni, V. A.; Soppet, W. K.; Rink, D. L.; Jun. 2002; 28p; In English

Report No.(s): DE2002-801566; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The deposition of carbon from carbonaceous gaseous environments is prevalent in many chemical and petrochemical processes such as reforming systems, syngas production systems, and iron reduction plants. One of the major consequences of carbon deposition is the degradation of structural materials by a phenomenon known as 'metal dusting.' There are two major issues of importance in metal dusting. First is formation of carbon and subsequent deposition of carbon on metallic materials. Second is the initiation of metal dusting degradation of the alloy. Details are presented on a research program that is underway at Argonne National Laboratory to study the metal dusting phenomenon from a fundamental scientific base involving laboratory research in simulated process conditions and field testing of materials in actual process environments. The project has participation from the U.S. chemical industry, alloy manufacturers, and the Materials Technology Institute, which serves the chemical process industry.

NTIS  
*Carbon; Degradation; Deposition; Chemical Reactions*

**20030003787** NASA Glenn Research Center, Cleveland, OH USA

**Quench Crack Behavior of Nickel-Base Disk Superalloys**

Gayda, John, NASA Glenn Research Center, USA; Kantzos, Pete, Ohio Aerospace Inst., USA; Miller, Jason, Akron Univ., USA; November 2002; 16p; In English; Original contains color illustrations

Contract(s)/Grant(s): RTOP 708-31-13

Report No.(s): NASA/TM-2002-211984; E-13654; NAS 1.15:211984; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

There is a need to increase the temperature capability of superalloy turbine disks to allow higher operating temperatures in advanced aircraft engines. When modifying processing and chemistry of disk alloys to achieve this capability, it is important to preserve the ability to use rapid cooling during supersolvus heat treatments to achieve coarse grain, fine gamma prime microstructures. An important step in this effort is an understanding of the key variables controlling the cracking tendencies of nickel-base disk alloys during quenching from supersolvus heat treatments. The objective of this study was to investigate the quench cracking tendencies of several advanced disk superalloys during simulated heat treatments. Miniature disk specimens were rapidly quenched after solution heat treatments. The responses and failure modes were compared and related to the quench cracking tendencies of actual disk forgings. Cracking along grain boundaries was generally observed to be operative. For the alloys examined in this study, the solution temperature not alloy chemistry was found to be the primary factor controlling quench cracking. Alloys with high solvus temperatures show greater tendency for quench cracking.

Author

*Crack Propagation; Nickel Alloys; Heat Resistant Alloys; Rapid Quenching (Metallurgy); Microstructure; Disks (Shapes)*

**20030003789** NASA Marshall Space Flight Center, Huntsville, AL USA

**Effects of Thermal Exposure on Properties of Al-Li Alloys**

Shah, Sandeep, NASA Marshall Space Flight Center, USA; Wells, Doug, NASA Marshall Space Flight Center, USA; Stanton, William, NASA Marshall Space Flight Center, USA; Lawless, Kirby, NASA Marshall Space Flight Center, USA; Russell, Carolyn, NASA Marshall Space Flight Center, USA; Wagner, John, NASA Langley Research Center, USA; Domack, Marcia, NASA Langley Research Center, USA; Babel, Henry, Boeing Co., USA; Farahmand, Bahram, Boeing Co., USA; Schwab, David, Boeing Co., USA; Sep. 05, 2002; 25p; In English; AMPET 2002 Conference, 16-18 Sep. 2002, Huntsville, AL, USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper presents viewgraphs on the effects of thermal exposure on the mechanical properties of both developmental and production mature Al-Li alloys. The topics include: 1) Aluminum-Lithium Alloys Composition and Features; 2) Key Characteristics of Al-Li Alloys; 3) Research Approach; 4) Available and Tested Material; and 5) Thermal Exposure Matrix. The alloy temperatures, gage thickness and product forms show that there is no deficit in mechanical properties at lower exposure temperatures in some cases, and a significant deficit in mechanical properties at higher exposure temperatures in all cases.

CASI

*Aluminum-Lithium Alloys; Mechanical Properties; Temperature Effects; Composition (Property); Metallurgy*

**20030003810** Lawrence Livermore National Lab., Livermore, CA USA

**Synchrotron-Based Experimental Investigations and Numerical Modeling of the Kinetics of Phase Transformations in the Heat Affected Zone of Welds**

Elmer, J. W.; Wong, J.; DebRoy, T.; Yang, Z.; Sista, S.; May 04, 2000; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-792799; UCRL-ID-138920; No Copyright; Avail: National Technical Information Service (NTIS)

Spatially Resolved X-Ray Diffraction (SRXRD) and Time Resolved X-Ray Diffraction (TRXRD) methods are being developed at LLNL for in-situ investigations of phase transformations in the heat-affected zone (HAZ) of welds. In this region of the weld, severe temperature gradients, high peak temperatures and rapid thermal fluctuations occur as the heat source passes through the material. These non-isothermal temperature fluctuations produce HAZ microstructures that cannot be predicted by conventional methods. The unique synchrotronbased experiments being developed here will enable the determination of phase transformation kinetics under true non-isothermal welding conditions, and can be used to aid in the development of models to predict HAZ microstructural evolution under a wide range of welding conditions. Commercially pure titanium, stainless steel alloys and plain carbon steels are currently under investigation.

NTIS

*Phase Transformations; Heat Affected Zone; Welded Joints*

## 27

### NONMETALLIC MATERIALS

*Includes physical, chemical, and mechanical properties of plastics, elastomers, lubricants, polymers, textiles, adhesives, and ceramic materials. For composite materials see 24 Composite Materials.*

**20030002484** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Hydraulic Actuation Based on Flow of Non-wetting Fluids in Micro-channels**

Hoffman, W.; Wapner, P.; Oct. 13, 1999; 17p; In English

Contract(s)/Grant(s): AF Proj. 2306

Report No.(s): AD-A408083; AFRL-PR-ED-TP-1999-0186; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The behavior of non-wetting fluids in micro-channels can be utilized to create an unusual form of micro-hydraulic technology that enables fabrication of various kinds of micro-actuators and micro-bearings. In addition, this same technology can be used to construct micro-pumps capable of generating flows of wetting fluids in micro-channels and to manipulate and control these flows.

DTIC

*Hydraulic Fluids; Fluidics; Microchannels; Hydraulic Equipment; Microelectromechanical Systems; Fabrication*

**20030002523** NASA Marshall Space Flight Center, Huntsville, AL USA

**Thermostructural Analysis of Carbon Cloth Phenolic Material Tested at the Laser Hardened Material Evaluation Laboratory**

Clayton, J. Louie, NASA Marshall Space Flight Center, USA; Ehle, Curt, ATK-Thiokol Propulsion, USA; [2002]; 1p; In English; JANNAF Interagency Propulsion Committee, 26-29 Aug. 2002, San Antonio, TX, USA; Sponsored by Department of the Navy, USA; No Copyright; Avail: Issuing Activity; Abstract Only

RSRM nozzle liner components have been analyzed and tested to explore the occurrence of anomalous material performance known as pocketing erosion. Primary physical factors that contribute to pocketing seem to include the geometric permeability, which governs pore pressure magnitudes and hence load, and carbon fiber high temperature tensile strength, which defines a material limiting capability. The study reports on the results of a coupled thermostructural finite element analysis of Carbon Cloth Phenolic (CCP) material tested at the Laser Hardened Material Evaluation Laboratory (the LHMEEL facility). Modeled test configurations will be limited to the special case of where temperature gradients are oriented perpendicular to the composite material ply angle. Analyses were conducted using a transient, one-dimensional flow/thermal finite element code that models pore pressure and temperature distributions and in an explicitly coupled formulation, passes this information to a 2-dimensional finite element structural model for determination of the stress/deformation behavior of the orthotropic fiber/matrix CCP. Pore pressures are generated by thermal decomposition of the phenolic resin which evolve as a multi-component gas phase which is partially trapped in the porous microstructure of the composite. The nature of resultant pressures are described by using the Darcy relationships which have been modified to permit a multi-specie mass and momentum balance including water vapor condensation. Solution to the conjugate flow/thermal equations were performed using the SINDA code. of particular importance

to this problem was the implementation of a char and deformation state dependent (geometric) permeability as describing a first order interaction between the flow/thermal and structural models. Material property models are used to characterize the solid phase mechanical stiffness and failure. Structural calculations were performed using the ABAQUS code. Iterations were made between the two codes involving the dependent variables temperature, pressure and across-ply strain level. Model results comparisons are made for three different surface heat rates and dependent variable sensitivities discussed for the various cases.

Author

*Carbon Fibers; Composite Materials; Laser Materials; Phenolic Resins; Mathematical Models; Thermal Analysis*

**20030002628** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Wahana Dirgantara, Jakarta, Indonesia  
**Influence of the "Catalyst-Cocatalyst Ratio" (Ziegler-Natta Catalyst) on Acetylene Polymerization Rates Pengaruh "Catalyst-Cocatalyst Ratio" Pada Laju Polimerisasi Asetilen (Katalis Ziegler-Natta)**

Satibi, Loekman, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 1-10; In Malay-Indonesian; Copyright; Avail: Issuing Activity

In order to obtain an electric conductor polymer in the form of thin film, acetylene was polymerized. to enhance this polymerization process, ZIEGLER-NATTA catalytic system, composing of the rabutoxytitan as catalyst and triethylaluminium as co-catalyst was used. The objective of this research was to determine the most powerful catalyst to cocatalyst ratio in obtaining polyacetylene film. The result showed that the most powerful catalyst to co-catalyst ratio was achieved at the value of 0,25.

Author

*Polymerization; Thin Films; Ziegler Catalyst; Polyacetylene; Chemical Reactions*

**20030002630** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Dirgantara Terapan, Jakarta, Indonesia  
**Preliminary Research of Heat Resistance Material Serving as an Alternative Material for Nozzle Penelitian Awal Pembuatan Material Tahan Panas Sebagai Bahan Alternatif Untuk Nosel**

Rosman, Elly, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Herusulistyo, Kamidjo, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 56-64; In Malay-Indonesian; Copyright; Avail: Issuing Activity

Nozzle is a part of the rocket motor, which its function to rise the moments of gas result of the combustion process. Ceramic is a good capability of the high temperature and high pressure. Because of that, ceramic is the alternative material as well as to built and coating it. The main material was to be used in the research was the alumina-zirkonia as solid matter and polyvinil alcohol acetat or polyvinil alcohol as a binder. As the tool of the printing process of heat resistant ceramic it has been made "Injection Moulding". The experiment, it found that this ceramic which its mechanical characteristic was still brittle. This was caused by its purity of the material was less. The analysis by x-ray diffraction, alumina which was used consist of Calcium aluminat, Magnesium Phosphite and Cobalt Tungsten.

Author

*Rocket Engines; Rocket Nozzles; Mechanical Properties; Thermal Resistance; Injection Molding*

**20030002640** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Dirgantara Terapan, Jakarta, Indonesia  
**Influence of Mixing Temperatures of CTPB Elastomers on Viscosity and Gel Point Pengaruh Temperatur Pengadukan pada CTPB Elastomer Terhadap Viskositas dan Gel Point**

Rosita, Geni, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 32-40; In Malay-Indonesian; Copyright; Avail: Issuing Activity

The Elastomer polymerization research of CTPB with MAPO and EPON as curing agents has done. Research conducted with numerous temperatures variation of mixing temperature. Result showed the endoterm reaction, where faster reaction would happen if mixing temperatures increased.

Author

*Elastomers; Gels; Mixing; Velocity; Polymerization; Temperature Dependence*

**20030002669** Spire Corp., Bedford, MA USA

**Superhard Nanocrystalline Homometallic Stainless Steel on Steel for Seamless Coatings Final Report, 2 Nov. 2001 - 1 Nov. 2002**

Tobin, Eric J., Spire Corp., USA; Dec. 19, 2002; 22p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS1-02041

Report No.(s): FR-60436; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this work is to deposit nanocrystalline stainless steel onto steel substrates (homometallic) for enhanced wear and corrosion resistance. Homometallic coatings provide superior adhesion, and it has been shown that ultrafine-grained materials exhibit the increased hardness and decreased permeability desired for protective coatings. Nanocrystals will be produced by controlling nucleation and growth and use of an ion beam during deposition by e-beam evaporation or sputtering. Phase I is depositing 31 6L nanocrystalline stainless steel onto 31 6L stainless steel substrates. These coatings exhibit hardnesses comparable to those normally obtained for ceramic coatings such ZrO<sub>2</sub>, and possess the superior adhesion of seamless, homometallic coatings. Hardening the surface with a similar material also enhances adhesion, by avoiding problems associated with thermal and lattice mismatch. So far we have deposited nanocrystalline homometallic 316L stainless steel coatings by varying the ions and the current density of the ion beams. For all deposition conditions we have produced smooth, uniform, superhard coatings. All coatings exhibit hardness of at least 200% harder than that of bulk materials. Our measurements indicate that there is a direct relationship between nanohardness and the current density of the ion beam. Stress measurements indicate that stress in the films is increasingly proportional to current density of the ion beam. TEM, XPS, and XRD results indicate that the coated layers consist of FCC structure nanocrystallites with a dimension of about 10 to 20 nm. The Ni and Mo concentration of these coating are lower than those of bulk 316L but the concentration of Cr is higher.

Author

*Stainless Steels; Protective Coatings; Nanocrystals; Nanofabrication; Crystal Growth*

**20030002828** NASA Marshall Space Flight Center, Huntsville, AL USA

**Deployment, Foam Rigidization, and Structural Characterization of Inflatable Thin-Film Booms**

Schnell, Andrew R., Tennessee Technological Univ., USA; Leigh, Larry M., Jr., South Dakota State Univ., USA; Tinker, Michael L., NASA Marshall Space Flight Center, USA; [2002]; 8p; In English; AIAA Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA  
Contract(s)/Grant(s): RTOP 903-01-94

Report No.(s): AIAA Paper 2002-1376; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Detailed investigation of the construction, packaging/deployment, foam rigidization, and structural characterization of polyimide film inflatable booms is described. These structures have considerable potential for use in space with solar concentrators, solar sails, space power systems including solar arrays, and other future missions. Numerous thin-film booms or struts were successfully constructed, inflated, injected with foam, and rigidized. Both solid-section and annular test articles were fabricated, using Kapton polyimide film, various adhesives, Styrofoam end plugs, and polyurethane pressurized foam. Numerous inflation/deployment experiments were conducted and compared to computer simulations using the MSC/DYTRAN code. Finite element models were developed for several foam-rigidized struts and compared to model test results. Several problems encountered in the construction, deployment, and foam injection/rigidization process are described. Areas of difficulty included inadequate adhesive strength, cracking of the film and leakage, excessive bending of the structure during deployment, problems with foam distribution and curing properties, and control of foam leakage following injection into the structure. Many of these problems were overcome in the course of the research.

Author

*Booms (Equipment); Foams; Structural Analysis; Fabrication; Performance Tests; Inflatable Structures; Stiffness; Mathematical Models; Performance Prediction*

**20030002839** Michigan Univ., Dept. of Electrical Engineering and Computer Science, Ann Arbor, MI USA

**Nanocomposite and Photonic-Crystal Polymer Structures for Nonlinear Photonic Applications Final Report, 15 Jan. 2001-31 Mar. 2002**

Guo, L. J.; Sep. 2002; 20p; In English

Contract(s)/Grant(s): F49620-01-1-0135; AF Proj. 2303

Report No.(s): AD-A408053; AFRL-SR-AR-TR-02-0341; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We have developed two experimental techniques for creating photonic structures in nonlinear optical (NLO) polymers with precisions down to nanoscale. The first technique uses nanoimprinting technology to directly pattern the guest-host NLO polymers. It can be applied to the fabrication of photonic bandgap structures in NLO materials, as well as many other photonic structures in both linear and nonlinear polymers. For example, we have shown that micro-ring optical resonator structure can be fabricated by using the imprinting technique. The second technique utilize self-assembly of NLO polymer monolayers onto nanostructured template. This approach provides a highly effective means to implement waveguide devices using high performance self-assembled polymers with large electro-optic activity and inherent long-term stability. Such method can also be extended to Langmuir-Blodgett (LB) and covalently self-assembled thin films, and enables practical device applications for

nonlinear optical thin films synthesized by these different layer-by-layer growth approaches to utilize their material properties, such as high nonlinear optical coefficient, very fast electronic response and good thermal and temporal stability.

DTIC

*Crystal Structure; Composite Materials; Nonlinear Optics; Photonics; Nanofabrication; Polymers; Nanoindentation; Optical Resonators*

**20030003689** Stanford Linear Accelerator Center, USA

**Dynamic Response of Stereoblock Elastomeric Polypropylenes Studied by Rheo-Optics and X-ray Scattering, 1., Influence of Isotacticity**

Wiyatno, W.; Fuller, G. G.; Gast, A. P.; Pople, J. A.; Waymouth, R. M.; May 2002; 40p; In English

Report No.(s): DE2002-799986; SLAC-PUB-9344; No Copyright; Avail: Department of Energy Information Bridge

The dynamic response of elastomeric polypropylene (ePP) prepared by metallocene 2-arylidene hafnium catalyst was investigated by rheo-optical birefringence as well as wide-and small-angle X ray scattering (WAXS and SAXS). Solvent extraction of ePP ((mmmm) = 34%) results in three fractions with increasing tacticity, crystallinity, and molecular weight in the following order: ether soluble ((mmmm) = 21%), heptane soluble (44%), and heptane insoluble (76%).

NTIS

*Dynamic Response; Elastomers; Polypropylene; X Ray Scattering; Birefringence; Rheology*

**20030003690** Stanford Linear Accelerator Center, Stanford, CA USA

**Dynamic Response of Stereoblock Elastomeric Polypropylenes Studied by Rheo-Optics and X-ray Scattering, 2, Orthogonally Oriented Crystalline Chains**

Wiyatno, W.; Fuller, G. G.; Gast, A. P.; Pople, J. A.; Waymouth, R. M.; May 2002; 46p; In English

Report No.(s): DE2002-799987; SLAC-PUB-9345; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A combination of tensile stress, rheo-optical birefringence, and wide-angle X-ray scattering (WAXS) was used to probe the dynamics response of the low-tacticity ether-soluble (ES) fraction of elastomeric polypropylene (ePP) derived from metallocene 2-arylidene hafnium catalyst.

NTIS

*Dynamic Response; Elastomers; Polypropylene*

**20030003707** NASA Glenn Research Center, Cleveland, OH USA

**Radiation Durability of Candidate Polymer Films for the Next Generation Space Telescope Sunshield**

Dever, Joyce, NASA Glenn Research Center, USA; Semmel, Charles, Qualis Corp., USA; Edwards, David, NASA Marshall Space Flight Center, USA; Messer, Russell, QSS Group, Inc., USA; Peters, Wanda, Swales Aerospace, USA; Carter, Amani, Swales Aerospace, USA; Puckett, David, NASA Goddard Space Flight Center, USA; April 2002; 12p; In English; Third AIAA Gossamer Spacecraft Forum, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-A4-06

Report No.(s): NASA/TM-2002-211508; E-13285; NAS 1.15:211508; AIAA Paper 2002-1564; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The Next Generation Space Telescope (NGST), anticipated to be launched in 2009 for a 10-year mission, will make observations in the infrared portion of the spectrum to examine the origins and evolution of our universe. Because it must operate at cold temperatures in order to make these sensitive measurements, it will use a large, lightweight, deployable sunshield, comprised of several polymer film layers, to block heat and stray light. This paper describes laboratory radiation durability testing of candidate NGST sunshield polymer film materials. Samples of fluorinated polyimides CP1 and CP2, and a polyarylene ether benzimidazole. TOR-LM(TM), were exposed to 40 keV electron and 40 keV proton radiation followed by exposure to vacuum ultraviolet (VUV) radiation in the 115 to 200 nm wavelength range. Samples of these materials were also exposed to VUV without prior electron and proton exposure. Samples of polyimides Kapton HN, Kapton E, and Upilex-S were exposed to electrons and protons only, due to limited available exposure area in the VUV facility. Exposed samples were evaluated for changes in solar absorptance and thermal emittance and mechanical properties of ultimate tensile strength and elongation at failure. Data obtained are compared with previously published data for radiation durability testing of these polymer film materials.

Author

*Spaceborne Telescopes; Solar Energy Absorbers; Radiation Dosage; Durability; Electromagnetic Shielding; Far Ultraviolet Radiation; Tensile Strength; Thermal Emission*

**20030003715** NASA Kennedy Space Center, Cocoa Beach, FL USA

**Surface Evaluation by X-Ray Photoelectron Spectroscopy of High Performance Polyimide Foams After Exposure to Oxygen Plasma**

Melendez, Orlando, NASA Kennedy Space Center, USA; Hampton, Michael D., University of Central Florida, USA; Williams, Martha K., NASA Kennedy Space Center, USA; Brown, Sylvia F., NASA Kennedy Space Center, USA; Nelson, Gordon L., Florida Inst. of Tech., USA; Weiser, Erik S., NASA Langley Research Center, USA; [2002]; 8p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1592; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Aromatic polyimides have been attractive in the aerospace and electronics industries for applications such as cryogenic insulation, flame retardant panels and structural subcomponents. Newer to the arena of polyimides is the synthesis of polyimide foams and their applications. In the present work, three different, closely related, polyimide foams developed by NASA Langley Research Center (LaRC) are studied by X-ray Photoelectron Spectroscopy (XPS) after exposure to radio frequency generated Oxygen Plasma. Although polyimide films exposure to atomic oxygen and plasma have been studied previously and reported, the data relate to films and not foams. Foams have much more surface area and thus present new information to be explored. Understanding degradation mechanisms and properties versus structure, foam versus solid is of interest and fundamental to the application and protection of foams exposed to atomic oxygen in Low Earth Orbit (LEO).

Author

*Polyimides; Foams; Fatigue (Materials); Degradation; Stability; Photoelectron Spectroscopy; Spectroscopic Analysis*

**20030003740** Stanford Linear Accelerator Center, Stanford, CA USA

**Component Stress-Strain Behavior and Small-Angle Neutron Scattering Investigation of Stereoblock Elastomeric Polypropylene**

Wiyatno, W.; Fuller, G. G.; Gast, A. P.; Pople, J. A.; Chen, Z.; Aug. 2002; 34p; In English

Report No.(s): DE2002-799990; SLAC-PUB-9348; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Elastomeric polypropylene (ePP) produced from unbridged 2-arylidene metallocene catalysts was studied by uniaxial tensile and small-angle neutron scattering (SANS) techniques. The ePP can be separated into three fractions by successive boiling-solvent fractionation method to yield: a low-tacticity fraction soluble in ether (ES), an intermediate-tacticity fraction soluble in heptane (HS), and a high-tacticity fraction insoluble in heptane (HI). Tensile properties of ePP were compared to its solvent fractions, and the role of each solvent fraction residing within ePP was investigated by blending 5 weight % deuterated fraction with ePP.

NTIS

*Stress-Strain Relationships; Neutron Scattering; Polypropylene; Elastomers*

**20030003800** NASA Langley Research Center, Hampton, VA USA

**Using Temperature Sensitive Paint Technology**

Hamner, M. P., LeaTech, LLC, USA; Popernack, T. G., Jr., NASA Langley Research Center, USA; Owens, L. R., NASA Langley Research Center, USA; Wahls, R. A., NASA Langley Research Center, USA; [2002]; 21p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0742; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

New facilities and test techniques afford research aerodynamicists many opportunities to investigate complex aerodynamic phenomena. For example, NASA Langley Research Center's National Transonic Facility (NTF) can hold Mach number, Reynolds number, dynamic pressure, stagnation temperature and stagnation pressure constant during testing. This is important because the wing twist associated with model construction may mask important Reynolds number effects associated with the flight vehicle. Beyond this, the NTF's ability to vary Reynolds number allows for important research into the study of boundary layer transition. The capabilities of facilities such as the NTF coupled with test techniques such as temperature sensitive paint yield data that can be applied not only to vehicle design but also to validation of computational methods. Development of Luminescent Paint Technology for acquiring pressure and temperature measurements began in the mid-1980s. While pressure sensitive luminescent paints (PSP) were being developed to acquire data for aerodynamic performance and loads, temperature sensitive luminescent paints (TSP) have been used for a much broader range of applications. For example, TSP has been used to acquire surface temperature data to determine the heating due to rotating parts in various types of mechanical systems. It has been used to determine the heating pattern(s) on circuit boards. And, it has been used in boundary layer analysis and applied to the validation

of full-scale flight performance predictions. That is, data acquired on the same model can be used to develop trends from off design to full scale flight Reynolds number, e.g. to show the progression of boundary layer transition. A discussion of issues related to successfully setting-up TSP tests and using TSP systems for boundary layer studies is included in this paper, as well as results from a variety of TSP tests. TSP images included in this paper are all grey-scale so that similar to pictures from sublimating chemical tests areas of laminar flow appear "lighter," or white, and areas of turbulent flow appear "darker."

Author

*Luminescence; Paints; Heating; Measuring Instruments; Thermal Analysis*

## 28

### PROPELLANTS AND FUELS

*Includes rocket propellants, igniters and oxidizers; their storage and handling procedures; and aircraft fuels. For nuclear fuels see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power, 20 Spacecraft Propulsion and Power, and 44 Energy Production and Conversion.*

**20030002246** California Inst. of Tech., Graduate Aeronautical Labs., Pasadena, CA USA

#### **Thermal and Catalytic Cracking of JP-10 for Pulse Detonation Engine Applications**

Cooper, M. A.; Shepherd, J. E.; Sobota, T. H.; Moore, K. C.; Nov. 06, 2001; 3p; In English; Prepared in cooperation with Advanced Projects Research, Inc., La Verne, CA

Report No.(s): AD-A407729; AFRL-PR-ED-AB-2001-233; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The results of previous catalytic cracking experiments have quantified the cooling capabilities, i.e., using endothermic reactions to absorb energy generated by the propulsion system. The focus was on selecting liquid fuels and reactor operating conditions that produce desirable reaction products with high heat sink capabilities. In the present study, we examined the combustion properties of JP-10 that have been modified by thermal and catalytic cracking. The goals of our program are to understand the implications for pulse-detonation engine performance when operating with modified fuels.

DTIC

*Fuels; Cracking (Fracturing)*

**20030002629** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Wahana Dirgantara, Jakarta, Indonesia

#### **Performance Prediction of the Rocket-Motor Control of an HTPB Propellant with a Hollow Configuration *Prediksi Kinerja Motor Roket Kendali Propelan HTPB Konfigurasi Hollow***

Jihad, Bagus H., Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Saeri, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 42-48; In Malay-Indonesian; Copyright; Avail: Issuing Activity

Design and computer simulations of HTPB propellant with hollow configuration have done. Simulation results; burning time was 6,7 second, maximum pressure chamber was 60 Kg/CM<sup>2</sup> and maximum of thrust was 1237 Kg. Those values resulted possibility to conduct flight test.

Author

*HTPB Propellants; Performance Prediction; Rocket Engine Control; Structural Design*

**20030002665** NASA Marshall Space Flight Center, Huntsville, AL USA

#### **Using Isothermal Microcalorimetry to Determine Compatibility of Structural Materials with High-Test Hydrogen Peroxide (HTP) Propellant**

Gostowski, Rudy, NASA Marshall Space Flight Center, USA; Villegas, Yvonne, Our Lady of the Lake Univ., USA; Nwosisi, Genne, Florida Agricultural and Mechanical Univ., USA; [2002]; 1p; In English; AMPET Meeting, 16-18 Sep. 2002, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only

High-Test Hydrogen Peroxide (HTP) propellant (equal to or greater than 70%) offers many advantages in space launch applications. However, materials used in construction of propulsion systems must be shown to be compatible with HTP. Isothermal Microcalorimetry (IMC) was used to determine the compatibility of several metallic and non-metallic materials with 90% HTP. The results of these experiments agreed with those from immersion bath tests when the values were converted to % Active Oxygen Loss per week (%AOL/wk).

Author

*Heat Measurement; Compatibility; Rocket Propellants; Materials Selection; Structural Design; Hydrogen Peroxide*

**20030002689** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Teknologi Wahana Dirgantara, Jakarta, Indonesia  
**Performance of Solid Polybutadiene Composite Propellants in Regard to their Material Composition *Kinerja Propelan Padat Komposit Polibutadien dalam Kaitannya dengan Komposisi Bahan-Bahannya***

Syarkawi, Atwirman, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 65-72; In Malay-Indonesian; Copyright; Avail: Issuing Activity

The performance of propellant are strongly dependent on the materials composition to be used. Tsiolkovsky equation gave two important criterias for basic performance parameters i.e. specific impulse (Isp) and propellant mass, both of them were burning rate implication. This paper discussed the correlation between these parameters from which the performance of the polybutadiene to be evaluated.

Author

*Composite Propellants; Polybutadiene; Solid Propellants; Performance Prediction*

**20030002693** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Nitric Oxide Depth-Profiles of Aged Double-Based Gun Propellants**

Pesce-Rodriguez, R. A.; Marsh, P. E.; Oct. 2002; 14p; In English

Report No.(s): AD-A407984; ARL-RP-58; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

As part of a propellant/epoxy compatibility study, double-base perforated stick gun propellant was downloaded from tank rounds subjected to temperature/ humidity cycling for one month. The propellant was analyzed by traditional HPLC methods and found to have experienced no significant depletion of stabilizer. Analysis by a new desorption-GC-MS method yielded depth-profiles of nitric oxide (NO) that indicated localized decomposition at propellant surfaces. Surfaces of the propellant that had been in direct contact with a layered material (glass-reinforced RTV rubber/RTV rubber/epoxy/composite sabot) showed NO levels well in excess of baseline measurements, and a level somewhat higher than that of exterior surfaces not in direct contact with the layered material. Nitric oxide 'enhancement' was observed as deep as 1-mm in from the exterior surfaces. Analysis of samples aged in the lab revealed that some of the NO generated by decomposing propellant diffuses into the silicone in the RTV rubber, thereby removing it from the autocatalytic degradation cycle and resulting in a decreased level of decomposition (as evidenced by NO levels at the core of the propellant). It was observed that uptake of NO by the silicone components was completely reversible. While the NO level at the core of the propellant was found to be lower for the samples exposed to the suspected incompatible material than for the control, elevated NO levels were found at depths up to 0.75 mm from the surface exposed to the suspected incompatible epoxy, confirming the existence of an incompatibility between the propellant and epoxy in the layered material.

DTIC

*Gun Propellants; Nitric Oxide; Epoxy Compounds*

**20030003744** Air Products and Chemicals, Inc., Allentown, PA USA

**Catalyst Activity Maintenance for the Liquid Phase Synthesis Gas-to-Dimethyl Ether Process *Final Report***

Peng, X. D.; May 2002; 40p; In English

Report No.(s): DE2002-801222; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

At the heart of the single-step liquid phase syngas-to-DME process (LPDME) is a catalyst system that can be active as well as stable. In the Alternative Fuels I program, a dual-catalyst system containing a Cu-based commercial methanol synthesis catalyst (BASF S3-86) and a commercial dehydration material was demonstrated. It provided the productivity and selectivity expected from the LPDME process. However, the catalyst system deactivated too rapidly to warrant a viable commercial process. The mechanistic investigation in the early part of the DOE's Alternative Fuels II program revealed that the accelerated catalyst deactivation under LPDME conditions is due to detrimental interaction between the methanol synthesis catalyst and methanol dehydration catalyst. The interaction was attributed to migration of Cu- and/or Zn-containing species from the synthesis catalyst to the dehydration catalyst. Identification of a dehydration catalyst that did not lead to this detrimental interaction while retaining adequate dehydration activity was elusive. Twenty-nine different dehydration materials were tested, but none showed the desired performance.

NTIS

*Catalysts; Liquid Phases; Synthesis Gas; Methyl Compounds*

**20030003779** Congressional Budget Office, Washington, DC USA

**Reducing Gasoline Consumption: Three Policy Options**

Nov. 2002; 52p; In English

Report No.(s): PB2003-101514; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The study weighs the relative merits of those policies against several major criteria: whether they would minimize costs to producers and consumers; how reliably they would achieve a given reduction in gasoline use; their implications for automobile safety; and their effects on such factors as traffic congestion, requirements for highway construction, and emissions of air pollutants other than carbon dioxide. In addition, the analysis examines two more policy implications that lawmakers may be concerned about: the impact on people at different income levels and in different regions, and the effects on federal revenue. In keeping with CBO's mandate to provide objective, impartial analysis, this report makes no recommendations.

NTIS

*Fuel Consumption; Gasoline*

**20030003784** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Synthesis and Screening of Advanced Hydrocarbon Fuels**

Suri, Suresh C.; Tinnirello, Michael; Marcischak, Jacob; Oct. 10, 2000; 3p; In English; Presented at HEDM Contractors Conf. Held in Park City, UT, 23-26 Oct. 2000. Prepared in collaboration with ERC, Inc. Abstract only

Contract(s)/Grant(s): Proj-2303

Report No.(s): AD-A407948; AFRL-PR-ED-AB-2002-190; AFRL-PR-ED-AB-2000-190; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

At AFRL/PRSP (Air Force Research Laboratory, Propulsion Sciences Division) research efforts have been directed towards high-density saturated/unsaturated strained ring hydrocarbons. The theoretical specific impulse (Isp) calculation reflected that hydrocarbons AFRL-1 (Isp = 311.4 sec), AFRL-2 (Isp = 307 sec), AFRL-3 (Isp = 307.2 sec), AFRL-4 (Isp = 321 sec) and AFRL-5 (Isp = 308.7 sec) outperform the current candidates. The synthesis of AFRL-1, AFRL-3 and AFRL-5 and their physical and hazardous properties shall be discussed.

DTIC

*Hydrocarbon Fuels; Hydrocarbons; Propulsion*

**20030004015** Defence Science and Technology Organisation, Edinburgh, Australia

**Evaluation of an Alternative Grade of CXM-7 for Use in PBXN-109, The Explosive Fill for the Penguin ASM Warhead**

Dexter, Richard M., Defence Science and Technology Organisation, Australia; Hamshere, Brian L., Defence Science and Technology Organisation, Australia; Lochert, Ian J., Defence Science and Technology Organisation, Australia; August 2002; 25p; In English

Report No.(s): DSTO-TN-0441; DODA-AR-012-365; Copyright; Avail: Issuing Activity

An evaluation of a new grade of CXM-7, the explosive component of PBXN-109, was conducted at DSTO (Defence Science & Technology) as R & D support to ADI Ltd, the sub-contractor for the manufacture of the Penguin ASM warhead. Tests were performed to characterize the material's physico-chemical and sensitiveness properties. The processing properties of PBXN-109 incorporating this grade of CXM-7 were also evaluated and the explosive performance properties were determined. Testing showed the new CXM-7 to be contaminated with an unknown material which adversely affected its processing properties. However, it was noted that the new material had a particle morphology more suited to processing than the original CXM-7. The explosive properties of PBXN-109 containing the new CXM-7 were equivalent to the current material. If the new material can be obtained free from contaminants it does offer some advantages, in terms of processing and quality of the explosive fill, over the original CXM-7.

Author

*Explosives; Warheads; Physical Chemistry*

## 29

### SPACE PROCESSING

*Includes space-based development of materials, compounds, and processes for research or commercial application. Also includes the development of materials and compounds in simulated reduced-gravity environments. For legal aspects of space commercialization see 84 Law, Political Science and Space Policy.*

**20030003628** NASA Glenn Research Center, Cleveland, OH USA

**Recent Results from the Physics of Colloids in Space**

Weitz, David A., Harvard Univ., USA; Bailey, A., Harvard Univ., USA; Christianson, R., Harvard Univ., USA; Manley, S., Harvard Univ., USA; Prasad, V., Harvard Univ., USA; Segre, P., Harvard Univ., USA; Gasser, U., Harvard Univ., USA; Cipelletti, L., Harvard Univ., USA; Schoefield, A., Edinburgh Univ., UK; Pusey, P., Edinburgh Univ., UK; Sixth Microgravity Fluid Physics

and Transport Phenomena Conference; November 2002; Volume 1, pp. 91-132; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The Physics of Colloids in Space is an experiment which flew in the ISS. Data on several different samples of colloidal particles were obtained. They provided unexpected information about the behavior of the samples in microgravity. The data are currently being analyzed. The most recent findings will be discussed in this talk.

Author

*Colloids; Microgravity; Spaceborne Experiments; Physical Sciences*

**20030003629** NASA Glenn Research Center, Cleveland, OH USA

**Physics of Hard Sphere Experiment: Scattering, Rheology and Microscopy Study of Colloidal Particles**

Cheng, Z.-D., Princeton Univ., USA; Zhu, J., Princeton Univ., USA; Phan, S.-E., Princeton Univ., USA; Russel, W. B., Princeton Univ., USA; Chaikin, P. M., Princeton Univ., USA; Meyer, W. V., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 133-160; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The Physics of Hard Sphere Experiment has two incarnations: the first as a scattering and rheology experiment on STS-83 and STS-94 and the second as a microscopy experiment to be performed in the future on LMM on the space station. Here we describe some of the quantitative and qualitative results from previous flights on the dynamics of crystallization in microgravity and especially the observed interaction of growing crystallites in the coexistence regime. To clarify rheological measurements we also present ground based experiments on the low shear rate viscosity and diffusion coefficient of several hard sphere experiments at high volume fraction. We also show how these experiments will be performed with confocal microscopy and laser tweezers in our lab and as preparation for the phAsE II experiments on LMM. One of the main aims of the microscopy study will be the control of colloidal samples using an array of applied fields with an eye toward colloidal architectures. Temperature gradients, electric field gradients, laser tweezers and a variety of switchable imposed surface patterns are used toward this control.

Author

*Colloids; Microgravity; Microscopy; Rheology; Scattering; Spaceborne Experiments; Condensed Matter Physics; Particles*

**20030003630** Stanford Univ., Dept. of Biophysics, Stanford, CA USA

**Two-Dimensional Streptavidin Crystals on Giant Lipid Bilayer Vesicles**

Ratanabanangkoon, Pasut, Stanford Univ., USA; Gropper, Michael, Technical Univ. of Munich, Germany; Gast, Alice P., Massachusetts Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 161-162; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche

Two-dimensional (2D) ordering of macromolecules is of particular interest due to their scientific importance as fundamental models for studying phase transitions and self-assembly. It is also a basis for the design and development of many biosensor and bioassay devices and engineered biomaterials. The ability to create and manipulate self-assembled structures of macromolecules requires a thorough understanding and control of the various intermolecular forces involved. In this study, we used 2D streptavidin crystallization as a model system to study 2D protein organization on lipid bilayers and their effect on bilayer properties. We studied the crystallization of streptavidin on giant lipid bilayer vesicles. Giant Unilamellar Vesicles (GUVs) are composed of a single lipid bilayer membrane with sizes of approximately 10-100 microns in diameter. Due to the sensitivity to ionic species, they remain stable in only extremely low ionic strength solutions. Once bound to the vesicle surface, streptavidin crystallized to form a rigid polycrystalline shell surrounding the vesicle. The ability to create crystals on GUVs provides a means to study many crystals in a single experiment and in a microgravity environment. Transmission Electron Microscopy (TEM) images of negatively stained vesicles revealed that the crystals are of the lowest-density C222 symmetry, and does not change with solution pH unlike those grown in high ionic strength conditions. The lack of higher density 2D crystal forms is due to the strong electrostatic repulsion. Despite the presence of only one crystal structure, the change in solution pH changed the macroscopic crystal morphology and crystal growth pattern, and the vesicles were distorted into either roughened spheres or footballshaped ellipsoids.

Author

*Lipids; Macromolecules; Polycrystals; Crystal Morphology; Two Dimensional Models*

**20030003634** Pennsylvania State Univ., Dept. of Physics, University Park, PA USA

**Molecular Dynamics Simulations of Crystallization of Hard Spheres**

Volkov, Igor, Pennsylvania State Univ., USA; Cieplak, Marek, Polish Academy of Sciences, Poland; Koplik, Joel, New York Univ., USA; Banavar, Jayanth R., Pennsylvania State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena

Conference; November 2002; Volume 1, pp. 211-221; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The use of colloidal particles for engineering new materials is a relatively unexplored field which promises to revolutionize materials synthesis. On earth, the effects of sedimentation and gravity-induced convection cloud, and sometimes can even radically alter the intrinsic behavior of certain classes of colloidal systems. Because the binding energies of the crystalline phases are low and comparable to each other, gravity can greatly influence the kinetics of formation and, indeed, the nature of the observed crystal structure. Colloidal suspensions of hard spheres are model systems for studying the statistical mechanics of structural phase transitions. Such suspensions undergo an entropy-driven phase transition from fluid to crystal as a function of increasing volume fraction. Unlike comparable phase transitions in conventional systems of condensed matter, the dynamics of such structural phase transitions can be monitored with 'atomic' resolution using conventional light microscopy. In hard sphere systems, at high volume fractions, glass formation competes with the nucleation and growth of the crystalline phase. The Chaikin-Russel experiments on the Space Shuttle have led to the striking result that samples of hard sphere colloids that remain glassy for more than a year on earth crystallize within a few weeks in a microgravity environment. We have carried out molecular dynamics simulations of the crystallization of hard spheres. Our aim is to study the dynamics of colloidal systems, using microscopic probes which complement conventional earth and space-based measurements and probe the effects of weak gravitational forces, polydispersity and the effect of bounding walls on phase structure.

Derived from text

*Crystallization; Molecular Dynamics; Simulation; Colloids; Microscopy; Condensed Matter Physics*

**20030003638** Illinois Univ., Dept. of Mechanical and Industrial Engineering, Chicago, IL USA

**Molten-Metal Droplet Deposition on a Moving Substrate in Microgravity: Aiding the Development of Novel Technologies for Microelectronic Assembly**

Megaridis, C. M., Illinois Univ., USA; Bayer, I. S., Illinois Univ., USA; Poulikakos, D., Ecole Polytechnique Federale, Switzerland; Nayagam, V., National Center for Microgravity Research on Fluids and Combustion, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 272-292; In English; Also announced as 20030003624

Contract(s)/Grant(s): NAG3-2456; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Driven by advancements in microelectronics manufacturing, this research investigates the oblique (non-axisymmetric) impact of liquid-metal droplets on flat substrates. The problem of interest is relevant to the development of the novel technology of on-demand dispensation (printing) of microscopic solder deposits for the surface mounting of microelectronic devices. The technology, known as solder jetting, features on-demand deposition of miniature solder droplets (30 to 120 microns in diameter) in very fine, very accurate patterns using techniques analogous to those developed for the ink-jet printing industry. Despite its promise, severe limitations exist currently with regards to the throughput rates of the technology; some of these limitations are largely due to the lack of the capability for reliable prediction of solder bump positioning and shapes, especially under ballistic deposition conditions where the droplet impact phenomena are inherently three-dimensional. The study consists of a theoretical and an experimental component. The theoretical work uses a finite element formulation to simulate numerically the non-axisymmetric (3-D) fluid mechanics and heat transfer phenomena of a liquid solder droplet impacting at an angle  $\alpha$  on a flat substrate. The work focuses on the pre-solidification regime. The modeling of the most challenging fluid mechanics part of the process has been completed successfully. It is based upon the full laminar Navier-Stokes equations employing a Lagrangian frame of reference. Due to the large droplet deformation, the surface (skin) as well as the volumetric mesh have to be regenerated during the calculations in order to maintain the high accuracy of the numerical scheme. The pressure and velocity fields are then interpolated on the newly created mesh. The numerical predictions are being tested against experiments, for cases where wetting phenomena are not important. For the impact parameters used in the example shown ( $We = 2.38$ ,  $Fr = 16300$ ,  $Re = 157$ ), the droplet rolls along the substrate, but its shape remains practically axisymmetric for all impact angles within the range from 0 to 60 deg. Interestingly, the substrate/droplet contact area during the recoiling phase of the impact is not a monotonically decreasing function of time. The experimental component of the research tests the numerical predictions and provides necessary input data (contact angles) for the theoretical model. The experiments are performed in microgravity (2.2s drop tower of the NASA GRC) in order to allow for the use of mm-size solder droplets, which make feasible the performance of accurate measurements, while maintaining similitude of the relevant fluid dynamic groups ( $Re$ ,  $Fr$ ,  $We$ ,  $Ste$ ). Preliminary oblique impact experiments have been performed using water droplets in normal gravity.

Author

*Liquid Metals; Drops (Liquids); Substrates; Microgravity; Fluid Mechanics; Heat Transfer*

**20030003639** Georgia Inst. of Tech., Atlanta, GA USA

**Non-Coalescence in Microgravity: Science and Technology**

Neitzel, G. Paul, Georgia Inst. of Tech., USA; Nagy, P., Georgia Inst. of Tech., USA; Carnasciali, M. I., Georgia Inst. of Tech., USA; DellAversana, P., Microgravity Advanced Research and Support Center, Italy; Vetrano, M. R., Microgravity Advanced Research and Support Center, Italy; Chen, J.-C., National Central Univ., Taiwan, Province of China; Kuo, C. W., National Central Univ., Taiwan, Province of China; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 293-324; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

In this project we examine non-coalescence and non-wetting phenomena driven by either thermocapillary convection or forced motion of one surface relative to the other. In both cases, the non-coalescence or non-wetting is enabled by the existence of a lubricating layer of gas that exists to keep the two surfaces in question from coming into contact with one another. Recent progress has been made on several fronts: 1) measurement of the vibrational modes of pinned droplets; 2) development of an apparatus for the measurement of the frictional forces associated with a non-wetting droplet sliding over a solid surface; 3) measurements of the failure modes for non-wetting droplets and the influence of static electric charge on failure-, and 4) numerical simulation of a two-dimensional non-wetting droplet revealing a possible explanation for why the phenomenon has not been able to be observed using water as the droplet liquid. Issue 1) above is of relevance to the use of non-wetting droplets as positioning mechanisms and vibration dampers in a microgravity environment; issue 2) relates to the use of non-wetting droplets as nearly 'frictionless' bearings in low-load applications. Understanding of the failure modes identified in 3) is of importance to any potential application and the numerical simulations conducted under 4) allow us to obtain information about these systems that is currently not available through experimentation Each of these topics will be discussed briefly during the presentation.

Author

*Drops (Liquids); Coalescing; Microgravity; Wetting; Thermocapillary Migration; Surface Tension Driven Convection; Solid Surfaces*

**31**

**ENGINEERING (GENERAL)**

*Includes general research topics to engineering and applied physics, and particular areas of vacuum technology, industrial engineering, cryogenics, and fire prevention. For specific topics in engineering see categories 32 through 39.*

**20030002251** Office of Naval Research European Office, FPO New York, NY USA

**European Science Notes Information Bulletin: Reports on Current European and Middle Eastern Science**

Dec. 1992; 100p; In English

Report No.(s): AD-A407721; ONREUR-92-06; No Copyright; Avail: CASI; A05, Hardcopy; A02, Microfiche

European Science Notes Information Bulletin describes research being conducted and ideas being developed in Europe and the Middle East as reported by scientists assigned to the Office of Naval Research European Office and guest authors. It is published 6-8 times per year, on an irregular basis.

DTIC

*Europe; Research*

**20030002680** Federal Aviation Administration, William J. Hughes Technical Center, Atlantic City, NJ USA

**Development of a Minimum Performance Standard for Hand-Held Fire Extinguishers as a Replacement for Halon 1211 on Civilian Transport Category Aircraft Final Report**

Webster, Harry; Aug. 2002; 43p; In English; Original contains color images

Report No.(s): AD-A408024; DOT/FAA/AR-01/37; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One or more Halon 1211 hand-held fire extinguishers are specified in Federal Aviation Regulation (FAR) Part 25.851 as a requirement on transport category aircraft with 31 or more seats. Halon 1211 has been linked to the destruction of the ozone layer and production of new Halon 1211 has been halted per the Montreal Protocol in 1993. The phase out of Halon 1211, as the hand-held firefighting agent of choice, for civilian transport category aircraft has necessitated the development of a Minimum Performance Standard (MPS) to evaluate replacement agents. The purpose of the MPS is to insure that there is no reduction in safety, both in terms of effectiveness in fighting onboard fires and toxicity to the passengers and crew. The MPS specifies two new tests that replacement agents must pass in addition to requiring national certifications such as provided by Underwriters Laboratories. The first test evaluates the "flooding" characteristics of the agent against a hidden in-flight fire. This test determines the ability of a streaming agent to function as a flooding agent. The second test evaluates the performance of the agent in fighting

a terrorist fire scenario and the associated toxicity hazard. This test measures the agent's ability to extinguish a triple-seat fire in an aircraft cabin under in-flight conditions and the toxicity characteristics of both the neat agent and the products of decomposition. This MPS will insure that the replacement agents will meet or exceed the performance of Halon 1211 both in fighting fires and maintaining a safe breathing environment in aircraft cabins.

DTIC

*Fire Extinguishers; Alternatives; Fires; Toxicity and Safety Hazard*

**20030002838** Oklahoma Space Industry Development Authority, Oklahoma City, OK USA

**Oklahoma Space Industry Development Authority**

December 2002; 19p; In English

Contract(s)/Grant(s): NAG1-01056; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this grant was to increase the awareness of students of space sciences and commerce through experimentation. This objective was carried out through the award and administration, by OSIDA, the Oklahoma Space Industry Development Authority, of eleven smaller grants to fund thirteen projects at schools determined by competitive application. Applications were graded on potential outreach, experimentation objectives and impact on students' awareness of space sciences. We chose projects from elementary, middle and high schools as well as colleges that would encourage students through research and experimentation to consider education and careers in related disciplines. Each organization did not receive an equal share of the grant; instead, OSIDA distributed the money to each project based on the organization's need. A copy of the dispersement record is enclosed with this final grant report. The projects covered topics such as: space colonization, space stations, constellations, model rocketry, and space commerce.

Author

*Students; Education; Schools; Aerospace Sciences*

**20030003762** California Univ., Berkeley, CA USA

**A Novel Method for Cuttings Removal from Holes During Percussive Drilling on Mars**

Zancy, Kris, California Univ., USA; Quayle, Michael, California Univ., USA; McFadden, Mara, California Univ., USA; Neugebauer, Adam, California Univ., USA; Huang, Kenji, California Univ., USA; Cooper, George, California Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 107-121; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Acquiring samples from the subsurface of Mars poses many challenges. The scientific return increases with the depth from which the samples are obtained, but so does the risk. Thus, it is important to develop a fully autonomous drilling platform that will be capable of accessing the required depth and retrieving cores for scientific analysis. The method of drilling most likely to succeed will be a conventional mechanical core drill, either rotary or percussive, with a mechanical system for removing the cuttings and rock core from the hole. Instead of fluid flushing systems for removing cuttings, which would be very difficult to provide and in addition may contaminate the sample, an auger system is the best solution for rotary drilling. However, no such solution has been identified for the percussive drilling method. To solve this problem, a novel means of conveying cuttings out of the hole during percussive drilling has been developed and is presented in this paper. It relies on the reciprocating action between a pair of surfaces covered with bristles. Experimental results show that there is an optimum ratio of particle diameter to bristle length that gives the highest speed of particle conveyance. This new method also stabilizes the hole so that the drill string may be removed to recover a rock core sample.

Author

*Mars Surface Samples; Autonomy; Drilling; Holes (Mechanics); Mars (Planet)*

**20030003781** Helsinki Univ. of Technology, Espoo Finland

**Simulation of a Hybrid Locomotion Robot Vehicle**

Aarnio, P.; Oct. 06, 2002; 152p

Report No.(s): PB2003-101519; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

This study describes a simulation process of a mobile robot. The focus is in kinematic and dynamic behavior simulations of hybrid locomotion robot vehicles. This research is motivated by the development needs of the WorkPartner field service robot. The whole robot system consists of a mobile platform and a two-hand manipulator. The robot platform, called Hybtor, is a hybrid locomotion robot capable of walking and driving by wheels as well as combining these two locomotion modes. This study describes first the general problems and their solutions in the dynamic simulation of mobile robots. A kinematic and dynamic virtual model of the Hybtor robot was built and simulations were carried out using one commercial simulation tool. Walking,

wheel driven and rolling mode locomotion, which is a special hybrid locomotion style, has been simulated and analyzed. Position and force control issues during obstacle overrun and climbing were also studied.

NTIS

*Locomotion; Robots; Computerized Simulation*

**20030003795** Argonne National Lab., IL USA

**Enhanced Teleoperation Exhibiting Tele-Autonomy and Tele-Collaboration**

Park, Y. S.; Ewing, T. F.; Yule, T. J.; Colgate, E.; Peshkin, M.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799834; No Copyright; Avail: National Technical Information Service (NTIS)

This paper presents enhanced remote manipulation of tools for D&D tasks by extending teleoperation with tele-autonomy and tele-collaboration. This work builds on a reactive, agent-based control architecture, which is well suited to unstructured and unpredictable environments, and cobot control technology, which implements a virtual fixture that can be used to guide the application of tools with passive force-feedback control. Developed methodologies are tested using simulation, and then planned to be implemented using a structured light sensor and cobot hand controller on a dual-arm system to measure the enhanced performance of key tool operations that are tedious and difficult to perform purely by teleoperation.

NTIS

*Robotics; Decommissioning; Feedback Control; Autonomy*

**32**

**COMMUNICATIONS AND RADAR**

*Includes radar; radio, wire, and optical communications; land and global communications; communications theory. For related information see also 04 Aircraft Communications and Navigation; and 17 Space Communications, Spacecraft Communications, Command and Tracking; for search and rescue see 03 Air Transportation and Safety, and 16 Space Transportation and Safety.*

**20030002342** Defence Research and Development Canada, Ottawa, Ontario Canada

**Moving Target Detection with Along-Track SAR Interferometry. A Theoretical Analysis**

Glerull, Christoph H.; Aug. 2002; 59p; In English; Original contains color images

Contract(s)/Grant(s): DRDC-TR-2002-084

Report No.(s): AD-A407708; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

This technical report analyses, theoretically, the capability of ground moving target detection based on the SAR along-track interferometric phase. The probability density function of the interferometric phase is derived for the general case that moving target signals are superimposed upon the stationary clutter. This theoretical analysis is an extension of the known statistics for the clutter-only case. Several target models are proposed that depend on one hand on the spatial dimension of the moving target compared to the multilook resolution cell size, and on the other hand on the backscattering type, i.e., deterministic or random target signal. The derived density functions provide the means to quantify the performance limits (by determining the receiver operating characteristics) for any set of system and target parameters, such as false alarm rate, signal-to-clutter ratios (SCR) and target velocities. Hence, deeper insight is provided into results expected from upcoming SAR/GMTI systems such as the Radarsat2 Modex experiment or the enhanced airborne Aurora CP-140 SpotSAR system.

DTIC

*Detection; Interferometry; Moving Target Indicators; Synthetic Aperture Radar*

**20030002344** Air Force Inst. of Tech., Wright-Patterson AFB, OH USA

**A Novel Method for Achieving Synthetic Aperture Radar Imagery by Means of a Micro-Satellite Constellation**

Mitchell, Olivia S.; Dec. 14, 2001; 161p; In English

Report No.(s): AD-A407703; AFIT-C102-525; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The current emphasis in the satellite industry is on replacing large satellite platforms with one or more smaller satellites, built at lower costs, yet able to accomplish similar mission objectives. In this context, there is increasing interest in the potential capabilities and applications of so-called "micro-satellites" satellites of 10-100 kg. However it is recognized that such small satellites pose severe constraints on payload volume, mass and power. Thus, they would appear to be inappropriate for missions such as synthetic aperture radar (SAR) imaging, where payloads have significant size and power demands - specifically the large SAR antenna and high-power radar transmitter. The primary reason for the high transmit power requirement is that traditional SAR systems use backscatter, which is weak from most terrain types as most energy is scattered in the forward direction. Thus,

if it were possible to gather this forward scattered element, then the transmit power requirements could drop significantly, potentially making it feasible for installation on a micro-satellite. This research is based on this principle of collecting to the forward scattered element - a novel method by which two micro-satellites 'fly' in a specific formation to accomplish a SAR imaging mission bi-statically. The transmitting satellite will be the master, with the receiver satellite slaved off it for synchronization. The satellites view a swath of 30x30 km, at a ground resolution of 30 m, from an altitude of 700 km. The constellation geometry proposed requires minimal orbit control resources, and allows for the resolution of the left-right ambiguity. The satellite design is based on the Surrey Satellite Technology, Ltd. enhanced micro-satellite, with a mass of 100 kg, and a standard volume of 1x1m base and a 0.6 m height.

DTIC

*Radar Imagery; Synthetic Aperture Radar; Microsatellites; Constellations; Satellite Design; Imaging Techniques*

**20030002466** South Dakota State Univ., Electrical Engineering Dept., Brookings, SD USA

**Utilization of KSC Present Broadband Communications Data System for Digital Video Services**

Andrawis, Alfred S., South Dakota State Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

This report covers a visibility study of utilizing present KSC broadband communications data system (BCDS) for digital video services. Digital video services include compressed digital TV delivery and video-on-demand. Furthermore, the study examines the possibility of providing interactive video on demand to desktop personal computers via KSC computer network.

Author

*Computer Networks; Data Systems; Digital Television; Video Communication*

**20030002482** Air Force Research Lab., Information Directorate, Rome, NY USA

**Applying Model Abstraction Techniques to the Advanced Low Altitude Radar Model (ALARM) Final Report, Oct. 1999-Sep. 2002**

Plotz, Gary; Dibble, Serena; Oct. 2002; 19p; In English; Original contains color images

Contract(s)/Grant(s): AF Proj. 459S

Report No.(s): AD-A408085; AFRL-IF-RS-TR-2002-275; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Modeling of real systems relies on the arduous task of describing the physical phenomena in terms of mathematical models, which often require excessive amounts of computation time when used in simulations. In the last few years there has been a growing acceptance of model abstraction whose emphasis rests on the development of more manageable models. Abstraction refers to the intelligent capture of the essence of the behavior of a model, without all the details. In the past, model abstraction techniques have been applied to complex models, such as Advanced Low Altitude Radar Model (ALARM) to simplify analysis. The scope of this effort is to apply model abstraction techniques to ALARM; a DoD prototype radar model for simulating the volume detection capability of low flying targets within a digitally simulated environment. Due to the complexity of these models, it is difficult to capture and assess the relationship between the model parameters and the performance of the simulation. Under this effort, ALARM parameters were modified and/or deleted and the impact on the simulation run time assessed. In addition, several meta-models were developed and used to assess the impact of ALARM parameters on the simulation run time. This report establishes a baseline for ALARM from which additional meta-models can be compared and analyzed.

DTIC

*Radar; Low Altitude*

**20030002641** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Capacitance Gain by Means of the Thorough Description of Cable Bundles and Its Technical and Economic Usefulness**

Matzner, Rolf; Apr. 2000; 165p; In German

Report No.(s): AD-A407969; X5-X5; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

Matzner's specialty is transmission, this his first chapter deals with the symmetrical double loaders in the local connection network (OAsL) and their significance for transmission today and in the future. He then describes the MIMO (Multiple Input-Multiple Output) structure of the OAsL and some troubleshooting; and then the transmission system for multi-source, multi-decrease and a MIMO channel. The expansive fifth chapter is devoted to the capacitance of the MIMO channel. The MIMO transmission system is then considered in terms of the time and frequency. The value of a technical example using the MIMO system comprises the eight and final chapter.

DTIC

*Communication Networks; Capacitance*

**20030002698** California Inst. of Tech., Div. of Engineering and Applied Science, Pasadena, CA USA

**A Multi-Vehicles, Wireless Testbed for Networked Control, Communications and Computing Final Report, 1 Apr. 2001-31 Mar. 2002**

Murray, Richard; Doyle, John; Effros, Michelle; Hickey, Jason; Low, Steven; Mar. 31, 2002; 4p; In English

Contract(s)/Grant(s): F49620-01-1-0227

Report No.(s): AD-A407995; AFRL-SR-AR-TR-02-0331; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have constructed a testbed consisting of 4 mobile vehicles (with 4 additional vehicles being completed), each with embedded computing and communications capability for use in testing new approaches for command and control across dynamic networks. The system is being used or is planned to be used for testing of a variety of communications-related technologies, including distributed command and control algorithms, dynamically reconfigurable network topologies, source coding for real-time transmission of data in lossy environments, and multi-network communications. A unique feature of the testbed is the use of vehicles that have second order dynamics. Requiring real-time feedback algorithms to stabilize the system while performing cooperative tasks. The testbed was constructed in the Caltech Vehicles Laboratory and consists of individual vehicles with PC-based computation and controls, and multiple communications devices (802.11 wireless Ethernet, Bluetooth, and infrared). The vehicles are freely moving, wheeled platforms propelled by high performance dotted fairs. The room contains an access points for an 802.11 network, overhead visual sensing (to allow emulation of CI'S signal processing), a centralized computer for emulating certain distributed computations, and network gateways to control and manipulate communications traffic.

DTIC

*Radiotelephones; Command and Control; Test Stands; Wireless Communication; Computer Networks*

**20030002702** Defence Science and Technology Organisation, Information Technology Div., Canberra Australia

**Ad Hoc Networks: Headline 2000 Communications Analysis**

Blair, W. D.; Reynolds, A. B.; Jun. 2002; 45p; In English; Original contains color images

Report No.(s): AD-A408000; DSTO-TR-1317; DODA-AR-012-358; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report examines unit location data and terrain from Headline 2000 to investigate communications networks within the maneuver units. Within the Enhanced Combat Force timeframe, such units would be supported by a Tactical Data Distribution Subsystem (TDDS). This is envisaged as an ad hoc network changing its topology as units maneuver across the battlespace. The report describes approaches that can be applied to Headline 2000 and other data to characterize the nature of the network topology, both statically and as it changes over time, in order to explore the impact on the TDDS network capacity and hence to assist in elucidating consequent requirements of a candidate TDDS.

DTIC

*Communication Networks; Radio Transmission; Tacan*

**20030002765** Brown Univ., Dept. of Physics, Providence, RI USA

**Semiconductor Selection and Optimization for use in a Laser Induced Pulsed Pico-Second Electromagnetic Source Final Report, Mar. 1998-Sep. 1999**

Crisman, Everett E.; Jan. 2000; 30p; In English

Contract(s)/Grant(s): F30602-98-C-0019; AF Proj. 2305

Report No.(s): AD-A408051; AFRL-SN-HS-TR-2002-049; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of optically induced, d.c. accelerated, semiconductor carriers as a source of picosecond microwave pulses is examined. The purpose of this study was to determine whether 1) phase shifted, multiple (optical) pulses could be generate on a single semiconductor element and 2) whether multiple inline elements could be stimulated with a single optical pulse. Both of the configurations have potential for simultaneously providing the source and phase control necessary for a steerable target recognition array. The efficiency of both techniques are demonstrated in this preliminary study and the gain which could be realized from cooling the semiconductor sources was evaluated for one specimen. Phase differences for multiple pulses were observed and directly related to the special position of the optical pulses with respect to the detector. The cascades sources showed enhanced forward microwave intensity and also an angular dependence consistent with the two sources and detector geometry. Cooling from room temperature to 100k resulted in approximately a three fold improvement in microwave strength (from a single element).

DTIC

*Pulsed Lasers; Semiconductor Devices; Pulse Generators; Electromagnetic Pulses*

**20030002840** Michigan Univ., Ann Arbor, MI USA

**MEMS For Wireless Communications Final Report, Apr. 1997-Sep. 2001**

Nguyen, Clark T.; Sep. 2002; 81p; In English; Original contains color images

Contract(s)/Grant(s): F30602-97-2-0101; DARPA Order E117; AF Proj. E117

Report No.(s): AD-A408056; AFRL-IF-RS-TR-2002-247; No Copyright; Avail: Defense Technical Information Center (DTIC)

The primary objectives of this project are 1) identification and study of the physical performance limitations incurred when extending the frequency range of miniaturized, micro-scale mechanical resonators to the VHF, UHF, and S-Band ranges; 2) implementation of prototype high-Q micromechanical filters and oscillators in these frequency ranges; and 3) subsequent incorporation of these components into the RF and IF stages of compact, inexpensive wireless transceivers. The proposed devices are not only orders of magnitude smaller than existing discrete resonator equivalents, but are also expected to outperform their macroscopic counterparts in insertion loss and percent bandwidth.

DTIC

*Radiotelephones; Microelectromechanical Systems; Wireless Communication*

**20030003708** Argonne National Lab., IL USA

**Design of Dielectric Accelerator Using TE-TM Mode Converter**

Liu, W.; Gai, W.; 2002; 12p; In English

Report No.(s): DE2002-799799; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A new design for X band dielectric accelerator using a TE-TM mode converter has been proposed and studied. It first converts RF from TE to TM mode in a pure metal section, then a tapered transition section is used for high efficiency transmission to the dielectric accelerator section. Because there is no dielectrics near the RF coupler, this scheme has potential to overcome RF breakdown problems near the coupling holes in the dielectric based accelerators, as it happened in the older designs. A detailed design study shows that high conversion efficiency can be achieved for both single and dual coupling ports and it is less sensitive to machine errors than previous designs. Another advantage of this design is that it can be made to different modules thus greatly reduce the R&D cycles.

NTIS

*Dielectrics; Superhigh Frequencies; Design Analysis; Accelerators*

**20030003777** Texas Univ., Center for Transportation Research, Austin, TX USA

**Development and Implementation of a Telecommuting Evaluation Framework, and Modeling the Executive Telecommuting Adoption Process**

Vora, V. P.; Mahmassani, H. S.; Feb. 2002; 132p; In English

Report No.(s): PB2003-101448; SWUTC/02/167505-1; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This work proposes and implements a comprehensive evaluation framework to document the telecommuter, organizational, and societal impacts of telecommuting through telecommuting programs. Evaluation processes and materials within the outlined framework are also proposed and implemented. As the first component of the evaluation process, the executive survey is administered within a public sector agency. The survey data is examined through exploratory analysis and is compared to a previous survey of private sector executives. The ordinal probit, dynamic probit, and dynamic generalized ordinal probit (DGOP) models of telecommuting adoption are calibrated to identify factors which significantly influence executive adoption preferences and to test the robustness of such factors. The public sector DGOP model of executive willingness to support telecommuting under different program scenarios is compared with an equivalent private sector DGOP model. Through the telecommuting program, a case study of telecommuting travel impacts is performed to further substantiate research.

NTIS

*Personnel; Telecommunication*

**20030003796** Argonne National Lab., IL USA

**Evaluation of a User-Level Data Transfer Mechanism for High-Performance Networks**

Dickens, P. M.; Gropp, W.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799819; No Copyright; Avail: National Technical Information Service (NTIS)

In this paper, we describe FOBS: a simple user-level communication protocol designed to take advantage of the available bandwidth in a high-bandwidth, high-delay network environment. We compare the performance of FOBS with that of TCP both

with and without the so-called Large Window extensions designed to improve the performance of TCP in this type of network environment.

NTIS

*Computer Networks; Data Transmission; Protocol (Computers)*

**20030004225** Anteon Corp., Fairfax, VA USA

**Advanced Communications Technology: Mobile Communications Requirements Report**

May 1998; 84p; In English

Report No.(s): PB2003-101439; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The Coast Guard's mobile communications requirements will outstrip existing system capabilities, available capacity, and affordability by the late 1990s. This will require changes in the mix of mobile communications equipment and services used by operational units. New commercial mobile satellite services are available now, with many others arriving on the market between 1998 and 2003. These new services present unique opportunities to satisfy mission requirements, reduce investment in communications infrastructure, and realize more costeffective communications services. The Coast Guard Research and Development Center (R&DC) has undertaken an effort to identify and evaluate current and emerging satellite services that may be used to satisfy Coast Guard mobile communications requirements. As part of this effort, Anteon Corporation has been tasked by R&DC to collect the mobile communications functional requirements that have been identified by program managers. Anteon analysts have reviewed the Government Furnished Information (GFI) and researched other related documentation to identify and collect the requirements that may be used to describe the needed operating environment. Anteon analysts assessed the functional requirements to develop system requirements that describe the features that a communications system must provide to support the functional requirements. This report presents the current and projected Coast Guard mobile communications system requirements.

NTIS

*Mobile Communication Systems; Telecommunication; Requirements; USA*

### 33

## ELECTRONICS AND ELECTRICAL ENGINEERING

*Includes development, performance, and maintainability of electrical/electronic devices and components; related test equipment. and microelectronics and integrated circuitry. For related information see also 60 Computer Operations and Hardware; and 76 Solid-State Physics. For communications equipment and devices see 32 Communications and Radar.*

**20030002322** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Design Parameter Variation of Highly Stressed, Bi-Conal Graphite Electrode Connections through Numerical Simulation**

Mohammed, Ali; Jan. 2000; 131p; In German

Report No.(s): AD-A407764; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The dissertation delves into the mediation of change effects between geometrical and materially technical design parameters of graphite electrode connections and the optimization of their combinations. The graphite electrodes are first described in their utility as process components in steel fabrication. The development of a three-dimensional Finite Elements-thread model (FEM) for large-format electrode connections is then discussed. The fourth chapter yields experiments on large-format graphite electrode trains, while the fifth endeavors a theoretical look at the experiments in consideration of both numerical and experimental tests. The sixth and final chapter contains design parameter variations for the optimization of the load behavior under mechanical burdens.

DTIC

*Numerical Analysis; Electrodes*

**20030002374** Lockheed Martin Corp., Hampton, VA USA

**User's Manual for FEM-BEM Method, 1.0**

Butler, Theresa, Lockheed Martin Corp., USA; December 2002; 26p; In English

Contract(s)/Grant(s): NAS1-00135; RTOP 706-31-41-01

Report No.(s): NASA/CR-2002-211966; NAS 1.26:211966; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A user's manual for using FORTRAN code to perform electromagnetic analysis of arbitrarily shaped material cylinders using a hybrid method that combines the finite element method (FEM) and the boundary element method (BEM). In this method, the material cylinder is enclosed by a fictitious boundary and the Maxwell's equations are solved by FEM inside the boundary and

by BEM outside the boundary. The electromagnetic scattering on several arbitrarily shaped material cylinders using this FORTRAN code is computed to as examples.

Author

*Boundary Element Method; Finite Element Method; User Manuals (Computer Programs); Electromagnetic Scattering*

**20030002387** Colorado State Univ., Dept. of Computer Science, Fort Collins, CO USA

**Cameron - Optimized Compilation of Visual Programs for Image Processing on Adaptive Computing Systems (ACS) Final Report, 8 May 1998-31 Dec. 2001**

Boehm, Wim; Draper, Bruce; Beveridge, Ross; Jan. 2002; 326p; In English; Original contains color images

Contract(s)/Grant(s): F33615-98-C-1319; Proj-ARPI

Report No.(s): AD-A407678; AFRL-IF-RS-TR-2002-1526; No Copyright; Avail: Defense Technical Information Center (DTIC)

This report states the work performed by the Cameron project. The goal of the Cameron project is to make FPGAs and other adaptive computer systems available to more applications programmers, by raising the abstraction level from hardware circuits to software algorithms. To this end, we have developed a variant of the C programming language and an optimizing compiler that maps high-level programs directly onto FPGAs, and have tested the language and compiler on a variety of image processing (and other) applications. A high level language with its one step compiler for Adaptive Computing Systems has been designed and implemented, and the performance of DoD relevant applications has been analyzed on commercial off-the-shelf reconfigurable hardware.

DTIC

*Compilers; Optimization; Image Processing; Computer Systems Programs; Adaptive Control; Field-Programmable Gate Arrays*

**20030002389** Naval Postgraduate School, Monterey, CA USA

**A Novel Approach for the Development and Optimization of State-of-the-Art Photovoltaic Devices Using Silvaco**

Michalopoulos, Panayiotis; Mar. 2002; 187p; In English; Original contains color images

Report No.(s): AD-A407676; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

In this thesis, a new method for developing realistic simulation models of advanced solar cells is presented. Several electrical and optical properties of exotic materials, used in such designs, are researched and calculated. Additional software has been developed to facilitate and enhance the modeling process. Furthermore, specific models of an InGaP/GaAs and of an InGaP/GaAs/Ge multi-junction solar cells are prepared and are tally simulated. The major stages of the process are explained and the simulation results are compared to published experimental data. Finally, additional optimization is performed on the last state-of-the-art cell, to further improve its efficiency. The flexibility of the proposed methodology is demonstrated and example results are shown throughout the whole process.

DTIC

*Solar Cells; Semiconductors (Materials); Electrical Properties; Optical Properties*

**20030002513** Northwestern Univ., Dept. of Chemistry, Evanston, IL USA

**Composite, Polymer-Based Electrolytes for Advanced Batteries Final Report, 1 Apr. 1998-31 Mar. 2001**

Ratner, Mark A.; Shriver, Duward F.; Mar. 2001; 7p; In English

Contract(s)/Grant(s): DAAG55-98-1-0233

Report No.(s): AD-A407992; ARO-37411.6-CH; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The series of investigations based on synthesis, physical characterization, charge transport measurements, and appropriate modeling studies has been completed, in the general area of polymer based electrolyte systems. Several substantive advances towards new, improved performance electrolyte materials both for low temperature fuel cell applications and for advanced secondary lithium battery materials have been reported. Particular advances in discovery areas include rigid polymer based electrolyte systems using carbonates, Lewis acid enhancement mechanisms for ionic conductivity in salts, optimization of local basicity and polyelectrolytes, and understanding of a phase diagram in mixed polymer complex polyelectrolyte structures.

DTIC

*Synthesis (Chemistry); Lithium Batteries; Components*

**20030002636** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Gateisolatoren fuer MOS-Feldeffekttransistoren (Gate Isolators for MOSFETs)**

Pompi, Thomas; Oct. 2000; 174p; In German

Report No.(s): AD-A407967; X5-X5; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The dissertation deals with Metal Oxide Semiconductor (MO S) field-effect transistors and how gate isolators have come to play a role in these semiconductors since the latter's introduction in the early 1970s. Testing the reliability of MOSFETs under hot carrier and bias temperature stress, the author then proceeds to the nitrogen barrier against boron diffusion. The bulk of the work concentrates on the tunneling of charged particles through a thin silicon dioxide layer as it functions in dual work function complementary MOS technology. Various gate leak flow mechanisms are used in examples with alternated MOSes. An analysis of the reliability with silicon dioxide layers with a thickness under five newtonmeters and titanium dioxide as an alternative gate nonconductor comprise, respectively, the last two chapters.

DTIC

*Silicon Dioxide; Field Effect Transistors*

**20030002638** Massachusetts Inst. of Tech., Artificial Intelligence Lab., Cambridge, MA USA

**Amorphous and Cellular Computing Final Report, 1 Sep. 1996-31 Aug. 2001**

Abelson, Harold; Sussman, Gerald J.; Knight, Thomas F., Jr; Aug. 31, 2001; 12p; In English

Contract(s)/Grant(s): N00014-96-1-1228

Report No.(s): AD-A408046; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The objective of this research is to create the architectural, algorithmic, and technological foundations for exploiting programmable materials. These are materials that incorporate vast numbers of programmable elements that react to each other and to their environment. Such materials can be fabricated economically, provided that the computing elements are amassed in bulk without arranging for precision interconnect and testing. In order to exploit programmable materials we must identify engineering principles for organizing and instructing myriad programmable entities to cooperate to robustly achieve pre-established goals, even though the individual entities are unreliable and interconnected in unknown, irregular, and time-varying ways. Progress in microfabrication and in bioengineering will make it possible to assemble such amorphous systems at almost no cost, provided that (1) the units need not all work correctly; (2) the units are identically programmed; and (3) there is no need to manufacture precise geometrical arrangements of the units or precise interconnections among them.

DTIC

*Bioengineering; Amorphous Materials; Computers; Logic Circuits*

**20030002656** Aerospace Structural Research Corp., Albuquerque, NM USA

**H2 Reconstitution Final Report, Dec. 2000-Jan. 2002**

Skipper, Mike; Feb. 2002; 50p; In English

Contract(s)/Grant(s): F29601-00-D-0074; AF Proj. 4867

Report No.(s): AD-A408020; DC-TR-0328.008-1; AFRL-DE-TR-0328.008-1; No Copyright; Avail: Defense Technical Information Center (DTIC)

The high power microwave program at the Air Force Research Laboratory (AFRL) includes high power source development in narrow band and wideband technologies. The H2 source is an existing wideband source that was developed at the AFRL. A recent AFRL requirement for a wideband impulse generator to use in materials tests has provided the need to update the H2 source for the current test requirements. The H2 source is composed of a dual resonant transformer that charges a short length of coaxial transmission line. The transmission line is then discharged into an output coaxial transmission line with a self-break hydrogen switch. The dual resonant transformer is driven by a low inductance primary capacitor bank operating through a self-break gas switch. The upgrade of the coaxial hydrogen output switch is the focus of this report. The hydrogen output switch was developed through extensive electrical and mechanical simulations. The switch insulator is made of Ultem 2300 and is designed to operate with a mechanical factor of safety equal to 4.0 at 1,000 psi. The design criteria, design data and operational data will be presented.

DTIC

*Microwave Equipment; Pulse Generators*

**20030002692** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Microsystem-Technical Realization of Inductances**

Wiest, Florian; Oct. 2001; 138p; In German

Report No.(s): AD-A407983; X5-X5; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The dissertation discusses a completely new concept for the realization of specific inductance construction forms, with which, in parallel construction, one might work on a multitude of coils integrated into processing usage. Firstly, the author sets out his principles for production and characterization; secondly, he describes the usage process in detail, so as to provide examples for his empirical research. The next and largest chapter focuses on the deformation of the microstructures, including the area

metalization, the photolithographic manufacture of galvanic forms, the Excimer laser-photolithography, the deformation of the track run, and dielectric passivation. The last chapter involves electric characterization.

DTIC

*Electronic Equipment; Miniaturization*

**20030003782** Helsinki Univ. of Technology, Dept. of Electrical and Communications Engineering, Espoo, Finland

**Nonmonotone Norm-Reduction Method in Numerical Circuit Analysis**

Honkala, M.; 2002; 18p; In English

Report No.(s): PB2003-101520; CT-46; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Nonlinear circuit equations can be solved using Newton-Raphson iteration. However, due to poor initial guesses, the convergence of the iteration may need aiding. Norm-reduction methods ensure that the function norm is reduced at every iteration and thus prevents the iteration from diverging. However, the monotone-decrease requirement is often too strict. This can be avoided by allowing some increase in the norm during the iteration. A nonmonotone norm-reduction method has been applied in nonlinear DC and harmonic-balance analysis, and the simulation results with some benchmark circuits show that a nonmonotone norm-reduction may reduce the number of line searches.

NTIS

*Numerical Analysis; Circuits*

**20030003803** Argonne National Lab., IL USA

**X-Ray Lenses Fabricated by Deep X-Ray Lithography**

Mancini, D. C.; Moldovan, N.; Divan, R.; DeCarlo, F.; Yaeger, J.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801584; No Copyright; Avail: National Technical Information Service (NTIS)

Refractive x-ray lenses have been fabricated using deep x-ray lithography. Lenses were produced directly in 1- to 6-mm-thick sheets of polymethyl methacrylate (PMMA) with as many as 100 cylindrical lenses along the optical axis. The fabrication process consists of exposing the PMMA sheets to high energy synchrotron radiation through a mask of 50-micron-thick gold on silicon and subsequent development in ketone. The lenses are suitable for use in synchrotron radiation from a bending magnet at the Advanced Photon Source in the energy range of 8-16 keV. Results of measurements of focus quality, flux density gain, and scatter are presented and discussed with regard to the quality of lens material and fabrication method. Means for improving the performance of the lenses is discussed.

NTIS

*Lithography; Lenses; X Rays*

**20030004090** General Accounting Office, Washington, DC USA

**Electronic Warfare: Comprehensive Strategy Still Needed for Suppressing Enemy Air Defenses**

Nov. 2002; 28p; In English

Report No.(s): PB2003-101427; GAO-03-51; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

U.S. military aircraft are often at great risk from enemy air defenses, and the services use specialized aircraft to neutralize or destroy them. In January 2001, GAO reported that a gap existed between the services' suppression capabilities and their needs and recommended that a comprehensive strategy was needed to fix the situation. In response to GAO's report, DOD emphasized that a major study underway at the time would provide the basis for a Department-wide strategy and lead to a balanced set of acquisition programs between the services. This report updates our previous work and assesses actions that DOD has taken to improve its suppression capabilities.

NTIS

*Air Defense; Electronic Warfare; Jamming*

## FLUID MECHANICS AND THERMODYNAMICS

*Includes fluid dynamics and kinematics and all forms of heat transfer; boundary layer flow; hydrodynamics; hydraulics; fluidics; mass transfer and ablation cooling. For related information see also 02 Aerodynamics.*

**20030002223** NASA Langley Research Center, Hampton, VA USA

### **Numerical Simulations of Vortex Generator Vanes and Jets on a Flat Plate**

Allan, Brian G., Institute for Computer Applications in Science and Engineering, USA; Yao, Chung-Sheng, NASA Langley Research Center, USA; Lin, John C., NASA Langley Research Center, USA; [2002]; 15p; In English; 1st AIAA Flow Control Conference, 24-27 Jun. 2002, Saint Louis, MO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS1-97046

Report No.(s): AIAA Paper 2002-3160; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Numerical simulations of a single low-profile vortex generator vane, which is only a small fraction of the boundary-layer thickness, and a vortex generating jet have been performed for flows over a flat plate. The numerical simulations were computed by solving the steady-state solution to the Reynolds-averaged Navier-Stokes equations. The vortex generating vane results were evaluated by comparing the strength and trajectory of the streamwise vortex to experimental particle image velocimetry measurements. From the numerical simulations of the vane case, it was observed that the Shear-Stress Transport (SST) turbulence model resulted in a better prediction of the streamwise peak vorticity and trajectory when compared to the Spalart-Allmaras (SA) turbulence model. It is shown in this investigation that the estimation of the turbulent eddy viscosity near the vortex core, for both the vane and jet simulations, was higher for the SA model when compared to the SST model. Even though the numerical simulations of the vortex generating vane were able to predict the trajectory of the stream-wise vortex, the initial magnitude and decay of the peak streamwise vorticity were significantly under predicted. A comparison of the positive circulation associated with the streamwise vortex showed that while the numerical simulations produced a more diffused vortex, the vortex strength compared very well to the experimental observations. A grid resolution study for the vortex generating vane was also performed showing that the diffusion of the vortex was not a result of insufficient grid resolution. Comparisons were also made between a fully modeled trapezoidal vane with finite thickness to a simply modeled rectangular thin vane. The comparisons showed that the simply modeled rectangular vane produced a streamwise vortex which had a strength and trajectory very similar to the fully modeled trapezoidal vane.

Author

*Direct Numerical Simulation; Computational Fluid Dynamics; Navier-Stokes Equation; Turbulence Models; Turbulent Flow; Vortices; Vortex Generators; Flow Visualization; Wind Tunnel Tests; Vanes*

**20030002266** NASA Langley Research Center, Hampton, VA USA

### **Unsteady Simulation of a Landing-Gear Flow Field**

Li, Fei, High Technology Corp., USA; Khorrami, Mehdi R., NASA Langley Research Center, USA; Malik, Mujeeb R., High Technology Corp., USA; [2002]; 16p; In English; 8th AIAA/CEAS Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Contract(s)/Grant(s): NAS1-00088

Report No.(s): AIAA Paper 2002-2411; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper presents results of an unsteady Reynolds-averaged Navier-Stokes simulation of a landing-gear flow field. The geometry of the four-wheel landing gear assembly consists of several of the fine details including the oleo-strut, two diagonal struts, a door, yokes/pin and a flat-plate simulating the wing surface. The computational results, obtained by using 13.3 million grid points, are presented with an emphasis on the characteristics of the unsteadiness ensuing from different parts of the landing-gear assembly, including vortex shedding patterns and frequencies of dominant oscillations. The results show that the presence of the diagonal struts and the door significantly influence the flow field. Owing to the induced asymmetry, vortices are shed only from one of the rear wheels and not the other. Present computations also capture streamwise vortices originating from the upstream corners of the door.

Author

*Flow Distribution; Landing Gear; Navier-Stokes Equation; Reynolds Averaging; Reynolds Equation; Simulation; Computerized Simulation*

**20030002350** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**In Situ Poling and Imidization of Amorphous Piezoelectric Polyimides *Final Report***

Park, Cheol, Institute for Computer Applications in Science and Engineering, USA; Ounaies, Zoubeida, Institute for Computer Applications in Science and Engineering, USA; Wise, Kristopher E., Institute for Computer Applications in Science and Engineering, USA; Harrison, Joycelyn S., NASA Langley Research Center, USA; October 2002; 20p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211948; NAS 1.26:211948; ICASE-2002-39; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An amorphous piezoelectric polyimide containing polar functional groups has been developed using a combination of experimental and molecular modeling for potential use in high temperature applications. This amorphous polyimide, (Beta-CN)APB/ODPA, has exhibited good thermal stability and piezoelectric response at temperatures up to 150C. Density functional calculations predicted that a partially cured amic acid (open imide ring) possesses a dipole moment four times larger than the fully imidized closed ring. In situ poling and imidization of the partially cured (Beta-CN)APB/ODPA, was studied in an attempt to maximize the degree of dipolar orientation and the resultant piezoelectric response. A positive corona poling was used to minimize localized arcing during poling and to allow use of higher poling fields without dielectric breakdown. The dielectric relaxation strength, remanent polarization, and piezoelectric response were evaluated as a function of the poling profile. The partially cured, corona poled polymers exhibited higher dielectric relaxation strength ( $\Delta \epsilon''$ ), remanent polarization ( $P_r$ ) and piezoelectric strain coefficient ( $d_{33}$ ) than the fully cured, conventionally poled ones.

Author

*Polyimides; Amorphous Materials; Piezoelectricity; Polarization (Spin Alignment); Dielectric Properties; Electric Dipoles; Polarization Characteristics*

**20030002361** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Polymer-Single Wall Carbon Nanotube Composites for Potential Spacecraft Applications *Final Report***

Park, C., Institute for Computer Applications in Science and Engineering, USA; Ounaies, Z., Institute for Computer Applications in Science and Engineering, USA; Watson, K. A., Institute for Computer Applications in Science and Engineering, USA; Pawlowski, K., NASA Langley Research Center, USA; Lowther, S. E., NASA Langley Research Center, USA; Connell, J. W., NASA Langley Research Center, USA; Siochi, E. J., NASA Langley Research Center, USA; Harrison, J. S., NASA Langley Research Center, USA; St.Clair, T. L., NASA Langley Research Center, USA; October 2002; 11p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211940; NAS 1.26:211940; ICASE-2002-36; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Polymer-single wall carbon nanotube (SWNT) composite films were prepared and characterized as part of an effort to develop polymeric materials with improved combinations of properties for potential use on future spacecraft. Next generation spacecraft will require ultra-lightweight materials that possess specific and unique combinations of properties such as radiation and atomic oxygen resistance, low solar absorptivity, high thermal emissivity, electrical conductivity, tear resistance, ability to be folded and seamed, and good mechanical properties. The objective of this work is to incorporate sufficient electrical conductivity into space durable polyimides to mitigate static charge build-up. The challenge is to obtain this level of conductivity ( $10(\exp -8)$  S/cm) without degrading other properties of importance, particularly optical transparency. Several different approaches were attempted to fully disperse the SWNTs into the polymer matrix. These included high shear mixing, sonication, and synthesizing the polymers in the presence of pre-dispersed SWNTs. Acceptable levels of conductivity were obtained at loading levels less than one tenth weight percent SWNT without significantly sacrificing optical properties. Characterization of the nanocomposite films and the effect of SWNT concentration and dispersion on the conductivity, solar absorptivity, thermal emissivity, mechanical and thermal properties were discussed. Fibers and non-woven porous mats of SWNT reinforced polymer nanocomposite were produced using electrospinning.

Author

*Carbon Nanotubes; Nanocomposites; Technology Utilization; Electrical Resistivity; Smart Materials; Optical Properties; Design Analysis; Nanostructure (Characteristics)*

**20030002380** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Computation of Multimodal Size-Velocity-Temperature Spray Distribution Functions**

Archambault, Mark R.; Sep. 2002; 4p; In English

Report No.(s): AD-A407733; AFRL-PR-ED-AB-2002-229; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

An alternative approach to modeling spray flows—one which does not involve simulation or stochastic integration is to directly compute the evolution of the probability density function (PDF) describing the drops. The purpose of this paper is to continue exploring an alternative method of solving the spray flow problem. The approach is to derive and solve a set of Eulerian moment transport equations for the quantities of interest in the spray, coupled with the appropriate gas-phase (Eulerian) equations. A second purpose is to continue to explore how a maximum-entropy criterion may be used to provide closure for such a moment-based model. The hope is to further develop an Eulerian-Eulerian model that will permit one to solve for detailed droplet statistics directly without the use of stochastic integration or post-averaging of simulations.

DTIC

*Probability Density Functions; Sprayers*

**20030002483** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**The Use of Microtube Technology in Smart Devices**

Hoffman, Wesley P.; Wapner, Phillip G.; Nov. 02, 1999; 117p; In English

Contract(s)/Grant(s): AF Proj. 2306

Report No.(s): AD-A408084; AFRL-PR-ED-TP-1999-0208; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Microtubes are very small diameter tubes (in the nanometer and micron range) with very high aspect ratios that can be made from practically any material with any combination of cross-sectional and axial shapes desired. In smart structures, these microscopic tubes can function as sensors and actuators, as well as components of fluidic logic systems. In many technological fields including smart structures, Microtube Technology enables the fabrication of components and devices that have to date been impossible to produce, offers a lower cost route for the fabrication of some current products, and provides the opportunity to miniaturize numerous components and devices that are currently in existence.

DTIC

*Miniaturization; Fluidics; Capillary Tubes; Microelectromechanical Systems*

**20030002485** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Utilization of Surface Tension and Wettability in the Design and Operation of Microsensors**

Wagner, Phillip G.; Hoffman, Wesley P.; Aug. 25, 1999; 12p; In English

Contract(s)/Grant(s): AF Proj. 2306

Report No.(s): AD-A408082; AFRL-PR-ED-TP-1999-0173; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The behavior of fluid droplets contained within shaped capillaries and voids can be utilized to convert forces acting upon the droplets to observable displacements which accurately quantify these forces. The position of droplets within such micro-sensors is governed by surface tension, wettability, and the geometric configuration of the confining walls. If non-wetting fluids are employed, the micro-sensors can also be made to operate as micro-valves, micro-switches, optical micro-shutters, as well as other devices. Having no mechanical parts to wear out, such micro-sensors are inherently immune to many orders-of-magnitude over-actuation. Both circular and non-circular confining structures can be employed.

DTIC

*Fluidics; Microinstrumentation; Interfacial Tension; Drops (Liquids)*

**20030002486** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Micro-Hydraulics Employing Non-Wetting Fluids**

Wapner, P.; Hoffman, W.; Jun. 26, 2000; 4p; In English; Fall Meeting of the Electrochemical Soc. Held in Phoenix, AZ, 22 Oct 2000

Contract(s)/Grant(s): AF Proj. 2306

Report No.(s): AD-A408081; AFRL-PR-ED-AB-2000-141; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Hydraulic actuation is a mature technology that is widely used in a variety of applications in the macroscopic world. Its use in miniaturized devices such as microelectromechanical systems (MEMS), however, is just beginning to be exploited. This lag in development of micro-hydraulics results from the fact that it is not easy to construct miniaturized analogs of macroscopic hydraulic system using traditional MEMS fabrication techniques, such as photolithography. Tight-clearance pistons that do not allow bypass flow are difficult to fabricate in micro-devices. Fortunately, the very fact that MEMS devices are so tiny enables a very different kind of hydraulic technology to be utilized. It is based on surface-related phenomena associated with flows of non-wetting fluids in micro-channels.

DTIC

*Hydraulic Equipment; Fluidics; Microelectromechanical Systems; Microchannels*

**20030002487** Air Force Research Lab., Propulsion Directorate West, Edwards AFB, CA USA

**Microsensors that Function on the Basis of Surface and Wettability**

Wapner, P.; Hoffman, W.; Jun. 26, 2000; 3p; In English; Fall Meeting of Materials Res. Society. Held in Boston, MA, 3 Dec 2000  
Contract(s)/Grant(s): AF Proj. 2306

Report No.(s): AD-A408080; AFRL-PR-ED-AB-2000-142; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The displacement of non-wetting fluid droplets contained within capillaries that have axial profiles and are non-uniform can be used to accurately and reproducibly measure the forces acting upon these droplets. The position of droplets within such micro-sensors is dictated by surface tension, wettability, geometric configuration of the confining walls, and the forces acting upon the droplet. These micro-sensors can measure pressure and acceleration, and can also be made to operate as micro-valves, micro-switches, optical shutters, as well as other devices. They have no moving mechanical parts to wear out, and can theoretically endure high amounts of over-actuation and still return to initial levels of accuracy and precision without harm. The axial profiles of these shaped capillaries are easily fabricated using microtube technology developed at the Air Force Research Laboratory at Edwards Air Force Base. However, it is also possible to use non-circular shaped voids and still achieve similar capabilities with some limitations. These non-circular shaped voids can be manufactured using more conventional MEMS technologies such as photo lithography and LIGA.

DTIC

*Fluidics; Microinstrumentation; Microchannels*

**20030002512** Army Engineer Research and Development Center, Coastal and Hydraulics Lab, Vicksburg, MS USA

**Desktop Study for La Quinta Project; Shoaling Prediction in La Quinta Navigation Channel and Effect of a Barrier on Siltation in Extended La Quinta Channel Final Report**

Parchure, Trimbak M.; Sarruff, Soraya; Brown, Ben; Sep. 2002; 80p; In English

Report No.(s): AD-A407991; ERDC/CHL-TR-02-19; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

The U.S. Army Engineer District, Galveston, proposed two modifications of the La Quinta navigation channel: (1) extension of the navigation channel and providing a new turning basin at the end of the extension, both having the same depth as that of the present navigation channel, namely 13.7 m (45 ft), and (2) constructing a barrier on the south side of the extended channel. The District requested the Coastal and Hydraulics Laboratory (CHL) of the U.S. Army Engineer Research and Development Center (ERDC), Vicksburg, MS, conduct a desktop study for estimation of future shoaling in the navigation channel with these two modifications. The results of a desktop study are given in this report in two parts for the above two problems. Shoaling Prediction in La Quinta Navigation Channel The approach consisted of the following steps. Field data already available as well as those collected by CHL were analyzed and the results of analysis used. Assumptions were made on the spatial and temporal variation in the values of relevant parameters. Runs were conducted on the existing numerical hydrodynamic model for a few selected conditions to determine the effect of channel extension on the currents in the area of interest. A quantitative estimate was provided on future shoaling in the navigation channel based on the field and model data analysis. The following conclusions were drawn.

- Proposed extension of La Quinta navigation channel and provision of a new turning basin will cause an increase in the present tidal currents. This is expected to increase the inflow of sediment in the channel, which would result in increased shoaling.
- Bed sediment in the La Quinta channel consists of mostly fine sediment in the category of silt and clay. This suggests that the major process of shoaling consists of deposition of suspended sediment.

DTIC

*Hydrodynamics; Dredged Materials*

**20030002658** Army Research Lab., Human Research and Engineering Directorate, Aberdeen Proving Ground, MD USA

**Numerical Investigation of Aerodynamics of Canard-Controlled Missile Using Planar and Grid Tail Fins. Part 1. Supersonic Flow Final Report, Oct. 2001-Jun. 2002**

DeSpirito, James; Vaughn, Milton E., Jr.; Washington, W. D.; Sep. 2002; 91p; In English; Original contains color images

Contract(s)/Grant(s): DA Pro. 1L1162618-AH-80

Report No.(s): AD-A408016; ARL-TR-2848; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

Viscous computational fluid dynamic simulations were used to predict the aerodynamic coefficients and flowfield around a generic canard-controlled missile configuration in supersonic flow. Computations were performed for Mach 1.5 and 3.0, at six angles of attack between 0 and 10, with 0 and 10 canard deflection, and with planar and grid tail fins, for a total of 48 cases. Validation of the computed results was demonstrated by the very good agreement between the computed aerodynamic coefficients and those obtained from wind tunnel measurements. Visualizations of the flowfield showed that the canard trailing vortices and downwash produced a low-pressure region on the starboard side of the missile that in turn produced an adverse side force. The pressure differential on the leeward fin produced by the interaction with the canard trailing vortices is primarily responsible for

the adverse roll effect observed when planar fins are used. Grid tail fins improved the roll effectiveness of the canards at low supersonic speed. No adverse rolling moment was observed with no canard deflection, or at the higher supersonic speed for either tail fin type due to the lower intensity of the canard trailing vortices in these cases. Flow visualizations from the simulations performed in this study help in the understanding of the flow physics and can lead to improved canard and tail fin designs for missiles and rockets.

DTIC

*Computational Fluid Dynamics; Flow Distribution; Aerodynamic Characteristics; Supersonic Flow; Viscosity; Fins*

**20030002660** Energy Research and Consultants Corp., Laguna Hills, CA USA

**Correcting for Attenuation Effects in Optical Patterning of Sprays**

McDonell, V. G.; Talley, D. G.; Jun. 2000; 12p; In English; Presented at the Intl Symposium on Applications of Laser Techniques to Fluid Mechanics (10th), Held in Lisbon, Portugal, on 10-13 Jul. 2000; Intl Conference on Liquid Atomization and Spray Systems (8th) Held in Pasadena, CA on 16-20 June 2000

Contract(s)/Grant(s): F04611-97-C-0084

Report No.(s): AD-A408013; AFRL-PR-ED-TP-2000-140; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

No abstract available.

Author

*Image Processing; Laser Applications; Spray Characteristics; Attenuation*

**20030002696** Universitaet der Bundeswehr Muenchen, Fakultae fuer Luft- UND Raumfahrttechnik, Neubiberg Germany

**Influence of Surface Roughness Generated by Modern Production Processes on the Flow Process of Compressor Grids**

Leipold, Robert; Jan. 2000; 177p; In German

Report No.(s): AD-A407988; X5-X5; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The dissertation opens with a review of the influence of (surface) roughness in various contexts, from the theoretical, such as in simple geometry, and compressor performance statistics. A detailing of the trial construction within a high-speed cascade tunnel is followed by the measurement and transfer of roughness in modern production processes. The second half of the dissertation is devoted entirely to experiments. Firstly, the author investigates the influence of surface roughness on: (1) isotropic profile Mach critical velocity ration distributions; (2) total pressure loss correction values; (3) boundary layer development; (4) turbulence in the boundary layer. Secondly, he undertakes numerical experiments with the Alfa II and the Alpha 3.0 calculation methods.

DTIC

*Surface Roughness; Boundary Layers*

**20030002758** Lawrence Livermore National Lab., Livermore, CA USA

**Shock-Turbulence Interaction: Annotated Reference**

Buckingham, A. C.; Sep. 15, 1999; 29p; In English

Report No.(s): DE2002-793708; UCRL-ID-136183; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Amplification of turbulence with a shock wave has been a central issue in compressible fluid dynamics research for over fifty years. While considerable progress has been made in understanding the phenomenon many unresolved questions remain and a consistent theory adequate for a usefully broad range of supersonic - hypersonic flow speeds, constituent gases, and unshocked/shocked thermodynamic state conditions has not emerged. However, very significant amplification of field-averaged turbulence intensity, factors of 6 to 10 or greater, have been measured in air at near standard atmospheric ambient conditions for low shock Mach numbers. Intensity is a convenient and commonly encountered measure of the vigor of turbulence. It is defined as the ratio of the rms fluctuating velocity magnitude to the mean flow speed. It is often expressed as a percentage.

NTIS

*Shock Waves; Compressible Fluids; Turbulence; Fluid Dynamics*

**20030002809** NASA Ames Research Center, Moffett Field, CA USA

**Analysis of High Order Difference Methods for Multiscale Complex Compressible Flows**

Sjoegreen, Bjoern, Royal Inst. of Tech., Sweden; Yee, H. C., NASA Ames Research Center, USA; [2002]; 14p; In English; 9th International Conference on Hyperbolic Problems, 25-29 Mar. 2002, Pasadena, CA, USA; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Accurate numerical simulations of complex multiscale compressible viscous flows, especially high speed turbulence combustion and acoustics, demand high order schemes with adaptive numerical dissipation controls. Standard high resolution

shock-capturing methods are too dissipative to capture the small scales and/or long-time wave propagations without extreme grid refinements and small time steps. An integrated approach for the control of numerical dissipation in high order schemes with incremental studies was initiated. Here we further refine the analysis on, and improve the understanding of the adaptive numerical dissipation control strategy. Basically, the development of these schemes focuses on high order nondissipative schemes and takes advantage of the progress that has been made for the last 30 years in numerical methods for conservation laws, such as techniques for imposing boundary conditions, techniques for stability at shock waves, and techniques for stable and accurate long-time integration. We concentrate on high order centered spatial discretizations and a fourth-order Runge-Kutta temporal discretizations as the base scheme. Near the boundaries, the base scheme has stable boundary difference operators. To further enhance stability, the split form of the inviscid flux derivatives is frequently used for smooth flow problems. To enhance nonlinear stability, linear high order numerical dissipations are employed away from discontinuities, and nonlinear filters are employed after each time step in order to suppress spurious oscillations near discontinuities to minimize the smearing of turbulent fluctuations. Although these schemes are built from many components, each of which is well-known, it is not entirely obvious how the different components be best connected. For example, the nonlinear filter could instead have been built into the spatial discretization, so that it would have been activated at each stage in the Runge-Kutta time stepping. We could think of a mechanism that activates the split form of the equations only at some parts of the domain. Another issue is how to define good sensors for determining in which parts of the computational domain a certain feature should be filtered by the appropriate numerical dissipation. For the present study we employ a wavelet technique introduced in as sensors. Here, the method is briefly described with selected numerical experiments.

Derived from text

*Numerical Analysis; Numerical Control; Adaptive Control; Boundary Conditions; Computational Grids; Nonlinear Filters; Turbulent Flow; Viscous Flow*

**20030002841** Universitaet der Bundeswehr Muenchen, Fakultae fuer Luft- UND Raumfahrttechnik, Neubiberg Germany

**Examination of Flow Behavior of Highly Loaded Uncooled Low-Pressure Turbine Grids with Regard to Rotor-Stator Interaction** *Untersuchung des Stroemungsverhaltens von hochbelasteten ungekuehlten Niederdruck-Turbinengittern unter Beruecksichtigung der Rotor-Stator Interaktion*

Brunner, Stefan; Nov. 2000; 185p; In German

Report No.(s): AD-A408057; X5-X5; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

Tests are made on two highly loaded low-pressure turbine grids, which have been specially developed in order to make use of the positive effects of rotor-stator interaction, observing simultaneously the typical Mach and Reynolds number combinations. After an introduction on the influence of rotor-stator interaction on the profile border layers in turbo machines, a trial construction ensues in a High-Speed Grid Wind Canal (HSGWC), the dimensions and problematic areas of which are also described. The next two chapters compare the results of the experiment with the non-empirical, theoretical data. The last chapter contains recommendations on how one might outfit a low-pressure turbine grid with regard to periodically non-stationary afflux.

DTIC

*Turbines; Fluid Flow; Wind Tunnel Tests; Rotors; Stators*

**20030003624** NASA Glenn Research Center, Cleveland, OH USA

**Sixth Microgravity Fluid Physics and Transport Phenomena Conference, Volume 1, Plenary and Sessions 1-6**

Singh, Bhim, Compiler, NASA Glenn Research Center, USA; November 2002; 1018p; In English, 14-16 Aug. 2002, Cleveland, OH, USA; Sponsored by NASA Glenn Research Center, USA; Also announced as 20030003625 through 20030003669

Contract(s)/Grant(s): RTOP 101-43-0B

Report No.(s): NASA/CP-2002-211212/VOL1; E-13064/VOL1; NAS 1.55:211212/VOL1; No Copyright; Avail: CASI; A99, Hardcopy; A10, Microfiche

The Sixth Microgravity Fluid Physics and Transport Phenomena Conference provides the scientific community the opportunity to view the current scope of the Microgravity Fluid Physics and Transport Phenomena Program, current research opportunities, and plans for the near future. The conference focuses not only on fundamental research but also on applications of this knowledge towards enabling future space exploration missions. A whole session dedicated to biological fluid physics shows increased emphasis that the program has placed on interdisciplinary research. The conference includes invited plenary talks, technical paper presentations, poster presentations, and exhibits. This CP (conference proceeding) is a compilation of the abstracts, presentations, and posters presented at the conference.

Author

*Fluid Dynamics; Fluid Flow; Microgravity; Heat Transfer; Phase Transformations; Stability; Turbulence; Transport Properties*

**20030003625** NASA, Washington, DC USA

**Physical Sciences Research Priorities and Plans in OBPR**

Trinh, Eugene, NASA, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 1-11; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents viewgraphs of physical sciences research priorities and plans at the Office of Biological and Physical Sciences Research (OBPR). The topics include: 1) Sixth Microgravity Fluid Physics and Transport Phenomena Conference; 2) Beneficial Characteristics of the Space Environment; 3) Windows of Opportunity for Research Derived from Microgravity; 4) Physical Sciences Research Program; 5) Fundamental Research: Space-based Results and Ground-based Applications; 6) Nonlinear Oscillations; and 7) Fundamental Research: Applications to Mission-Oriented Research.

CASI

*Physical Sciences; Research and Development; Microgravity; Fluid Dynamics*

**20030003626** NASA, Washington, DC USA

**NASA Research Announcement**

Chiaromonte, Fran, NASA, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 12-23; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This paper presents viewgraphs of NASA's strategic and fundamental research program at the Office of Biological and Physical Research (OBPR). The topics include: 1) Colloid-Polymer Samples; 2) Pool Boiling Experiment; 3) The Dynamics of Miscible Interfaces: A Space Flight Experiment (MIDAS); and 4) ISS and Ground-based Facilities.

CASI

*NASA Programs; Research and Development; Physical Sciences; Fluid Dynamics*

**20030003632** Princeton Univ., Dept. of Chemical Engineering, NJ USA

**Electrically Guided Assembly of Colloidal Particles**

Ristenpart, W. D., Princeton Univ., USA; Aksay, I. A., Princeton Univ., USA; Saville, D. A., Princeton Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 192-193; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche

In earlier work it was shown that the strength and frequency of an applied electric field alters the dynamic arrangement of particles on an electrode. Two-dimensional 'gas,' 'liquid' and 'solid' arrangements were formed, depending on the field strength and frequency. Since the particles are similarly charged, yet migrate over large distances under the influence of steady or oscillatory fields, it is clear that both hydrodynamic and electrical processes are involved. Here we report on an extensive study of electrically induced ordering in a parallel electrode cell. First, we discuss the kinetics of aggregation in a DC field as measured using video microscopy and digital image analysis. Rate constants were determined as a function of applied electric field strength and particle zeta potential. The kinetic parameters are compared to models based on electrohydrodynamic and electroosmotic fluid flow mechanisms. Second, using monodisperse micron-sized particles, we examined the average interparticle spacing over a wide range of applied frequencies and field strengths. Variation of these parameters allows formation of closely-spaced arrangements and ordered arrays of widely separated particles. We find that there is a strong dependence on frequency, but there is surprisingly little influence of the electric field strength past a small threshold. Last, we present experiments with binary suspensions of similarly sized particles with negative but unequal surface potentials. A long-range lateral attraction is observed in an AC field. Depending on the frequency, this attractive interaction results in a diverse set of aggregate morphologies, including superstructured hexagonal lattices. These results are discussed in terms of induced dipole-dipole interactions and electrohydrodynamic flow. Finally, we explore the implications for practical applications.

Author

*Colloids; Electric Fields; Electric Field Strength; Microparticles; Photomicrography*

**20030003633** Pennsylvania Univ., Dept. of Physics and Astronomy, Philadelphia, PA USA

**Self-Assembly of Colloidal Particles on Template Structures**

Yodh, Arjun G., Pennsylvania Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 194-210; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

I will discuss recent experiments from my lab, which use surface templates to induce ordered colloidal structures. Particle assembly driven by entropic depletion, fluid convection, and sedimentation will be described. Confocal microscopy was used to visualize most of these samples.

Author

*Colloids; Microscopy; Self Assembly; Microparticles; Rheology*

**20030003635** California Univ., Dept. of Mechanical Engineering, Santa Barbara, CA USA

### **Electrohydrodynamically Driven Chaotic Advection in Drops**

Ward, Thomas, California Univ., USA; Homsy, G. M., California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 240-241; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A01, Hardcopy; A10, Microfiche

When a liquid drop of given dielectric constant, resistivity and viscosity is translating in a liquid of different dielectric constant, resistivity and viscosity under Stokes flow conditions in the presence of an electric field, the resulting internal circulation is a superposition of the Hadamard-Rybcynski circulation and the circulation first described theoretically by G. I. Taylor. For sufficiently strong electric field strengths, the quadrupole structure of the Taylor circulation can cause an internal stagnation disk to occur. Our interest is in the situation where a modulation of the electric field causes the stagnation disk to modulate its position, potentially leading to chaotic flows within the drop. The dimensionless electric field strength is characterized by  $W = 4V(1+\lambda)/U$  where  $V$  is the maximum interfacial velocity of the Taylor circulation,  $U$  the translational velocity, and  $\lambda$  the viscosity ratio. The streamfunction for the flow is:  $1) \psi = (r(\exp 4) - r(\exp 2)) \sin(\exp 2)(\theta) + W(t) (r(\exp 3) - r(\exp 5)) \sin(\exp 2) (\theta) \cos(\theta)$   $2) W(t) = W(\text{sub } 1) + W(\text{sub } 2) \cos((\epsilon)t)$  where  $\epsilon$  is the dimensionless frequency, and  $W_1, W_2$  are the amplitudes of the DC and AC components, respectively. We have found it useful to replace these parameters by a secondary set,  $\epsilon, W(\text{sub } \max)$  and  $\delta = (1 / W(\text{sub } 1) - 1 / W(\text{sub } 2)) - (1 / W(\text{sub } 1) + 1 / W(\text{sub } 2))$ . As shown in Figure 1a,  $\delta$  is the dimensionless distance the stagnation disk moves over one period of modulation. The advection equations corresponding to the flow were integrated by standard techniques, and it was found that the trajectories were chaotic over a wide range of parameters. Experiments were conducted to test the predictions of rapid mixing on convective time scales. Drops of silicon oil were suspended in a small 60 mm x 120 mm x 120 mm test cell filled with castor oil, and subject to time-modulated axial electric fields with a wave form corresponding to eq(2). The drops were typically 5 mm in diameter and settled with typical speeds of  $O(10(\exp -1) \text{ mm/s})$ . Once formed, the drops were inoculated with small scattering particles and illuminated in an equatorial plane by an Argon-ion laser. Fields of  $O(10(\exp -1) \text{ kV/mm})$  and frequencies of  $O(10(\exp -2) \text{ Hz})$  resulted in typical values of  $W(\text{sub } \max) = 20, \epsilon = 8, \delta = 0.4$ . The resulting advection of the particles was imaged by a CCD camera, which collected images over a number of modulation periods. In order to make comparisons between these images and the corresponding theory, the trajectories of a large number of particles (typically  $O(10(\exp 4))$ ) were simulated, with initial positions approximately the same as in the experiments.

Author

*Advection; Drops (Liquids); Electrohydrodynamics; Electric Fields*

**20030003636** NASA Glenn Research Center, Cleveland, OH USA

### **The Effects of Ultra Thin Films on Dynamic Wetting**

Chen, Xia, Carnegie-Mellon Univ., USA; Garoff, Stephen, Carnegie-Mellon Univ., USA; Rame, Enrique, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 242-252; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Dynamic wetting, the displacement of one fluid by another immiscible fluid on a surface, controls many natural and technological phenomena, such as coating, printing, spray painting and lubricating. Particularly in coating and spraying applications, contact lines advance across pre-existing fluid films. Most previous work has focused on contact lines advancing across films sufficiently thick that they behave as simple Newtonian fluids. Ultrathin films, where the film thickness may impinge on fundamental length scales in the fluid, have received less attention. In this talk, we will discuss the effects of ultrathin polymer films on dynamic wetting. We measure the interface shape within microns of moving contact lines advancing across preexisting films and compare the measurements to existing models of viscous bending for interfaces advancing across dry surfaces and 'thick' (in the sense that they behave as liquids) films. In the experiments, we advance a contact line of 10-poise and 1-poise polydimethylsiloxane (silicone oil) across pre-coated films of the same fluid with thickness from a single chain thickness (approx. 10 Å) through a couple of radii of gyration (100-200 Å) to films so thick they are likely bulk in behavior ( $10(\exp 3) \text{ Å}$ ). All films are physisorbed, i.e. they readily rinse from the surface. Thus, molecules in the film are not anchored to the surface and can move within the film if the hydrodynamics dictate such motion. For films of the thickness of a single chain (approx. 10 Å), our experiments indicate that the advancing fluid behaves just as it would if it advanced over a dry surface. For the thicker films

(10(exp 3) A), we find behavior indicating that the molecules in the film are acting as a fluid with the bulk properties. In this regime, results for the two different fluids are identical when the experiments are performed at the same pre-existing film thickness and advancing capillary number,  $Ca$ . For film of thickness of a few radii of gyration (approx. 100-200 Å), the behavior depends on  $Ca$  of the advancing meniscus. At low  $Ca$ , the viscous bending of the interface near the contact line does not behave as it would on a dry surface. It has a lower curvature than expected. However, at higher  $Ca$ , the viscous bending is described by the model for spreading over a dry surface. These results show that the fluid flow in the film does behave differently than bulk as the film thickness becomes comparable to molecular length scale. But even more intriguing is the unusual velocity dependence of that behavior where the film behaves more solid-like at higher contact line speeds. We will discuss these results in terms of the properties of confined polymer melts.

Author

*Thin Films; Wetting; Methyl Polysiloxanes; Film Thickness*

**20030003637** Washington State Univ., Physics Dept., Pullman, WA USA

**Passive and Active Stabilization of Liquid Bridges in Low Gravity**

Thiessen, David B., Washington State Univ., USA; Wei, Wei, Washington State Univ., USA; Marston, Philip L., Washington State Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 253-271; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The cylindrical liquid bridge of arbitrary size surrounded by air or vacuum is a fluid configuration that is essentially unique to the zero-gravity environment. An associated technology, which is enhanced in zero gravity, is the float-zone process of crystal growth, which involves a molten liquid bridge between a feed rod and the growing cylindrical crystal. There are several advantages to the crystal growth process in using long molten zones. Unfortunately, long liquid bridges are more susceptible to g-jitter. Also, a cylindrical liquid bridge in zero gravity is unstable if its length exceeds its circumference, or stated in another way, when the slenderness, defined as the length to diameter ratio, exceeds  $\pi$ . This is the well-known Rayleigh-Plateau (RP) instability involving the growth of a varicose mode leading to breaking of the bridge. Stabilization of liquid bridges in air in the low-gravity environment of NASA's KC-135 aircraft has been demonstrated for slenderness values in excess of 4.0 using two techniques, passive acoustic stabilization (PAS) and active electrostatic stabilization (AES). The PAS method is theoretically capable of stabilizing a bridge of any length, provided a sound field of appropriate dimension is available. The AES method in its current form controls only the (2,0) mode of the bridge, which is the varicose mode that becomes unstable when the slenderness ( $S$ ) exceeds  $\pi$ . By controlling only the (2,0) mode, the current form of the AES method cannot stabilize cylindrical bridges beyond  $S=4.493$  at which point the (3,0) mode becomes unstable. At present, the longest bridge stabilized on the KC-135 by the AES method had a slenderness of 4.4 [3]. The AES method has the advantage that it can be used to control both the frequency and damping of the (2,0) mode of the bridge. This would be useful in reducing the susceptibility of a long molten zone to g-jitter in that the (2,0) mode frequency could be shifted away from a particularly noisy vibration frequency band of the spacecraft and the response further reduced by control of the damping of the mode. The principle behind the AES method is to sense the (2,0)-mode amplitude and then apply a mode-coupled feedback stress to control the mode dynamics. Two concentric ring electrodes are used to produce a Maxwell-stress distribution that couples into the (2,0) mode of the bridge. By applying a feedback stress in proportion to the (2,0)-mode amplitude with appropriate gain, the mode frequency can be raised and bridges can be stabilized beyond  $S=\pi$ . Models show that the stability is affected by the bandwidth of the controller and the (2,0)-mode damping. If the feedback stress is applied in proportion to the velocity of the mode amplitude with appropriate sign, the damping of the mode can be increased. Active control of damping has recently been demonstrated in Plateau-tank experiments. The dynamic response of a bridge to feedback control is predicted to be significantly different for bridges in air compared to those in a Plateau tank because of the different nature of the viscous damping for the two cases. Boundary-layer damping at the free interface is much more important for the case of a Plateau-tank bridge. A new fluid system is being used in the Plateau-tank facility to allow for studies of bridge dynamics and active control of damping with the AES system. The bath fluid is a high-density (1.61 g/cc), low viscosity (0.77 cS), low dielectric constant, fluorinated liquid with low water solubility. The bridge liquid is an aqueous solution of CsCl, density matched to the bath (approx. 52.3 wt% CsCl). The Ohnesorge number (ratio of viscous to inertial effects) for bridges with the new fluid system is around 0.003 which is close to that of a pure water bridge in air of the same diameter. The new system is still not dynamically similar to a bridge in air because the dynamics also depend on the density and viscosity ratios between the inner and outer fluids. Dynamics studies involve driving the (2,0) mode by modulating the electrode potentials and then cutting off modulation to allow for a free decay of the mode. Feedback can be active during the entire modulation and free-decay sequence. Results obtained with the new system show that mode damping increases in proportion to the velocity gain as expected. Also, by using negative velocity feedback, damping can be reduced to the point that the bridge spontaneously begins oscillating at the natural (2,0)-mode frequency leading to breakup of the bridge. By using both amplitude and velocity feedback, the mode frequency can be shifted upward and the damping increased. KC-135 experiments performed in 2001 concentrated on passive acoustic

stabilization. Real-time measurements of transducer power consumption and acoustic pressure were made while stabilizing a bridge. Also, progress was made on confirming the theoretical understanding of PAS by performing experiments with different bridge radii but the same acoustic wavenumber. The theory predicts optimum stabilization for a particular value of the wavenumber-radius product ( $kR$  approx. 0.86). As expected, a bridge with a  $kR$  value significantly larger than the predicted optimum could not be stabilized. Because of the limited duration and quality of low gravity, studies of bridge dynamics on the KC-135 using the AES system in the manner described above for the Plateau-tank are very difficult. Some oscillation and free-decay measurements for a bridge in air without feedback were made on the KC-135 in 2000. The measured frequency and damping of the mode agreed reasonably well with theory. Active damping of bridges in air would be investigated best on the ISS, although a demonstration on the KC-135 may be possible.

Author

*Liquid Bridges; Microgravity; Stabilization; Feedback; Modulation; Feedback Control*

**20030003640** NASA Glenn Research Center, Cleveland, OH USA

### **Shadowgraph Study of Gradient Driven Fluctuations**

Cannell, David, California Univ., USA; Nikolaenko, Gennady, California Univ., USA; Giglio, Marzio, Milan Univ., Italy; Vailati, Alberto, Milan Univ., Italy; Croccolo, Fabrizio, Milan Univ., Italy; Meyer, William, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 325-344; In English; Also announced as 20030003624

Contract(s)/Grant(s): NAG3-2439; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

A fluid or fluid mixture, subjected to a vertical temperature and/or concentration gradient in a gravitational field, exhibits greatly enhanced light scattering at small angles. This effect is caused by coupling between the vertical velocity fluctuations due to thermal energy and the vertically varying refractive index. Physically, small upward or downward moving regions will be displaced into fluid having a refractive index different from that of the moving region, thus giving rise to the enhanced scattering. The scattered intensity is predicted to vary with scattering wave vector  $q$ , as  $q^{(sup -4)}$ , for sufficiently large  $q$ , but the divergence is quenched by gravity at small  $q$ . In the absence of gravity, the long wavelength fluctuations responsible for the enhanced scattering are predicted to grow until limited by the sample dimensions. It is thus of interest to measure the mean-squared amplitude of such fluctuations in the microgravity environment for comparison with existing theory and ground based measurements. The relevant wave vectors are extremely small, making traditional low-angle light scattering difficult or impossible because of stray elastically scattered light generated by optical surfaces. An alternative technique is offered by the shadowgraph method, which is normally used to visualize fluid flows, but which can also serve as a quantitative tool to measure fluctuations. A somewhat novel shadowgraph apparatus and the necessary data analysis methods will be described. The apparatus uses a spatially coherent, but temporally incoherent, light source consisting of a super-luminescent diode coupled to a single-mode optical fiber in order to achieve extremely high spatial resolution, while avoiding effects caused by interference of light reflected from the various optical surfaces that are present when using laser sources. Results obtained for a critical mixture of aniline and cyclohexane subjected to a vertical temperature gradient will be presented. The sample was confined between two horizontal parallel sapphire plates with a vertical spacing of 1 mm. The temperatures of the sapphire plates were controlled by independent circulating water loops that used Peltier devices to add or remove heat from the room air as required. For a mixture with a temperature gradient, two effects are involved in generating the vertical refractive index gradient, namely thermal expansion and the Soret effect, which generates a concentration gradient in response to the applied temperature gradient. For the aniline/cyclohexane system, the denser component (aniline) migrates toward the colder surface. Consequently, when heating from above, both effects result in the sample density decreasing with altitude and are stabilizing in the sense that no convective motion occurs regardless of the magnitude of the applied temperature gradient. The Soret effect is strong near a binary liquid critical point, and thus the dominant effect is due to the induced concentration gradient. The results clearly show the divergence at low  $q$  and the predicted gravitational quenching. Results obtained for different applied temperature gradients at varying temperature differences from the critical temperature, clearly demonstrate the predicted divergence of the thermal diffusion ratio. Thus, the more closely the critical point is approached, the smaller becomes the temperature gradient required to generate the same signal. Two different methods have been used to generate pure concentration gradients. In the first, a sample cell was filled with a single fluid, ethylene glycol, and a denser miscible fluid, water, was added from below thus establishing a sharp interface to begin the experiment. As time went on the two fluids diffused into each other, and large amplitude fluctuations were clearly observed at low  $q$ . The effects of gravitational quenching were also evident. In the second method, the aniline/cyclohexane sample was used, and after applying a vertical temperature gradient for several hours, the top and bottom temperatures were set equal and the thermal

gradient died on a time scale of seconds, leaving the Soret induced concentration gradient in place. Again, large-scale fluctuations were observed and died away slowly in amplitude as diffusion destroyed the initial concentration gradient.

Author

*Shadowgraph Photography; Gradients; Light Scattering; Aniline; Glycols*

**20030003641** City Coll. of the City Univ. of New York, Levich Inst., NY USA

**Particle Segregation in a Flowing Suspension Subject to High-Gradient Strong Electric Fields**

Acrivos, Andreas, City Coll. of the City Univ. of New York, USA; Qiu, Zhiyong, City Coll. of the City Univ. of New York, USA; Khusid, Boris, New Jersey Inst. of Tech., USA; Markarian, Nikolai, New Jersey Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 346-369; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The widespread use of electro-hydrodynamic devices and processes emphasizes a critical need for developing a comprehensive predictive theory capable of improving our fundamental understanding of the behavior of a suspension subject to an AC electric field and shear, and of facilitating the design and optimization of such devices. The currently favored approach to the qualitative interpretation of the AC field driven manipulation of suspensions is based on a model which considers only the force exerted on a single particle by an external field and neglects the field-induced and hydrodynamic interparticle interactions both being inversely proportional to the interparticle distance raised to the power three. On the other hand, the purpose of the field-induced separation is to concentrate particles in certain regions of a device. This clearly raises the fundamental question regarding the extent to which we can neglect these slow decaying electrical and hydrodynamic collective interactions and rely on the predictions of a single-particle model. Another important issue that still remains open is how to characterize the polarization of a particle exposed to a strong electric field. The presentation will address both these questions. Experiments were conducted in a parallel-plate channel in which a  $10(\text{exp } -3)$  (v/v) suspension of heavy, positively polarized  $\text{Al}_2\text{O}_3$  spheres was exposed to an AC field under conditions such that the field lines were arranged in the channel cross-section perpendicular to the streamlines of the main flow. To reduce the effects of the gravitational settling of the particles, the channel was slowly rotated (4 rpm) around a horizontal axis. Following the application of a high-gradient strong AC field (approx. kV/mm), the particles were found to move towards both the high-voltage (HV) and grounded (GR) electrodes and to form 'bristles' along their edges.

Author

*Particles; Separation; Suspensions; Electric Fields; Gradients*

**20030003643** California Inst. of Tech., Div. of Chemistry and Chemical Engineering, Pasadena, CA USA

**Gravitational Instability in Suspension Flows**

Carpen, Ileana C., California Inst. of Tech., USA; Brady, John F., California Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 386-394; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A02, Hardcopy; A10, Microfiche

The gravity-driven flow of non-neutrally buoyant suspensions is shown to be unstable to spanwise perturbations when the shearing motion generates a density profile that increases with height. The instability is simply due to having heavier material over light. The wavelength of the perturbation is found to be on the order of the thickness of the suspension layer. The parameters important to the problem are the angle of inclination of the layer relative to gravity, the relative density difference between the particles and fluid, the ratio of the particle size to the suspension layer, and the bulk volume fraction of particles. An example showing the growth rate as a function of wave number is shown.

Author

*Gravitational Instability; Suspensions; Shearing; Perturbation*

**20030003645** Florida Univ., FL USA

**Microgravity-Driven Instabilities in Gas-Fluidized Beds**

Ladd, Anthony J. C., Florida Univ., USA; Weitz, David, Harvard Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 417-434; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

A dense pack of solid particles can be fluidized by an upward flow of liquid, which counterbalances the gravitational force on the particles. The resulting suspension is stable for sufficiently small fluid velocities, although the particle dynamics are complex and still not fully understood. A packed particle bed can also be fluidized by a gas flow, but in this case a stable suspension of moving particles cannot be produced in earth's gravitational field. Kinetic theory of gas-fluidized beds predicts that the bed is always unstable to particle inertia, which is several orders of magnitude larger than fluid inertia in this case. In order to study the onset of this particle-induced instability, the minimum fluidization velocity must be reduced by several orders of magnitude;

we believe that this can be most successfully accomplished in a reduced gravity environment. We expect that in a microgravity environment it would be possible to explore the transition between stable and unstable flow regimes in gas-fluidized beds, and contrast the behavior of particle inertia (gas-fluidized) and fluid inertia (liquid fluidized) driven instabilities. However in this preliminary study the investigations of gas-fluidized systems will be done numerically. We will compare and contrast the stability conditions and flow patterns arising from increasing fluid inertia ( $Re$  is greater than 1,  $St$  is approx.  $Re$ ) and increasing particle-inertia ( $Re$  is less than 1,  $St$  is greater than 1). Laboratory experiments on liquid-fluidized beds are being used to validate the predictions of the numerical simulations. In this talk I will summarize results from computer simulations of particles settling in a low Reynolds number regime. Experimental measurements of the velocity fluctuations in a sedimenting suspension are independent of system size for sufficiently large containers. However, this observation is at odds with theoretical and numerical predictions for a random distribution of particles. I will present new data for suspensions bounded by a rigid container, and compare them with results for homogeneous suspensions with periodic boundary conditions. Velocity fluctuations in vertically inhomogeneous suspensions are found to saturate under conditions similar to those found in laboratory experiments, while in vertically homogeneous suspensions the velocity fluctuations diverge with increasing container dimension. The strikingly different behavior in the velocity fluctuations for the different boundary conditions is caused by the interfaces between the dense pack, the homogeneous suspension, and the supernatant fluid. These interfaces are a sink for the fluctuation energy, which drains out of the system at a rate that is roughly proportional to the inverse of the cell height. Random density fluctuations convect to one of these two interfaces and are absorbed by the density gradient at the interface. A scaling argument suggests that convection of density fluctuations to the boundaries at the top and bottom of the suspension leads to a correlation length proportional to the mean interparticle spacing ( $\alpha \exp(1/3)$ ).

Author

*Fluidized Bed Processors; Gas Flow; Microgravity; Numerical Analysis; Stability; Particles*

**20030003646** Cornell Univ., Sibley School of Mechanical and Aerospace Engineering, Ithaca, NY USA

**Studies of Gas-Particle Interactions in a Microgravity Flow Cell**

Louge, Michel Y., Cornell Univ., USA; Jenkins, James, Cornell Univ., USA; Xu, Haitao, Cornell Univ., USA; Keast, Stephen, Cornell Univ., USA; Reeves, Anthony, Cornell Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 435-452; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The NASA-Glenn Research Center is designing a microgravity flow cell in which to study the interaction of a flowing gas with relatively massive particles that collide with each other and with the moving boundaries of the cell. This cell will permit us to study suspensions over a range of laminar, steady, fully developed conditions where viscous forces dominate the gas flow and inertial forces proportional to the gas density are nearly eliminated. Unlike terrestrial flows, where the gas velocity must be set to a value large enough to support the weight of particles, the duration and quality of microgravity on the International Space Station will permit us to achieve suspensions in which the agitation of the particles and the gas flow can be controlled independently by adjusting the pressure gradient along the flow and the relative motion of the boundaries. To do this, we will use an axisymmetric Couette shearing cell permitting the independent control of the speeds of the moving inner and outer boundaries. This apparatus will be configured for two experiments on gas-solid interactions.

Author

*Gas Flow; Gas-Solid Interactions; International Space Station; Microgravity; Particles*

**20030003647** New Jersey Inst. of Tech., Dept. of Mathematical Sciences and Center for Applied Mathematics, Newark, NJ USA

**Dynamics of Sheared Granular Materials**

Kondic, Lou, New Jersey Inst. of Tech., USA; Utter, Brian, Duke Univ., USA; Behringer, Robert P., Duke Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 453-475; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This work focuses on the properties of sheared granular materials near the jamming transition. The project currently involves two aspects. The first of these is an experiment that is a prototype for a planned ISS (International Space Station) flight. The second is discrete element simulations (DES) that can give insight into the behavior one might expect in a reduced-g environment. The experimental arrangement consists of an annular channel that contains the granular material. One surface, say the upper surface, rotates so as to shear the material contained in the annulus. The lower surface controls the mean density/mean stress on the sample through an actuator or other control system. A novel feature under development is the ability to 'thermalize' the layer, i.e. create a larger amount of random motion in the material, by using the actuating system to provide vibrations as well control the mean volume of the annulus. The stress states of the system are determined by transducers on the non-rotating wall. These measure both shear and normal components of the stress on different size scales. Here, the idea is to characterize the system as the density varies

through values spanning dense almost solid to relatively mobile granular states. This transition regime encompasses the regime usually thought of as the glass transition, and/or the jamming transition. Motivation for this experiment springs from ideas of a granular glass transition, a related jamming transition, and from recent experiments. In particular, we note recent experiments carried out by our group to characterize this type of transition and also to demonstrate/ characterize fluctuations in slowly sheared systems. These experiments give key insights into what one might expect in near-zero g. In particular, they show that the compressibility of granular systems diverges at a transition or critical point. It is this divergence, coupled to gravity, that makes it extremely difficult if not impossible to characterize the transition region in an earth-bound experiment. In the DE modeling, we analyze dynamics of a sheared granular system in Couette geometry in two (2D) and three (3D) space dimensions. Here, the idea is to both better understand what we might encounter in a reduced-g environment, and at a deeper level to deduce the physics of sheared systems in a density regime that has not been addressed by past experiments or simulations. One aspect of the simulations addresses sheared 2D system in zero-g environment. For low volume fractions, the expected dynamics of this type of system is relatively well understood. However, as the volume fraction is increased, the system undergoes a phase transition, as explained above. The DES concentrate on the evolution of the system as the solid volume fraction is slowly increased, and in particular on the behavior of very dense systems. For these configurations, the simulations show that polydispersity of the sheared particles is a crucial factor that determines the system response. Figures 1 and 2 below, that present the total force on each grain, show that even relatively small (10 %) nonuniformity of the size of the grains (expected in typical experiments) may lead to significant modifications of the system properties, such as velocity profiles, temperature, force propagation, and formation shear bands. The simulations are extended in a few other directions, in order to provide additional insight to the experimental system analyzed above. In one direction, both gravity, and driving due to vibrations are included. These simulations allow for predictions on the driving regime that is required in the experiments in order to analyze the jamming transition. Furthermore, direct comparison of experiments and DES will allow for verification of the modeling assumptions. We have also extended our modeling efforts to 3D. The (preliminary) results of these simulations of an annular system in zero-g environment will conclude the presentation.

Author

*Granular Materials; Simulation; Shear Properties; Microgravity; Phase Transformations*

**20030003649** Stanford Univ., Dept. of Mechanical Engineering, Stanford, CA USA

**Measurements of Turbulence Attenuation by a Dilute Dispersion of Solid Particles in Homogeneous Isotropic Turbulence**  
Eaton, John, Stanford Univ., USA; Hwang, Wontae, Stanford Univ., USA; Cabral, Patrick, Stanford Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 515-528; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

This research addresses turbulent gas flows laden with fine solid particles at sufficiently large mass loading that strong two-way coupling occurs. by two-way coupling we mean that the particle motion is governed largely by the flow, while the particles affect the gas-phase mean flow and the turbulence properties. Our main interest is in understanding how the particles affect the turbulence. Computational techniques have been developed which can accurately predict flows carrying particles that are much smaller than the smallest scales of turbulence. Also, advanced computational techniques and burgeoning computer resources make it feasible to fully resolve very large particles moving through turbulent flows. However, flows with particle diameters of the same order as the Kolmogorov scale of the turbulence are notoriously difficult to predict. Some simple flows show strong turbulence attenuation with reductions in the turbulent kinetic energy by up to a factor of five. On the other hand, some seemingly similar flows show almost no modification. No model has been proposed that allows prediction of when the strong attenuation will occur. Unfortunately, many technological and natural two-phase flows fall into this regime, so there is a strong need for new physical understanding and modeling capability. Our objective is to study the simplest possible turbulent particle-laden flow, namely homogeneous, isotropic turbulence with a uniform dispersion of monodisperse particles. We chose such a simple flow for two reasons. First, the simplicity allows us to probe the interaction in more detail and offers analytical simplicity in interpreting the results. Secondly, this flow can be addressed by numerical simulation, and many research groups are already working on calculating the flow. Our detailed data can help guide some of these efforts. by using microgravity, we can further simplify the flow to the case of no mean velocity for either the turbulence or the particles. In fact the addition of gravity as a variable parameter may help us to better understand the physics of turbulence attenuation. The experiments are conducted in a turbulence chamber capable of producing stationary or decaying isotropic turbulence with nearly zero mean flow and Taylor microscale Reynolds numbers up to nearly 500. The chamber is a 410 mm cubic box with the corners cut off to make it approximately spherical. Synthetic jet turbulence generators are mounted in each of the eight corners of the box. Each generator consists of a loudspeaker forcing a plenum and producing a pulsed jet through a 20 mm diameter orifice. These synthetic jets are directed into ejector tubes pointing towards the chamber center. The ejector tubes increase the jet mass flow and decrease the velocity. The jets then pass through a turbulence grid. Each of the eight loudspeakers is forced with a random phase and frequency.

The resulting turbulence is highly Isotropic and matches typical behavior of grid turbulence. Measurements of both phases are acquired using particle image velocimetry (PIV). The gas is seeded with approximately 1 micron diameter seeding particles while the solid phase is typically 150 micron diameter spherical glass particles. A double-pulsed YAG laser and a Kodak ES-1.0 10-bit PIV camera provide the PIV images. Custom software is used to separate the images into individual images containing either gas-phase tracers or large particles. Modern high-resolution PIV algorithms are then used to calculate the velocity field. A large set of image pairs are acquired for each case, then the results are averaged both spatially and over the ensemble of acquired images. The entire apparatus is mounted in two racks which are carried aboard NASA's KC-135 Flying Microgravity Laboratory. The rack containing the turbulence chamber, the laser head, and the camera floats freely in the airplane cabin (constrained by competent NASA personnel) to minimize g-jitter.

Author

*Particle Image Velocimetry; Turbulent Flow; Gas Flow; Particles; Isotropic Turbulence; Dispersions*

**20030003650** NASA Glenn Research Center, Cleveland, OH USA

**A Mechanistic Study of Nucleate Boiling Under Microgravity Conditions**

Dhir, V. K., California Univ., USA; Warriar, G. R., California Univ., USA; Hasan, M. M., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 529-552; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The overall objective of this work is to study nucleate boiling heat transfer under microgravity conditions in such a way that while providing basic knowledge of the phenomena, it also leads to development of simulation models and correlations that can be used as design tools for a wide range of gravity levels. In the study a building block type of approach is used and both pool and low velocity flow boiling are investigated. Starting with experiments using a single bubble, the complexity of the experiments is increased to two or three inline bubbles, to five bubbles placed on a two-dimensional grid. Finally, experiments are conducted where a large number of prescribed cavities nucleate on the heater and when a commercial surface is used. So far experiments have been conducted at earth normal gravity and in the reduced gravity environment of the KC-135 aircraft whereas experiments on the space station are planned. Modeling/complete numerical simulation of the boiling process is an integral part of the total effort. Experiments conducted with single bubbles formed on a nucleation site microfabricated on a polished silicon wafer show that for gravity levels ( $g$ ) varying from  $1.5g(\text{sub } e)$  to  $0.01g(\text{sub } e)$ , the bubble diameter at departure varies approximately as  $(g(\text{sub } e)/g)(\text{exp } 1/2)$  and the growth period as  $(g(\text{sub } e)/g)$ . When bubbles merge either inline or in a plane, the bubble diameter at departure is found to be smaller than that obtained for a single bubble and shows a weaker dependence on the level of gravity. The possible reason is that as the bubbles merge they create fluid circulation around the bubbles, which in turn induces a lift force that is responsible for the earlier departure of the bubbles. The verification of this proposition is being sought through numerical simulations. There is a merger of two inline, three inline, and several bubbles in a plane in the low gravity environment of the KC-135 aircraft. After merger and before departure, a mushroom type of bubble with several stems attached to the heater surface is clearly evident. Local heat fluxes during growth and departure of a single bubble were also measured. It was found that during most of the growth period of the bubble, generally the wall heat flux decreased with time because of the increased dry area under the bubble. However, the heat flux increased rapidly just prior to departure of the bubble because of the transient conduction into the cold liquid rushing to fill the space vacated by the bubble as the bubble base shrinks. The measured heat fluxes at various radial locations are found to be in qualitative agreement with the numerical predictions. Single bubble studies at earth normal gravity have also been performed on surfaces oriented at different angles to the gravitational acceleration with flow parallel to the surface. It is found that in all cases the bubbles slide along the surface before lift-off from the surface. The lift force generated as a result of the relative motion between the sliding bubbles and the imposed flow is found to play an important role when the normal force due to buoyancy is reduced. An experimental apparatus for the study of the bubble behavior with imposed flow under reduced gravity conditions has been developed and will soon be employed for experiments in the KC-135 aircraft.

Author

*Bubbles; Heat Flux; Heat Transfer; Microgravity; Nucleate Boiling*

**20030003651** NASA Glenn Research Center, Cleveland, OH USA

**Investigation of Body Force Effects on Flow Boiling Critical Heat Flux**

Zhang, Hui, Purdue Univ., USA; Mudawar, Issam, Purdue Univ., USA; Hasan, Mohammad M., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 553-578; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The bubble coalescence and interfacial instabilities that are important to modeling critical heat flux (CHF) in reduced-gravity systems can be sensitive to even minute body forces. Understanding these complex phenomena is vital to the design and safe implementation of two-phase thermal management loops proposed for space and planetary-based thermal systems. While reduced

gravity conditions cannot be accurately simulated in 1g ground-based experiments, such experiments can help isolate the effects of the various forces (body force, surface tension force and inertia) which influence flow boiling CHF. In this project, the effects of the component of body force perpendicular to a heated wall were examined by conducting 1g flow boiling experiments at different orientations. FC-72 liquid was boiled along one wall of a transparent rectangular flow channel that permitted photographic study of the vapor-liquid interface at conditions approaching CHF. High-speed video imaging was employed to capture dominant CHF mechanisms. Six different CHF regimes were identified: Wavy Vapor Layer, Pool Boiling, Stratification, Vapor Counterflow, Vapor Stagnation, and Separated Concurrent Vapor Flow. CHF showed great sensitivity to orientation for flow velocities below 0.2 m/s, where very small CHF values were measured, especially with downflow and downward-facing heated wall orientations. High flow velocities dampened the effects of orientation considerably. Figure I shows representative images for the different CHF regimes. The Wavy Vapor Layer regime was dominant for all high velocities and most orientations, while all other regimes were encountered at low velocities, in the downflow and/or downward-facing heated wall orientations. The Interfacial Lift-off model was modified to predict the effects of orientation on CHF for the dominant Wavy Vapor Layer regime. The photographic study captured a fairly continuous wavy vapor layer travelling along the heated wall while permitting liquid contact only in wetting fronts, located in the troughs of the interfacial waves. CHF commenced when wetting fronts near the outlet were lifted off the wall. The Interfacial Lift-off model is shown to be an effective tool for predicting the effects of body force on CHF at high velocities.

Author

*Boiling; Flow Velocity; Heat Flux; Vapors; Bubbles; Gravitational Effects*

**20030003652** NASA Glenn Research Center, Cleveland, OH USA

**Length Scale and Gravity Effects on Microgravity Boiling Heat Transfer**

Kim, Jungho, Maryland Univ., USA; McQuillen, John, NASA Glenn Research Center, USA; Balombin, Joe, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 579-605; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Boiling is a complex phenomenon where hydrodynamics, heat transfer, mass transfer, and interfacial phenomena are tightly interwoven. An understanding of boiling and critical heat flux in microgravity environments is of importance to space based hardware and processes such as heat exchange, cryogenic fuel storage and transportation, electronic cooling, and material processing due to the large amounts of heat that can be removed with relatively little increase in temperature. Although research in this area has been performed in the past four decades, the mechanisms by which heat is removed from surfaces in microgravity are still unclear. In earth gravity, buoyancy is an important parameter that affects boiling heat transfer through the rate at which bubbles are removed from the surface. A simple model describing the bubble departure size based on a quasistatic force balance between buoyancy and surface tension is given by the Fritz [I] relation:  $Bo(\exp 1/2) = 0.0208 \theta$  where  $Bo$  is the ratio between buoyancy and surface tension forces. For small, rapidly growing bubbles, inertia associated with the induced liquid motion can also cause bubble departure. In microgravity, the magnitude of effects related to natural convection and buoyancy are small and physical mechanisms normally masked by natural convection in earth gravity such as Marangoni convection can substantially influence the boiling and vapor bubble dynamics. CHF (critical heat transfer) is also substantially affected by microgravity. In 1 g environments,  $Bo$  has been used as a correlating parameter for CHF. Zuber's CHF model for an infinite horizontal surface assumes that vapor columns formed by the merger of bubbles become unstable due to a Helmholtz instability blocking the supply of liquid to the surface. The jets are spaced  $\lambda(\text{sub } D)$  apart, where  $\lambda(\text{sub } D) = 2\pi \sqrt{3[(\sigma)/(\rho(\text{sub } l) - \rho(\text{sub } v))(\exp 1/2)]} = 2\pi \sqrt{3 L Bo(\exp -1/2)}$  and is the wavelength that amplifies most rapidly. The critical wavelength,  $\lambda(\text{sub } c)$ , is the wavelength below which a vapor layer underneath a liquid layer is stable. For heaters with  $Bo$  smaller than about 3 (heaters smaller than  $\lambda(\text{sub } D)$ ), the above model is not applicable, and surface tension effects dominate. Bubble coalescence is thought to be the mechanism for CHF under these conditions. Small  $Bo$  can result by decreasing the size of a heater in earth gravity, or by operating a large heater in a lower gravity environment. In the microgravity of space, even large heaters can have low  $Bo$ , and models based on Helmholtz instability should not be applicable. The macrolayer model of Haramura and Katto is dimensionally equivalent to Zuber's model and has the same dependence on gravity, so it should not be applicable as well. The goal of this work is to determine how boiling heat transfer mechanisms in a low-g environment are altered from those at higher gravity levels. Boiling data using a microheater array was obtained under gravity environments ranging from 1.8 g to 0.02 g with heater sizes ranging from 2.7 mm to 1 mm. The boiling behavior for 2.7 mm at 0.02 g looked quite similar to boiling on the 1 mm heater at 1 g—the formation of a large primary bubble surrounded by smaller satellite bubbles was observed under both conditions. The similarity suggests that for heaters smaller than some fraction

of I(sub c), coalescence and surface tension dominate boiling heat transfer. It also suggests that microgravity boiling can be studied by studying boiling on very small heaters.

Author

*Boiling; Bubbles; Buoyancy; Coalescing; Heat Transfer; Microgravity; Interfacial Tension*

**20030003653** Rensselaer Polytechnic Inst., Dept. of Chemical Engineering, Troy, NY USA

### **Constrained Vapor Bubble Experiment**

Gokhale, Shripad, Rensselaer Polytechnic Inst., USA; Plawsky, Joel, Rensselaer Polytechnic Inst., USA; Wayner, Peter C., Jr., Rensselaer Polytechnic Inst., USA; Zheng, Ling, Rensselaer Polytechnic Inst., USA; Wang, Ying-Xi, Rensselaer Polytechnic Inst., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 606-619; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Microgravity experiments on the Constrained Vapor Bubble Heat Exchanger, CVB, are being developed for the International Space Station. In particular, we present results of a precursory experimental and theoretical study of the vertical Constrained Vapor Bubble in the Earth's environment. A novel non-isothermal experimental setup was designed and built to study the transport processes in an ethanol/quartz vertical CVB system. Temperature profiles were measured using an in situ PC (personal computer)-based LabView data acquisition system via thermocouples. Film thickness profiles were measured using interferometry. A theoretical model was developed to predict the curvature profile of the stable film in the evaporator. The concept of the total amount of evaporation, which can be obtained directly by integrating the experimental temperature profile, was introduced. Experimentally measured curvature profiles are in good agreement with modeling results. For microgravity conditions, an analytical expression, which reveals an inherent relation between temperature and curvature profiles, was derived.

Author

*Bubbles; Microgravity; Vapors; Spaceborne Experiments*

**20030003662** NASA Glenn Research Center, Cleveland, OH USA

### **Containerless Ripple Turbulence**

Putterman, Seth, California Univ., USA; Wright, William, California Univ., USA; Duval, Walter, NASA Glenn Research Center, USA; Panzarella, Charles, NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 832-854; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

One of the longest standing unsolved problems in physics relates to the behavior of fluids that are driven far from equilibrium such as occurs when they become turbulent due to fast flow through a grid or tidal motions. In turbulent flows the distribution of vortex energy as a function of the inverse length scale [or wavenumber 'k'] of motion is proportional to  $1/k^{5/3}$  which is the celebrated law of Kolmogorov. Although this law gives a good description of the average motion, fluctuations around the average are huge. This stands in contrast with thermally activated motion where large fluctuations around thermal equilibrium are highly unfavorable. The problem of turbulence is the problem of understanding why large fluctuations are so prevalent which is also called the problem of 'intermittency'. Turbulence is a remarkable problem in that its solution sits simultaneously at the forefront of physics, mathematics, engineering and computer science. A recent conference [March 2002] on 'Statistical Hydrodynamics' organized by the Los Alamos Laboratory Center for Nonlinear Studies brought together researchers in all of these fields. Although turbulence is generally thought to be described by the Navier-Stokes Equations of fluid mechanics the solution as well as its existence has eluded researchers for over 100 years. In fact proof of the existence of such a solution qualifies for a 1 M\$ millennium prize. As part of our NASA funded research we have proposed building a bridge between vortex turbulence and wave turbulence. The latter occurs when high amplitude waves of various wavelengths are allowed to mutually interact in a fluid. In particular we have proposed measuring the interaction of ripples [capillary waves] that run around on the surface of a fluid sphere suspended in a microgravity environment. The problem of ripple turbulence poses similar mathematical challenges to the problem of vortex turbulence. The waves can have a high amplitude and a strong nonlinear interaction. Furthermore, the steady state distribution of energy again follows a Kolmogorov scaling law; in this case the ripple energy is distributed according to  $1/k^{7/4}$ . Again, in parallel with vortex turbulence ripple turbulence exhibits intermittency. The problem of ripple turbulence presents an experimental opportunity to generate data in a controlled, benchmarked system. In particular the surface of a sphere is an ideal environment to study ripple turbulence. Waves run around the sphere and interact with each other, and the effect of walls is eliminated. In microgravity this state can be realized for over 2 decades of frequency. Wave turbulence is a physically relevant problem in its own right. It has been studied on the surface of liquid hydrogen and its application to Alfvén waves in space is a source of debate. of course, application of wave turbulence perspectives to ocean waves has been a major success. The experiment which we plan to run in microgravity is conceptually straightforward. Ripples are excited on the surface of a spherical drop of fluid and then their amplitude is recorded with appropriate photography. A key challenge is posed by the

need to stably position a 10cm diameter sphere of water in microgravity. Two methods are being developed. Orbitec is using controlled puffs of air from at least 6 independent directions to provide the positioning force. This approach has actually succeeded to position and stabilize a 4cm sphere during a KC 135 segment. Guigne International is using the radiation pressure of high frequency sound. These transducers have been organized into a device in the shape of a dodecahedron. This apparatus 'SPACE DRUMS' has already been approved for use for combustion synthesis experiments on the International Space Station. A key opportunity presented by the ripple turbulence data is its use in driving the development of codes to simulate its properties.

Author

*Turbulence; Turbulent Flow; Spheres; Ripples; Vortices; Fluid Dynamics; Thermodynamic Equilibrium; Wave Excitation*

**20030003663** New Orleans Univ., Dept. of Physics, LA USA

**Phase Separation, Density Fluctuations, and Boiling Near the Liquid-Gas Critical Point**

Hegseth, John, New Orleans Univ., USA; Oprisan, Ana, New Orleans Univ., USA; Roy, Arun, New Orleans Univ., USA; Nikolayev, Vadim, Bordeaux Univ., France; Beysens, Daniel, Bordeaux Univ., France; Garrabos, Yves, Bordeaux Univ., France; Lecoutre-Chabot, Carole, Bordeaux Univ., France; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 855-895; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

A pure liquid-gas mixture is one of the simplest examples of a soft-matter system. In fact, when co-existing gas and liquid phases of pure fluid are heated to their critical point, large-scale density fluctuations make the fluid extremely compressible (to external forces), expandable (to heating), slows the diffusive transport, and decreases the surface tension. In principle these properties and others either diverge to infinity or converge to zero at the critical temperature. These properties lead to some very unusual behavior: large density gradients at the laboratory scale, a large mechanical response to heating, and perfect wetting of a solid wall by the liquid phase (zero contact-angle). We have further simplified this system by performing experiments in weightlessness (Mir spaces station). by controlling the fluid's temperature, these properties may be varied over large ranges in a single sample. When the fluid is driven out of equilibrium by a fast temperature quench from the single-phase (supercritical fluid) state into the two-phase state, we have observed universal growth laws of minority domains (gas bubbles) during phase separation. Prior to this quench we have also observed density fluctuations using optical microscopy near the critical point. When heat is applied to a liquid-gas mixture, we have observed a spectacular spreading of a gas bubble along a hot solid wall as well as gas bubble over-heating (where the interior of a gas bubble gains a higher temperature than the heating wall). Although this gas phase over-heating appears to violate the second law, it is really a transient out-of-equilibrium effect. Inside of these unusual bubbles we also have observed unusually large variations in liquid wetting film thickness that often appear to evolve into spreading contact lines on the sapphire wall when heat is applied. We have observed coarsening and growth of minority domains (gas bubbles) in SF6 near its liquid-gas critical point. Phase separation in our constant density samples was induced in our constant volume cells by temperature quenches in weightless conditions (Mir station), while visualizing density fluctuations and domain growth using optical microscopy. The optics of the formation of the density fluctuation images will be discussed. The well-known statistics of the density fluctuations provide natural space and time scales for domain growth. Previous experiments have documented two morphologies and two associated growth laws with a sharp transition between the two. This transition appears to be controlled by the minority volume fraction. While the slow,  $t^{(sup) 1/3}$  growth, for disconnected morphologies, is understood as a diffusion process, the fast growth,  $t^{(sup) 1}$  growth, for connected domains, is less well-understood. We will discuss several shallow quenching sequences at the critical density ( $\pm 0.02\%$ ) and slightly off-critical where we have observed fast linear growth.

Author

*Liquid-Gas Mixtures; Critical Temperature; Fluid Dynamics; Weightlessness; Equilibrium Flow; Phase Separation (Materials); Phase Transformations; Flux Density; Bubbles*

**20030003664** Colorado Univ., USA

**Stratified Taylor-Couette Flow with Radial Gravity**

Hart, John, Colorado Univ., USA; Ohlsen, Dan, Colorado Univ., USA; Tagg, Randall P., Colorado Univ., USA; Weidman, Patrick D., Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 896-918; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

An experiment to study stratified Taylor-Couette flow with radial, or cross-stream, gravity is being developed. The experiment uses ferromagnetic fluid (ferrofluid) and a unique stacked-magnet configuration to generate a strong (3 to 10 g) radial gravity field. In the microgravity environment this experiment will permit laboratory study of a wide range of stability, transitional, and turbulent flow problems in a simple re-entrant geometry. Important fundamental situations that can be implemented include thermal convection in a 'vertical' shear flow, stably stratified shear flows, and stably or unstably stratified centrifugal (spiral) instabilities. The linear stability problem for an axially and azimuthally invariant mean flow consisting of the

exact analytically determined fields  $V=[0,V(\text{sub } m)(r),W(\text{sub } m)(r)]$ ,  $T=T(\text{sub } m)(r)$  has been solved numerically for the terrestrial case with both  $g(\text{sub } e)$  and  $g(\text{sub } m)(r)$  present, and for the microgravity case where  $g(\text{sub } e)$  is negligible. Modifications to the usual Taylor-Couette modes are found, along with new disturbance modes arising from the radial magnetic gravity. In order to carry out meaningful experiments with this system, an effective visualization method for the opaque ferrofluid is required. Ultrasonic Doppler Velocimetry (UDV) has been used to measure the velocity distributions in ferrofluid for a simple mechanically forced un-heated configuration. The experimental results are in good agreement with direct numerical simulations of the axisymmetric (2D) steady flow, suggesting that UDV is a very promising tool for studying circulations in this medium. Other issues, such as determining the significance of non-Newtonian fluid effects, and predicting the nature of motions driven directly by magnet field imperfections (in height), have been studied theoretically, and will be summarized as time permits.

Author

*Microgravity; Magnetohydrodynamics; Velocity Distribution; Ferrofluids; Magnets; Gravitational Fields; Turbulent Flow; Couette Flow; Phase Transformations*

**20030003665** NASA Glenn Research Center, Cleveland, OH USA

### **An Experimental Investigation of Incompressible Richtmyer-Meshkov Instability**

Jacobs, J. W., Arizona Univ., USA; Niederhaus, C. E., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 919-937; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Richtmyer-Meshkov (RM) instability occurs when two different density fluids are impulsively accelerated in the direction normal to their nearly planar interface. The instability causes small perturbations on the interface to grow and eventually become a turbulent flow. It is closely related to Rayleigh-Taylor instability, which is the instability of a planar interface undergoing constant acceleration, such as caused by the suspension of a heavy fluid over a lighter one in the earth's gravitational field. Like the well-known Kelvin-Helmholtz instability, RM instability is a fundamental hydrodynamic instability which exhibits many of the nonlinear complexities that transform simple initial conditions into a complex turbulent flow. Furthermore, the simplicity of RM instability (in that it requires very few defining parameters), and the fact that it can be generated in a closed container, makes it an excellent test bed to study nonlinear stability theory as well as turbulent transport in a heterogeneous system. However, the fact that RM instability involves fluids of unequal densities which experience negligible gravitational force, except during the impulsive acceleration, requires RM instability experiments to be carried out under conditions of microgravity. This experimental study investigates the instability of an interface between incompressible, miscible liquids with an initial sinusoidal perturbation. The impulsive acceleration is generated by bouncing a rectangular tank containing two different density liquids off a retractable vertical spring. The initial perturbation is produced prior to release by oscillating the tank in the horizontal direction to produce a standing wave. The instability evolves in microgravity as the tank travels up and then down the vertical rails of a drop tower until hitting a shock absorber at the bottom. Planar Laser Induced Fluorescence (PLIF) is employed to visualize the flow. PLIF images are captured by a video camera that travels with the tank. Figure 1 is a sequence of images showing the development of the instability from the initial sinusoidal disturbance far into the nonlinear regime which is characterized by the appearance of mushroom structures resulting from the coalescence of baroclinic vorticity produced by the impulsive acceleration. At later times in this sequence the vortex cores are observed to become unstable showing the beginnings of the transition to turbulence in this flow. The amplitude of the growing disturbance after the impulsive acceleration is measured and found to agree well with theoretical predictions. The effects of Reynolds number (based on circulation) on the development of the vortices and the transition to turbulence are also determined.

Author

*Fluid Dynamics; Flow Stability; Turbulent Flow; Nonlinearity; Microgravity; Numerical Analysis; Differential Equations; Vortices*

**20030003666** Florida Univ., Dept. of Chemical Engineering, FL USA

### **The Use of Pulsatile Flow to Separate Species**

Narayanan, R., Florida Univ., USA; Thomas, Aaron M., Idaho Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 938-963; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The removal of carbon dioxide from air is important in producing a habitable environment for the self-supporting space stations of the space program. Pulsatile flow is a novel way to help in the partial separation of different species from air by using a purely mechanical method. The advantage of this is that no chemicals are needed. Pulsatile flow also has the advantage that it can handle large volumes. While it is not expected that this process will replace existing methods of separation, it can surely be used as a means to assist in the overall separation process, possibly as a precursor to conventional methods. This work specifically

focuses on the physics of pulsatile flow and its effect on the mass transfer of species and the separation that can be achieved. From the theoretical model that predicts the mass transfer and separation of species, we provide a physical explanation of the phenomena predicted by the models. If two dilute species are present in a carrier, the mass transfer of the faster diffusing species may be higher, lower, or the same as the slow diffusing species. This depends on the time constants associated with the system and the ability of a species to remain in the fast moving portion of the flow field. The difference in the mass transfer of each species can lead to a separation that can be used in a number of processes including the removal of carbon dioxide from the air. This phenomenon is modeled in an open tube geometry and in the annular space between two concentric cylinders. Further, in annular pulsatile flow, the effect of the inner cylinder being off center from the outer cylinder on the mass transfer and separation is also analyzed. Experiments were also conducted to verify the validity of the models and the viability of pulsatile flows as a separations procedure.

Author

*Gas-Gas Interactions; Carbon Dioxide; Carbon Dioxide Removal; Flow Distribution; Gas Flow; Gas Dynamics; Gaseous Diffusion*

**20030003667** Georgia Inst. of Tech., G. Woodruff School of Mechanical Engineering, Atlanta, GA USA

**Particle Proximity Sensors: A Novel Technique for Visualizing Particle Deposition in Suspension Flows**

Yoda, M., Georgia Inst. of Tech., USA; Bailey, B. C., Georgia Inst. of Tech., USA; Andresen, U. C., Georgia Inst. of Tech., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 964-981; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Efficient fluid reclamation is a critical technology for manned space exploration. Centrifugal filtration, where non-colloidal particles are deposited on filter fibers due to inertial impaction or direct interception, is a promising candidate for mechanical separation in variable gravity environments. Understanding how fluid inertia characterized by shear-based Reynolds number affects deposition is therefore critical in designing fluid reclamation systems for microgravity environments. This work will develop 'particle proximity sensors,' or non-intrusive optical diagnostic techniques for directly visualizing where and when non-colloidal particles deposit upon, or contact, solid surfaces. Essentially, any particle near the surface will scatter light at a different wavelength from that scattered by particles in the bulk suspension. The particles next to the surface can then be easily isolated using a wavelength filter. The technique exploits the pH sensitivity of fluorophores and uses an applied electric potential to create a pH gradient next to the surface of interest. The particle proximity sensors require aqueous chemistries. We have therefore developed and characterized a new aqueous model suspension system of polymethyl methacrylate (PMMA) particles suspended in a ternary mixture of the salt ammonium thiocyanate (NH<sub>4</sub>SCN), water and 3 glycerin. The model suspension has a refractive index  $n=1.4867$ , a density  $\rho=1.19$  g/cu cm, a viscosity  $\mu=4.99$  cP at 22C-giving a kinematic viscous four times that of water-and a pH of 4.5. Transmission measurements using both polydisperse and nearly monodisperse PMMA particles (diameters ranging from 106-212 micron and 75-90 micron, respectively) show that a 5% volume fraction suspension has an optical transmission through 1 cm of suspension that is 80% of that for the same solution without particles at 22.5C when illuminated at 488 and 514.5 nm. The optical transmission of this suspension is comparable to that of a suspension system used by 2 other researchers for laser-Doppler velocimetry studies. This aqueous system is less hazardous than previous model systems based on organic solvents and halogenated hydrocarbons. It is, with its relatively low viscosity, also useful for higher Reynolds number studies, including turbulent suspension flows.

Author

*Fluid Management; Microgravity; Fluid Flow; Deposition; Flow Visualization; Fluid Dynamics; Materials Recovery*

**20030003668** Arizona Univ., Aerospace and Mechanical Engineering Dept., Tucson, AZ USA

**Effects of Gravity Modulation on the Convective Instabilities of a Horizontal Double-Diffusive Layer**

Chen, Wen-Yau, Arizona Univ., USA; Chan, Cho Lik, Arizona Univ., USA; Chen, C. F., Arizona Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 982-1004; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Linear stability analysis of a horizontal double-diffusive layer under gravity modulation is performed. The steady part of the gravity is in the vertical direction while the oscillating part of the gravity is arbitrary. In the absence of gravity modulation, two modes of instabilities are possible, they are steady finger and oscillatory diffusive modes. The gravity modulation excites synchronous and quasi-periodic modes in the case of steady finger convection. In the oscillatory diffusive case, synchronous, quasi-periodic and subharmonic modes are found.

Author

*Fluid Dynamics; Fluid Flow; Gravitational Instability; Microgravity; Numerical Analysis; Velocity Modulation; Flow Equations*

**20030003714** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**A Deuterium NMR Study of Bent-Core Liquid Crystals, 1, Synthesis and Characterization of Deuterium-Labeled Oxadiazole-Containing Liquid Crystals Final Report**

Dingemans, Theo J., Institute for Computer Applications in Science and Engineering, USA; Madsen, Louis A., North Carolina Univ., USA; Samulski, Edward T., North Carolina Univ., USA; October 2002; 18p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211946; NAS 1.26:211946; ICASE-2002-37; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

We have synthesized two deuterated boomerang-shaped liquid crystals based on 2,5-bis(4-hydroxyphenyl)-1,3,4-oxadiazole (ODBP). Deuterium was introduced in the rigid 2,5-diphenyl-1,3,4-oxadiazole core and in the aromatic ring of the terminal 4-dodecyloxyphenyl moiety using standard acid catalyzed deuterium exchange conditions. Both compounds, ([4,4'(1,3,4-oxadiazole-2,5-diyl-d4)] di-4-dodecyloxybenzoate: ODBP-d4-Ph-O-C12) and ([4,4'(1,3,4-oxadiazole-2,5-diyl)] di-4-dodecyloxy-benzoate-d4; ODBP-Ph-d4-O-C12) were investigated by nuclear magnetic resonance, optical microscopy and differential scanning calorimetry. The optical textures and thermal behavior of both compounds were found to be identical to the non-deuterated analog [4,4'(1,3,4-oxadiazole-2,5-diyl)] di-4-dodecyloxybenzoate (ODBP-Ph-O-C12) which we reported earlier. These compounds exhibit behavior indicative of a biaxial nematic liquid crystal phase, which we hope to confirm using deuterium NMR spectroscopy in the next phase of this study.

Author

*Liquid Crystals; Oxazole; Deuterium Compounds; Diphenyl Compounds; Benzoic Acid; Nuclear Magnetic Resonance*

**20030003725** NASA Glenn Research Center, Cleveland, OH USA

**A Parametric Study of Fine-Scale Turbulence Mixing Noise**

Khavaran, Abbas, QSS Group, Inc., USA; Bridges, James, NASA Glenn Research Center, USA; Freund, Jonathan B., Illinois Univ. at Urbana-Champaign, USA; July 2002; 21p; In English; Eighth Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-90-43

Report No.(s): NASA/TM-2002-211696; E-13428; NAS 1.15:211696; AIAA Paper 2002-2419; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The present paper is a study of aerodynamic noise spectra from model functions that describe the source. The study is motivated by the need to improve the spectral shape of the MGBK jet noise prediction methodology at high frequency. The predicted spectral shape usually appears less broadband than measurements and faster decaying at high frequency. Theoretical representation of the source is based on Lilley's equation. Numerical simulations of high-speed subsonic jets as well as some recent turbulence measurements reveal a number of interesting statistical properties of turbulence correlation functions that may have a bearing on radiated noise. These studies indicate that an exponential spatial function may be a more appropriate representation of a two-point correlation compared to its Gaussian counterpart. The effect of source non-compactness on spectral shape is discussed. It is shown that source non-compactness could well be the differentiating factor between the Gaussian and exponential model functions. In particular, the fall-off of the noise spectra at high frequency is studied and it is shown that a non-compact source with an exponential model function results in a broader spectrum and better agreement with data. An alternate source model that represents the source as a covariance of the convective derivative of fine-scale turbulence kinetic energy is also examined.

Author

*Aerodynamic Noise; Covariance; Exponential Functions; Flow Measurement; Gas Jets; Noise Spectra; Noise Prediction; Mathematical Models; Turbulence*

**20030003836** NASA Langley Research Center, Hampton, VA USA

**Wall-Pressure-Array Measurements Beneath a Separating/Reattaching Flow Region**

Hudy, Laura M., Michigan State Univ., USA; Naguib, Ahmed M., Michigan State Univ., USA; Humphreys, William M., Jr., NASA Langley Research Center, USA; Bartram, Scott M., NASA Langley Research Center, USA; [2002]; 13p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0579; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A database of wall-pressure array measurements was compiled for studying the space-time character of the surface-pressure field within a separating/reattaching flow region. The experimental setup consisted of a long splitter plate instrumented with an

array of 80 flush-mounted microphones located within the wake of a fence. Data were acquired for a Reynolds number of 7885, based on the fence height. Two distinctive regions, defined based on their location relative to the position of the mean reattachment point ( $x_{sub r}$ ) of the shear layer, emerged from this investigation. Upstream, from the fence to  $1/4x_{sub r}$ , the surface-pressure signature was dominated by large time scale disturbances and an upstream convecting velocity of  $0.21U_{sub infinity}$ . Beyond  $1/4x_{sub r}$ , turbulent structures with small time scales and a downstream convection velocity of  $0.57U_{sub infinity}$  generated most of the pressure fluctuations. There was evidence that these structures began to form around  $1/4x_{sub r}$  and grew in strength and size with downstream distance before reattaching on the plate. Only the time-averaged results from the microphones have been examined hitherto and will be presented.

Author

*Data Bases; Pressure Measurement; Wall Pressure; Separated Flow; Reattached Flow*

**20030004231** Old Dominion Univ., Center for Advanced Engineering Environments, Hampton, VA USA

**Visualization of CFD Results in Immersive Virtual Environments**

Wasfy, Tamer M., Advanced Science and Automation Corp., USA; Noor Ahmed K., Old Dominion Univ., USA; *Advances in Engineering Software*; 2001; ISSN 0965-9978; Volume 32, pp. 717-730; In English

Contract(s)/Grant(s): NCC1-01040; Copyright; Avail: Issuing Activity

An object-oriented event-driven immersive virtual environment (VE) is described for the visualization of computational fluid dynamics (CFD) results. The VE incorporates the following types of primitive software objects: interface objects, support objects, geometric entities, and finite elements. The fluid domain is discretized using either a multi-block structured grid or an unstructured finite element mesh. The VE allows natural 'fly-through' visualization of the model, the CFD grid, and the model's surroundings. In order to help visualize the flow and its effects on the model, the VE incorporates the following objects: stream objects (lines, surface-restricted lines, ribbons, and volumes); colored surfaces; elevation surfaces; surface arrows; global and local iso-surfaces; vortex cores; and separation/attachment surfaces and lines. Most of these objects can be used for dynamically probing the flow. Particles and arrow animations can be displayed on top of stream objects. Primitive response quantities as well as derived quantities can be used. A recursive tree search algorithm is used for real-time point and value search in the CFD grid.

Author

*Scientific Visualization; Computational Fluid Dynamics; Virtual Reality*

**20030004237** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Imaging Carbon Nanotubes in High Performance Polymer Composites via Magnetic Force Microscope**

Lillehei, Peter T., NASA Langley Research Center, USA; Park, Cheol, Institute for Computer Applications in Science and Engineering, USA; Rouse, Jason H., Institute for Computer Applications in Science and Engineering, USA; Siochi, Emilie J., NASA Langley Research Center, USA; December 2002; 11p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-212137; NAS 1.26:212137; ICASE-2002-48; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Application of carbon nanotubes as reinforcement in structural composites is dependent on the efficient dispersion of the nanotubes in a high performance polymer matrix. The characterization of such dispersion is limited by the lack of available tools to visualize the quality of the matrix/carbon nanotube interaction. The work reported herein demonstrates the use of magnetic force microscopy (MFM) as a promising technique for characterizing the dispersion of nanotubes in a high performance polymer matrix.

Author

*Carbon Nanotubes; Composite Structures; Microscopy*

**20030004239** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Common-Path Heterodyne Laser-Induced Thermal Acoustics for Seedless Laser Velocimetry Final Report**

Hart, Roger C., Institute for Computer Applications in Science and Engineering, USA; Herring, G. C., NASA Langley Research Center, USA; Balla, R. Jeffrey, NASA Langley Research Center, USA; December 2001; 14p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2001-211252; NAS 1.26:211252; ICASE-2001-37; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We demonstrate the use of a novel technique for the detection of heterodyne laser-induced thermal acoustics signals, which allows the construction of a highly stable seedless laser velocimeter. A common-path configuration is combined with quadrature detection to provide flow direction, greatly improve robustness to misalignment and vibration, and give reliable velocity

measurement at low flow velocities. Comparison with Pitot tube measurements in the freestream of a windtunnel shows root-mean-square errors of 0.67 m/s over the velocity range 0-55 m/s.

Author

*Acoustics; Heterodyning; Laser Doppler Velocimeters; Laser Applications*

## 35

### INSTRUMENTATION AND PHOTOGRAPHY

*Includes remote sensors; measuring instruments and gauges; detectors; cameras and photographic supplies; and holography. For aerial photography see 43 Earth Resources and Remote Sensing. For related information see also 06 Avionics and Aircraft Instrumentation; and 19 Spacecraft Instrumentation.*

**20030002233** Virginia Univ., Medical Center, Charlottesville, VA USA

**Use of Real-Time Ground-to-Air Video during Aeromedical Response to Traffic Crashes *Final Report***

Perina, D.; Aug. 2002; 26p; In English

Report No.(s): PB2003-100174; Copyright; Avail: National Technical Information Service (NTIS), Microfiche

The purpose of this feasibility study was to determine whether the use of ground-based video imaging by local rescue squad personnel, along with real-time transmission of this information to the Pegasus helicopter medical crew, is technically feasible and of sufficient quality to be used as a tool to improve pre-hospital care provided to crash victims. The scope of this project was to investigate various types of existing technology and equipment that may allow for the desired communication linkage between aircraft and ground responders either as is or with achievable modifications. Additionally, other stakeholder entities in this project would be identified and approached to solicit cooperation in the subsequent deployment of the equipment.

NTIS

*Accidents; Real Time Operation; Medical Services; Video Equipment*

**20030002336** DYNACS Engineering Co., Inc., Cocoa Beach, FL USA

**Latest Development in Advanced Sensors at Kennedy Space Center**

Perotti, Jose P., NASA Kennedy Space Center, USA; Eckhoff, Anthony, DYNACS Engineering Co., Inc., USA; [2002]; 6p; In English; IEEE Sensors 2002, 12-14 Jun. 2002, Kissimmee, FL, USA; Sponsored by Institute of Electrical and Electronics Engineers, USA

Contract(s)/Grant(s): NAS10-98001

Report No.(s): KSC-2002-069; No Copyright; Avail: Issuing Activity

Inexpensive space transportation system must be developed in order to make space flight more affordable. To achieve this goal, there is a need to develop inexpensive smart sensors to allow autonomous checking of the health of the vehicle and associated ground support equipment, warn technicians or operators of an impending problem and facilitate rapid vehicle pre-launch operations. The Transducers and Data Acquisition group at Kennedy Space Center has initiated an effort to study, research, develop and prototype inexpensive smart sensors to accomplish these goals. Several technological challenges are being investigated and integrated in this project - multi-discipline sensors; self-calibration, health self-diagnosis capabilities embedded in sensors; advanced data acquisition systems with failure prediction algorithms and failure correction (self-healing) capabilities.

Author

*Algorithms; Calibrating; Data Acquisition; Diagnosis; Health; Predictions*

**20030002456** University of Central Florida, Chemistry Dept., Orlando, FL USA

**Repair and Utilization of the Kratos XSAM 800 X-Ray Photoelectron Spectrometer (XPS)**

Hampton, Michael D., University of Central Florida, USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

The objectives for this summer faculty fellowship were first to repair the Kratos XSAM 800 X-ray Photoelectron Spectrometer (XPS) and then to utilize the instrument to participate in ongoing research projects at KSC and in the researcher's own laboratory at UCF. The first 6 weeks were used in repairing the instrument. Working both alone and with the Kratos service engineer, a number of hardware problems, largely associated with the sample stage control system, were corrected. Defective parts were identified and fixed in the computer driver boards, the stage power supply, and the driver interface. The power supply was completely replaced. After four weeks of work, the instrument was functional. This occurred on a Wednesday. The following Friday the instrument had to be completely shut down because the power to the O & C Building was to be turned off. The

instrument was properly secured. On Monday, the instrument was powered up and the original problems returned. After another 2 weeks of work, a software problem was identified. This problem caused the computer to use a defective port for the sample stage control. It was circumvented by rewriting the startup routine. The final 3 weeks of the fellowship were spent using the XPS to analyze samples being studied in the Langley materials project (Martha Williams) and a catalyst project (Dr. Orlando Melendez). During this time, several sample analysis requests from other groups at KSC also came in and those samples were run as well. The summer faculty fellowship also allowed many contacts to be made. After meeting with the sensors group, two projects were identified for collaboration and white papers are being prepared. One project aims to develop small, very sensitive hydrogen detectors and the other to develop a broad area, easily monitored, zero power consumption hydrogen detector. In addition to the work mentioned above, the XPS was utilized in a study underway in Dr. Hampton's laboratory at UCF.

Author

*Defects; Energy Consumption; Maintenance; Photoelectron Spectroscopy; X Ray Spectrometers*

**20030002517** Florida Inst. of Tech., Physics and Space Sciences Dept., FL USA

**Evaluation of the Performance of the Mars Environmental Compatibility Assessment Electrometer**

Mantovani, James G., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

The Mars Environmental Compatibility Assessment (MECA) electrometer is an instrument that was designed jointly by researchers at the Jet Propulsion Laboratory and the Kennedy Space Center, and is intended to fly on a future space exploration mission of the surface of Mars. The electrometer was designed primarily to study (1) the electrostatic interaction between the Martian soil and five different types of insulators, which are attached to the electrometer, as the electrometer is rubbed over the Martian soil. The MECA/Electrometer is also capable of measuring (2) the presence of charged particles in the Martian atmosphere, (3) the local electric field strength, and (4) the local temperature. The goal of the research project described in this report was to test and evaluate the measurement capabilities of the MECA/Electrometer under simulated Martian surface conditions using facilities located in the Labs and Testbeds Division at the Kennedy Space Center. The results of this study indicate that the Martian soil simulant can triboelectrically charge up the insulator surface. However, the maximum charge buildup did not exceed 18% of the electrometer's full-range sensitivity when rubbed vigorously, and is more likely to be as low as 1% of the maximum range when rubbed through soil. This indicates that the overall gain of the MECA/Electrometer could be increased by a factor of 50 if measurements at the 50% level of full-range sensitivity are desired. The ion gauge, which detects the presence of charged particles, was also evaluated over a pressure range from 10 to 400 Torr (13 to 533 mbar). The electric field sensor was also evaluated. Although the temperature sensor was not evaluated due to project time constraints, it was previously reported to work properly.

Author

*Evaluation; Performance Prediction; Electrometers; Ionization Gages; Mars Atmosphere; Temperature Sensors*

**20030002695** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Selective Hydrogen Sensors on the Basis of Semiconductors Ga2O3 Thin Layers**

Weh, Thomas; Jan. 2002; 149p; In German

Report No.(s): AD-A407987; X5-X5; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This dissertation focuses on the modification of a semiconductive Ga<sub>2</sub>O<sub>3</sub> gas sensor for the detection of hydrogen, realized by the introduction of a Si-O<sub>2</sub> layer on the sensor. Despite experimentation with this initial and multi-tiered subsequent layers, an increase in the sensitivity or selectivity of the hydrogen sensor could not be obtained. The plausible emergence of dipole loadings near the interface of SiO<sub>2</sub> and Ga<sub>2</sub>O<sub>3</sub> can be attributed to the diffusion of hydrogen in the SiO<sub>2</sub> layer. Finally the hydrogen sensor was integrated into an online-monitoring system for the detection of H<sub>2</sub> in transformers' insulation oil, in order to show its capacity to fulfill its applications under real conditions.

DTIC

*Gallium Compounds; Gas Detectors*

**20030002701** Wisconsin Univ., Madison, WI USA

**Ultrafast Optical Wavelength Shuffling Based on Nonlinear Photonic Crystals**

McCaughan, Lean; Nov. 30, 2001; 4p; In English

Contract(s)/Grant(s): F49620-01-1-0077

Report No.(s): AD-A407999; AFRL-SR-AR-TR-02-0352; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

At the time of this proposal we had developed the theoretical foundation for analyzing 2D periodic second order nonlinearities, from which we developed demonstration of simultaneous optical wavelength interchange. I. shown that a properly

designed 2-D quadratic nonlinear lattice can be used to produce a simultaneous, one-step, interchange of data between two carrier wavelengths  $\lambda_1$  and  $\lambda_2$ . The two DFG processes essentially "diffract" the Interconverted signals from the unconverted ones, providing spatial segregation to eliminate coherent in band cross talk. Subsequent to this, we presented the first experimental demonstration of simultaneous optical wavelength interchange [2,3]. The nonlinear lattice, fabricated in LiNbO<sub>3</sub>, was designed to interchange the wavelengths 1535 nm and 1555 nm a theoretical was in that paper, Figure 1. Schematic representation of simultaneous wavelength interchange in 2D periodically poled LiNbO<sub>2</sub>.

DTIC

*Optical Properties; Crystals; Nonlinear Systems; Photons; Diagrams*

**20030002750** NASA Langley Research Center, Hampton, VA USA

**Photogrammetry Methodology Development for Gossamer Spacecraft Structures**

Pappa, Richard S., NASA Langley Research Center, USA; Jones, Thomas W., NASA Langley Research Center, USA; Walford, Alan, EOS Systems, Inc., Canada; Black, Jonathan T., George Washington Univ., USA; Robson, Stuart, University Coll., UK; Shortis, Mark R., Melbourne Univ., Australia; [2002]; 20p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, Denver, CO, USA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1375; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Photogrammetry--the science of calculating 3D object coordinates from images--is a flexible and robust approach for measuring the static and dynamic characteristics of future ultralightweight and inflatable space structures (a.k.a., Gossamer structures), such as large membrane reflectors, solar sails, and thin-film solar arrays. Shape and dynamic measurements are required to validate new structural modeling techniques and corresponding analytical models for these unconventional systems. This paper summarizes experiences at NASA Langley Research Center over the past three years to develop or adapt photogrammetry methods for the specific problem of measuring Gossamer space structures. Turnkey industrial photogrammetry systems were not considered a cost-effective choice for this basic research effort because of their high purchase and maintenance costs. Instead, this research uses mainly off-the-shelf digital-camera and software technologies that are affordable to most organizations and provide acceptable accuracy.

Author

*Inflatable Space Structures; Mathematical Models; Photogrammetry; Methodology; Dynamic Characteristics*

**20030003704** NASA Glenn Research Center, Cleveland, OH USA

**A Multilayered Thin Film Insulator for Harsh Environments**

Wrbanek, John D., NASA Glenn Research Center, USA; Fralick, Gustave C., NASA Glenn Research Center, USA; Blaha, Charles A., Akima Corp., USA; Busfield, A. Rachel, Rolls-Royce Ltd., UK; Thomas, Valarie D., Ohio Aerospace Inst., USA; September 2002; 12p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-73-51

Report No.(s): NASA/TM-2002-211873; E-13555; NAS 1.15:211873; AIAA Paper 2002-3731; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The status of work to develop a reliable high temperature dielectric thin film for use with thin film sensors is presented. The use of thin films to electrically insulate thin film sensors on engine components minimizes the intrusiveness of the sensor and allows a more accurate measurement of the environment. A variety of insulating films were investigated for preventing electrical shorting caused by insulator failure between the sensor and the component. by alternating layers of sputtered high temperature ceramics, a sequence of insulating layers was devised that prevents pinholes from forming completely through the insulator and maintains high electrical resistivity at high temperatures. The major technical challenge remaining is to optimize the fabrication of the insulator with respect to composition to achieve a reliable high temperature insulating film. Data from the testing of various potentially insulating thin film systems is presented and their application to thin film sensors is also discussed.

Author

*Thin Films; Insulators; Laminates; Dielectrics; Ceramics*

**20030004018** ProSensing, Inc., Amherst, MA USA

**Design of an Airborne L-Band Cross-Track Scanning Scatterometer Final Report**

Sep. 18, 2002; 30p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-12143; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this report, we describe the design of an airborne L-band cross-track scanning scatterometer suitable for airborne operation aboard the NASA P-3 aircraft. The scatterometer is being designed for joint operation with existing L-band radiometers developed by NASA for soil moisture and ocean salinity remote sensing. In addition, design tradeoffs for a space-based radar system have been considered, with particular attention given to antenna architectures suitable for sharing the antenna between the radar and radiometer. During this study, we investigated a number of imaging techniques, including the use of real and synthetic aperture processing in both the along track and cross-track dimensions. The architecture selected will permit a variety of beamforming algorithms to be implemented, although real aperture processing, with hardware beamforming, provides better sidelobe suppression than synthetic array processing and superior signal-to-noise performance. In our discussions with the staff of NASA GSFC, we arrived at an architecture that employs complete transmit/receive modules for each subarray. Amplitude and phase control at each of the transmit modules will allow a low-sidelobe transmit pattern to be generated over scan angles of +/- 50 degrees. Each receiver module will include all electronics necessary to downconvert the received signal to an IF offset of 30 MHz where it will be digitized for further processing.

Author

*Design Analysis; Space Based Radar; Scatterometers; Imaging Techniques; Radiometers; Soil Moisture*

## 36

### LASERS AND MASERS

*Includes lasing theory, laser pumping techniques, maser amplifiers, laser materials, and the assessment of laser and maser outputs. For cases where the application of the laser or maser is emphasized see also the specific category where the application is treated. For related information see also 76 Solid-State Physics.*

**20030002347** Universitaet der Bundeswehr, fachbereich Elektrotechnik, Hamburg, Germany

**Additive Pulse Mode-Coupling of a Nd: YAG Laser: Attempts at a Self-Stabilizing System**

Groninga, Hinrich; Jan. 1999; 128p; In German

Report No.(s): AD-A407695; X5-X5; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Using a numerical model, the dissertation describes, "an Additive-Pulse Mode Locked (APM) Nd:YAG-Laser" in various configurations. The relationship between the photon density and the occupational density of the laser's upper level represents the basis for the numerical treatment of the strengthening in the laser-active medium (chapter 2). The nonlinear medium of an APM-laser, the glass fiber, is described in chapter three. Chapter four treats the principle of mode-coupling, with the various principal orderings of the APM demonstrated. The aforementioned APM numerical model comprises chapter 5, with emphasis on the Fabry-Perot and the P- and Q-configurations. The final chapter yields the experimental results if the various configuration.

DTIC

*Mathematical Models; Coupled Modes; YAG Lasers; Neodymium*

**20030002475** NASA Marshall Space Flight Center, Huntsville, AL USA

**Laser Prevention of Earth Impact Disasters**

Campbell, Jonathan W., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; 53rd IAF, Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Today we are seeing the geological data base constantly expanding as new evidence from past impacts with the Earth are discovered and investigated. It is now commonly believed that a hypervelocity impact occurring approximately 65 million years ago in the Yucatan Peninsula area was the disaster responsible for the extinction of almost 70% of the species of life on Earth including of course the dinosaurs. What is sobering is that we believe now that this was just one of several such disasters and that some of the others caused extinctions to even a greater extent. Preventing collisions with the Earth by hypervelocity asteroids, meteoroids, and comets is the most important problem facing human civilization. While there are many global problems facing our planet including overpopulation, pollution, disease, and deforestation; none of these offer the potential of rapid, total extinction. Rapid is the operative word here in that many of the global problems we face may indeed, if not sufficiently addressed, pose a similar long-term threat. However, with the impact threat, a single, almost unpredictable event could lead to a chain reaction of disasters that would end everything mankind has worked to achieve over the centuries. Our chances of being hit are greater than our chance of winning the lottery. We now believe that while there are only about 2000-earth orbit crossing rocks great than 1 kilometer in diameter, there may be as many as 100,000 rocks in the 100 m size range. The 1 kilometer rocks are difficult to detect and even harder to track. The 100 m class ones are almost impossible to find with today's technology. Can anything be done about this fundamental existence question facing us? The answer is a resounding yes. by using an intelligent combination of Earth and space based sensors coupled with high-energy laser stations in orbit, we can deflect rocks from striking the Earth. This is

accomplished by irradiating the surface of the rock with sufficiently intense pulses so that ablation occurs. This ablation acts as a small rocket incrementally changing the shape of the rock's orbit around the Sun.

Author

*Hypervelocity Impact; Lasers; Earth Surface; Life Sciences; Paleobiology*

**20030002649** Aerosoft, Inc., Blacksburg, VA USA

**Computational Issues in Analysis and Design of Chemical-Laser Flow-Fields Final Report, 1 Apr. 2000-30 Jun. 2002**

Eppard, W. M.; Cliff, Eugene M.; Sep. 30, 2002; 62p; In English; Prepared in collaboration with Interdisciplinary Center for Applied Mathematics, Virginia Tech, Blacksburg, VA

Contract(s)/Grant(s): F49620-00-C-0011

Report No.(s): AD-A408006; AFRL-SR-AR-TR-02-0382; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

In support of the Air Force's airborne laser (ABL) development program. state-of-the-art CFD analysis and design methods have been extended to include the physical models important in chemical oxygen-iodine laser (COIL) systems. The three-dimensional COIL simulation model is based on the CFD flow solver GASP v4 which solves the conservative, finite-volume formulation of the Navier-Stokes equations with general thermo-chemistry. The COIL design software is based on the continuous sensitivity equation method (CSEM) and AeroSoft's flow-field sensitivity solver. SENSE. Extensions to GASP and SENSE include a COIL chemistry mechanism, a multicomponent diffusion model with pressure terms, and coupling with a laser optics resonator module based on the geometric ray-tracing method. In addition, GASP has been modified to include a water-vapor condensation model and a COIL surface catalysis model Simulations have been performed for the RADICL research laser for both power-on and power-off conditions.

DTIC

*Software Engineering; Laser Weapons; Chemical Lasers; Computation; Design Analysis; Flow Distribution; Laser Outputs*

**20030002694** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany

**Development of a Sensor System for the Detection of Gases with Near-Infrared Laser Diodes**

Magori, Erhard; Jan. 2001; 192p; In German

Report No.(s): AD-A407986; X5-X5; No Copyright; Avail: CASI; A09, Hardcopy; A02, Microfiche

The dissertation examines the possibility of a sensor system based upon spectroscopy with Near-Infrared (NIR) diodes, as opposed to the more traditional sensory analysis, which suffers from a dearth of gas sensors necessary to its implementation. With semiconductor laser diodes recently having been made available for sensory analysis, the author is convinced that this new path is ideal for optical, spectroscopic gas analysis. The principles and applications of and developments in absorption spectroscopy, as this precise technique has come to be known, takes up the first forty percent of the study. The second part tests out measurements, whereas the third and final section has the blueprints for the micro-controlled realization of the sensor system.

DTIC

*Diodes; Laser Applications; Infrared Radiation; Detection*

**20030002699** Florida International Univ., Dept. of Physics, Miami, FL USA

**Theoretical Modeling of Damage Mechanisms for Ultrashort Laser Pulses in Ocular Media Final Report, 1 Sep. 1996-30 Sep 2001**

Gerstman, Bernard; Oct. 31, 2002; 23p; In English

Contract(s)/Grant(s): F49620-96-1-0438

Report No.(s): AD-A407996; AFRL-SR-AR-TR-02-0396; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The funding provided in this grant has allowed the development of a comprehensive computational model for predicting the effect that any laser pulse will have on any spherical absorbing particle. This model is based upon fundamental principles and therefore is capable of determining all thermomechanical responses (temperature rise, shock wave, explosive vaporization) and is applicable to a wide range of materials with unprecedented accuracy. This allows the assessment of potential damage to a variety of materials, such as biological tissue. The computational model is also applicable for investigating and predicting laser induced damage in synthetic polymers and optical and electronic communication materials. The research also furnishes a technique for determining thermomechanical properties of microparticles used in novel medical, biological and material science applications. In addition, we have seen evidence that the thermomechanical response in various materials to a laser pulse is not only non-linear, but chaotic. This implies that small changes in laser pulse characteristics such as duration or energy may lead to enormous changes in response that are extremely damaging to the material whether biological or synthetic. The detailed nature of the investigation

and resulting model allowed for the discovery of this chaotic behavior, which had not been previously reported by any other investigators.

DTIC

*Pulsed Lasers; Laser Damage; Mathematical Models; Damage Assessment; Thermodynamics*

**20030002764** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

**Design and Fabrication of Micro-Electro-Mechanical Structures for Tunable Micro-Optical Devices**

Harvey, Michael C.; Mar. 2002; 215p; In English; Original contains color images

Report No.(s): AD-A408049; AFIT/ENG/GEO-02M-01; No Copyright; Avail: Defense Technical Information Center (DTIC)

Tunable micro-optical devices are expected to be vital for future military optical communication systems. In this research I seek to optimize the design of a microelectromechanical (MEM) structure integrated with a III-V semiconductor micro-optical device. The resonant frequency of an integrated optical device, consisting of a Fabry-Perot etalon or vertical cavity surface emitting laser (VCSEL), may be tuned by applying an actuation voltage to the MEM Flexure, thereby altering the device's optical cavity length. From my analysis I demonstrate tunable devices compatible with conventional silicon 5V integrated circuit technology. My design for a Fabry-Perot etalon has a theoretical tuning range of 200 nm, and my VCSEL design has a tuning range of 44nm, both achieved with actuation voltages as low as 4V. Utilizing my theoretical device designs I planned a new microelectronics fabrication process to realize a set of prototype MEM-tunable devices with a peak central emission wavelength at 980nm. I designed a mask set consisting of 8 mask levels and 252 distinct device designs, all within a die size of one square centimeter. My unique fabrication process utilizes a gold MEM flexure with a Si<sub>3</sub>N<sub>4</sub>/SiO<sub>2</sub> dielectric distributed Bragg reflector (DBR) mirror, grown on an all-semiconductor VCSEL or Fabry-Perot substrate. I successfully fabricated a complete set of MEM-tunable test structures using the cleanroom laboratory facilities at the Air Force Institute of Technology (AFIT) and the Air Force Research Laboratory (AFRL). The initial devices display minimum electrostatic actuation voltages as low as 1.8 V, which is comparable to existing MEM tunable VCSEL designs. In order to enhance device performance, I developed improvements to my laboratory process for incorporation in future fabrication runs. These results form the fundamental basis for advanced development of manufacturable MEM-tunable optical emitting and detecting device arrays.

DTIC

*Microelectromechanical Systems; Laser Cavities; Surface Emitting Lasers; Etalons; Tuning*

**20030002843** Princeton Univ., Dept. of Physics, NJ USA

**Physics Utilizing Spin-Polarized Gases Annual Report, 1 Aug. 1999-31 Jul. 2000**

Happer, William; Aug. 08, 2002; 5p; In English

Contract(s)/Grant(s): F49620-98-1-0127

Report No.(s): AD-A408059; AFRL-SR-AR-TR-02-0333; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

We have completed a thorough study of masing action of hyperpolarized He-3 gas in inhomogeneous magnetic fields. The self interaction of the He-3 magnetization has a large effect on the maser gain. We have developed a simple new magnetic resonance method for investigating the interactions of Xe-129 spins with protons in polymers. We have shown that there are novel magnetic resonance transitions in alkali-metal vapors that have vanishing spin-exchange broadening in the limit of high spin polarization. Such transitions could be useful for miniaturized atomic clocks. We have shown that spin-axis interactions in triplet molecules are responsible for much of the spin destruction rate dense alkali-metal vapors.

DTIC

*Polarization; Physics; Masers; Spin; Gases; Paramagnetism*

**20030002844** Stanford Univ., Dept. of Mechanical Engineering, Stanford, CA USA

**Development of a Pulsed 2 Gigawatt, 5 Kilojoule FEL Source at L-Band Final Report, 1 Jun. 1997-31 May 2002**

Kruger, Charles H.; Paterson, J.; Aug. 2002; 6p; In English

Contract(s)/Grant(s): F49620-97-1-0460; AF Proj. 3484

Report No.(s): AD-A408060; AFRL-SR-AR-TR-02-0329; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This AASERT program was originally under the direction of Prof. J. Paterson in 1999, this program was transferred to Prof Charles Kruger and the focus shifted to 'Graduate Research Training on Air Plasma Diagnostics' in the framework of the 'Air Plasma Ramparts' MURI research program entitled 'Mechanisms of Ionizational Nonequilibrium in Air Plasmas,' Two graduate students, Kate Snyder and Jonathan Flad, supported by this program have received training on temporally and spatially resolved Cavity Ring-Down spectroscopy measurements of electron density in a pulsed atmospheric pressure nitrogen plasma. They have

contributed also to the ongoing development of CRDS measurements of NO<sub>4</sub> concentrations in an air plasma produced with radio-frequency inductively coupled plasma torch.

DTIC

*Free Electron Lasers; Ultrahigh Frequencies; Plasmas (Physics)*

## 37

### MECHANICAL ENGINEERING

*Includes mechanical devices and equipment; machine elements and processes. For cases where the application of a device or the host vehicle is emphasized see also the specific category where the application or vehicle is treated. For robotics see 63 Cybernetics, Artificial Intelligence, and Robotics; and 54 Man/System Technology and Life Support.*

**20030002231** NASA Kennedy Space Center, Cocoa Beach, FL USA

#### **Review and Application of ASME NOG-1 and ASME NUM-1-2000**

Lytle, Bradford P., NASA Kennedy Space Center, USA; [2002]; 129p; In English; ASME International Enhanced Safety Crane Workshop, 15-16 May 2002, Beijing, China; Sponsored by American Society of Mechanical Engineers, USA; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The intent of the workshop is to review the application of the ASME Nuclear Crane Standards ASME NOG-1 and ASME NUM-1-2000. The ASME Nuclear Crane standards provide a basis for purchasing overhead handling equipment with enhanced safety features, based upon accepted engineering principles, and including performance and environmental parameters specific to nuclear facilities.

Derived from text

*Cranes; Mechanical Engineering; Materials Handling; Systems Engineering*

**20030002752** NASA Marshall Space Flight Center, Huntsville, AL USA

#### **Dynamics of a 4x6-Meter Thin Film Elliptical Inflated Membrane for Space Applications**

Casiano, Matthew J., NASA Marshall Space Flight Center, USA; Hamidzadeh, Hamid R., South Dakota State Univ., USA; Tinker, Michael L., NASA Marshall Space Flight Center, USA; [2002]; 6p; In English; AIAA Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA Contract(s)/Grant(s): RTOP 903-01-94

Report No.(s): AIAA Paper 2002-1557; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Dynamic characterization of a thin film inflatable elliptical structure is described in detail. A two-step finite element modeling approach in MSC/NASTRAN is utilized, consisting of (1) a nonlinear static pressurization procedure used to obtain the updated stiffness matrix, and (2) a modal "restart" eigen solution that uses the modified stiffness matrix. Unique problems encountered in modeling of this large Hexameter lightweight inflatable arc identified, including considerable difficulty in obtaining convergence in the nonlinear finite element pressurization solution. It was found that the extremely thin polyimide film material (.001 in or 1 mil) presents tremendous problems in obtaining a converged solution when internal pressure loading is applied. Approaches utilized to overcome these difficulties are described. Comparison of finite element predictions for frequency and mode shapes of the inflated structure with closed-form solutions for a flat pre-tensioned membrane indicate reasonable agreement.

Author

*Inflatable Structures; Stiffness Matrix; Structural Analysis; Dynamic Models; Structural Design; Space Erectable Structures; Loads (Forces); Finite Element Method*

**20030002754** NASA Marshall Space Flight Center, Huntsville, AL USA

#### **Full and Partial Admission Performance of the Simplex Turbine**

Dorney, D. J., NASA Marshall Space Flight Center, USA; Griffin, L. W., NASA Marshall Space Flight Center, USA; Sondak, D. L., Boston Univ., USA; [2002]; 21p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3638; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The turbines used in rocket-engine applications are often partial-admission turbines, meaning that the flow enters the rotor over only a portion of the annulus. These turbines have been traditionally analyzed, however, assuming full-admission characteristics. This assumption enables the simulation of only a portion of the 360-degree annulus, with periodic boundary

conditions applied in the circumferential direction. While this traditional approach to the simulating the flow in partial-admission turbines significantly reduces the computational requirements, the accuracy of the solutions has rarely been evaluated. In the current investigation, both full- and partial-admission three dimensional unsteady Navier-Stokes simulations were performed for a partial-admission turbine designed and tested at NASA Marshall Space Flight Center. The results indicate that the partial-admission nature of the turbine must be included in simulations to properly predict the performance and flow unsteadiness of the turbine.

Author

*Rocket Engine Design; Turbines; Propulsion System Performance; Unsteady Flow; Engine Tests; Rotor Blades (Turbomachinery)*

**20030003695** NASA Langley Research Center, Hampton, VA USA

**Description of New Inflatable/Rigidizable Hexapod Structure Testbed for Shape and Vibration Control**

Adetona, O., Tennessee State Univ., USA; Keel, L. H., Tennessee State Univ., USA; Horta, L. G., NASA Langley Research Center, USA; Cadogan, D. P., ILC Dover, USA; Sapna, G. H., ILC Dover, USA; Scarborough, S. E., ILC Dover, USA; [2002]; 5p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1451; Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Larger and more powerful space based instruments are needed to meet increasingly sophisticated scientific demand. To support this need, concepts for telescopes with apertures of 100 meters are being investigated, but the required technologies are not in hand today. Due to the capacity limits of launch vehicles, the idea of deploying, erecting, or inflating large structures in space is being considered. Recently, rigidization concepts of large inflatable structures have demonstrated the capability of weight reductions of up to 50% from current concepts with packaging efficiencies near 80%. One of the important aspects of inflatable structures is vibration mitigation and line-of-sight control. Such control tasks are possible only after actuators/sensors are properly integrated into a rigidizable concept. To study these issues, we have developed an inflatable/rigidizable hexapod structure testbed. The testbed integrates state of the art piezo-electric self-sensing actuators into an inflatable/rigidizable structure and a flat membrane reflector. Using this testbed, we plan to experimentally demonstrate achievable vibration and line-of-sight control. This paper contains a description of the testbed and an outline of the test plan.

Author

*Inflatable Structures; Large Space Structures; Test Stands; Vibration Damping; Shape Control; Research and Development; Design Optimization; Structural Stability*

**20030003697** NASA Glenn Research Center, Cleveland, OH USA

**Turbine Engine Clearance Control Systems: Current Practices and Future Directions**

Lattime, Scott B., Ohio Aerospace Inst., USA; Steinetz, Bruce M., NASA Glenn Research Center, USA; September 2002; 22p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-87-13

Report No.(s): NASA/TM-2002-211794; E-13489; NAS 1.15:211794; AIAA Paper 2002-3790; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Improved blade tip sealing in the high pressure compressor (HPC) and high pressure turbine (HPT) can provide dramatic reductions in specific fuel consumption (SFC), time-on-wing, compressor stall margin, and engine efficiency as well as increased payload and mission range capabilities. Maintenance costs to overhaul large commercial gas turbine engines can easily exceed \$1M. Engine removal from service is primarily due to spent exhaust gas temperature (EGT) margin caused mainly by the deterioration of HPT components. Increased blade tip clearance is a major factor in hot section component degradation. As engine designs continue to push the performance envelope with fewer parts and the market drives manufacturers to increase service life, the need for advanced sealing continues to grow. A review of aero gas turbine engine HPT performance degradation and the mechanisms that promote these losses are discussed. Benefits to the HPT due to improved clearance management are identified. Past and present sealing technologies are presented along with specifications for next generation engine clearance control systems.

Author

*Turbine Engines; Clearances; Blade Tips; Sealing*

**20030003721** NASA Marshall Space Flight Center, Huntsville, AL USA

**Macrostructure of Friction Stir Welds**

Aloor, S., Texas Univ., USA; Nowak, B., Sandia National Labs., USA; Vargas, R., Texas Univ., USA; McClure, J. C., Texas Univ., USA; Murr, L. E., Texas Univ., USA; Nunes, A. C., NASA Marshall Space Flight Center, USA; [2002]; 25p; In English  
Contract(s)/Grant(s): DE-FC04-01AL-67097; NAG8-1645; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper will discuss two of the well know large scale features of friction stir welds: the "onion rings" seen in transverse sections, and the striations on the surface of the work piece. It will be shown that the surface features (sometimes called "tool marks") are the result of irregularities on the rotating shoulder of the pin tool and disappear when the shoulder is polished. The "onion ring" structure seen in transverse cross sections is formed by parts of the "carousel", the zone of material adjacent to and rotating with the pin tool, that are shed off in each rotation. The relation between the carousel and the "ring vortex", a rotational flow extending both in and out of the carousel and resembling a smoke-ring with the hole centered on the pin tool, will be discussed.

Author

*Friction Stir Welding; Welded Joints; Striation; Fluid Flow*

**20030003733** NASA Glenn Research Center, Cleveland, OH USA

**Investigations of Control Surface Seals for Re-Entry Vehicles**

Dunlap, Patrick H., Jr., NASA Glenn Research Center, USA; Steinetz, Bruce M., NASA Glenn Research Center, USA; Curry, Donald M., NASA Johnson Space Center, USA; DeMange, Jeffrey J., Ohio Aerospace Inst., USA; Rivers, H. Kevin, NASA Langley Research Center, USA; Hsu, Su-Yuen, Lockheed Martin Space Operations, USA; July 2002; 29p; In English; 38th Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 706-85-33

Report No.(s): NASA/TM-2002-211708; E-13456; NAS 1.15:211708; AIAA Paper 2002-3941; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Re-entry vehicles generally require control surfaces (e.g., rudders, body flaps) to steer them during flight. Control surface seals are installed along hinge lines and where control surface edges move close to the vehicle body. These seals must operate at high temperatures and limit heat transfer to underlying structures to prevent them from overheating and causing possible loss of vehicle structural integrity. This paper presents results for thermal analyses and mechanical testing conducted on the baseline rudder/fin seal design for the X-38 re-entry vehicle. Exposure of the seals in a compressed state at the predicted peak seal temperature of 1900 F resulted in loss of seal resiliency. The vertical Inconel rudder/fin rub surface was re-designed to account for this loss of resiliency. Room temperature compression tests revealed that seal unit loads and contact pressures were below limits set to protect Shuttle thermal tiles on the horizontal sealing surface. The seals survived an ambient temperature 1000 cycle scrub test over sanded Shuttle tiles and were able to disengage and re-engage the tile edges during testing. Arc jet tests confirmed the need for seals in the rudder/fin gap location because a single seal caused a large temperature drop ( $\Delta T = 1710$  F) in the gap.

Author

*Control Surfaces; Seals (Stoppers); Compression Tests; High Temperature Tests; Reentry Vehicles; Thermal Analysis; X-38 Crew Return Vehicle*

**20030004014** Stone and Webster Engineering Corp., Boston, MA USA

**ASME Nuclear Crane Standards for Enhanced Crane Safety and Increased Profit**

Parkhurst, Stephen N., Stone and Webster Engineering Corp., USA; 2000; 23p; In English; ICONE 8: 8th International Conference on Nuclear Engineering, 2-6 Apr. 2000, Baltimore, MD, USA

Report No.(s): ICONE-8544; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The ASME NOG-1 standard, 'Rules for Construction of Overhead and Gantry Cranes', covers top running cranes for nuclear facilities; with the ASME NUM-1 standard, 'Rules for Construction of Cranes, Monorails, and Hoists', covering the single girder, underhung, wall and jib cranes, as well as the monorails and hoists. These two ASME nuclear crane standards provide criteria for designing, inspecting and testing overhead handling equipment with enhanced safety to meet the 'defense-in-depth' approach of the USA Nuclear Regulatory Commission (USNRC) documents NUREG 0554 and NUREG 0612. In addition to providing designs for enhanced safety, the ASME nuclear crane standards provide a basis for purchasing overhead handling equipment with standard safety features, based upon accepted engineering principles, and including performance and environmental parameters specific to nuclear facilities. The ASME NOG-1 and ASME NUM-1 standards not only provide enhanced safety for handling a

critical load, but also increase profit by minimizing the possibility of load drops, by reducing cumbersome operating restrictions, and by providing the foundation for a sound licensing position. The ASME nuclear crane standards can also increase profit by providing the designs and information to help ensure that the right standard equipment is purchased. Additionally, the ASME nuclear crane standards can increase profit by providing designs and information to help address current issues, such as the qualification of nuclear plant cranes for making 'planned engineered lifts' for steam generator replacement and decommissioning.

Author

*Gantry Cranes; Nuclear Energy; Standards; Safety*

## 38

### QUALITY ASSURANCE AND RELIABILITY

*Includes approaches to, and methods for reliability analysis and control, inspection, maintainability, and standardization.*

**20030002471** University of Central Florida, Electrical and Computer Engineering Dept., Orlando, FL USA

#### **LYAPUNOV-Based Sensor Failure Detection and Recovery for the Reverse Water Gas Shift Process**

Haralambous, Michael G., University of Central Florida, USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

Livingstone, a model-based AI software system, is planned for use in the autonomous fault diagnosis, reconfiguration, and control of the oxygen-producing reverse water gas shift (RWGS) process test-bed located in the Applied Chemistry Laboratory at KSC. In this report the RWGS process is first briefly described and an overview of Livingstone is given. Next, a Lyapunov-based approach for detecting and recovering from sensor failures, differing significantly from that used by Livingstone, is presented. In this new method, models used are in terms of the defining differential equations of system components, thus differing from the qualitative, static models used by Livingstone. An easily computed scalar inequality constraint, expressed in terms of sensed system variables, is used to determine the existence of sensor failures. In the event of sensor failure, an observer/estimator is used for determining which sensors have failed. The theory underlying the new approach is developed. Finally, a recommendation is made to use the Lyapunov-based approach to complement the capability of Livingstone and to use this combination in the RWGS process.

Author

*Static Models; Detection; Error Analysis; Failure; Liapunov Functions*

**20030002518** Miami Univ., Manufacturing Engineering Dept., FL USA

#### **Evaluation of the NASA Quality Surveillance System Pilot in Meeting Requirements for Contractor Surveillance Under Performance Based Contracting**

Schmahl, Karen E., Miami Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

The use of performance-based contracting at Kennedy Space Center has necessitated a shift from intrusive oversight of contractor activities to an insight surveillance role. This paper describes the results of a pilot implementation of the NASA Quality Surveillance System (NQSS) in the Space Shuttle Main Engines Processing Facility. The NQSS is a system to sample contractor activities using documented procedures, specifications, drawings and observations of work in progress to answer the question "Is the contractor doing what they said they would do?" The concepts of the NQSS are shown to be effective in providing assurance of contractor quality. Many of the concepts proven in the pilot are being considered for incorporation into an overall KSC Quality Surveillance System.

Author

*Evaluation; Surveillance; Qualitative Analysis*

**20030002822** NASA Langley Research Center, Hampton, VA USA

#### **Construction of Response Surface with Higher Order Continuity and Its Application to Reliability Engineering**

Krishnamurthy, T., NASA Langley Research Center, USA; Romero, V. J., Sandia National Labs., USA; [2002]; 14p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1466; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The usefulness of piecewise polynomials with C1 and C2 derivative continuity for response surface construction method is examined. A Moving Least Squares (MLS) method is developed and compared with four other interpolation methods, including kriging. First the selected methods are applied and compared with one another in a two-design variables problem with a known theoretical response function. Next the methods are tested in a four-design variables problem from a reliability-based design application. In general the piecewise polynomial with higher order derivative continuity methods produce less error in the response prediction. The MLS method was found to be superior for response surface construction among the methods evaluated.

Author

*Interpolation; Reliability Engineering; Continuity (Mathematics); Polynomials; Surface Geometry*

**20030004228** Nondestructive Testing Information Analysis Center, Austin, TX USA

**Development of Accept Reject Criteria for Requalification of High Pressure Steel and Aluminum Cylinders *Final Report***

Toughiry, M.; Jul. 2002; 42p; In English

Report No.(s): PB2003-101667; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Seamless steel cylinders that are used to transport high pressure gases are required to meet safety regulations promulgated by the U.S. Department of Transportation and other national authorities. As part of these safety regulations the cylinders are required to be periodically retested during their lifetime. This report describes a study where the performance of selected cylinders was evaluated based on the principals of structural integrity analysis. The effect of various types and sizes of flaws on the performance of seamless steel cylinders was evaluated by analytical modeling that was verified by using data from other studies which involved extensive testing of steel cylinders containing flaws. The API 579 Recommended Practice Fitness-for-Service methods of analysis were shown to reliably define the critical flaw sizes for flaws in seamless steel cylinders. Allowable flaw sizes can be established by calculating the amount of fatigue crack growth during the use of the cylinder using established fatigue crack growth data and analysis. The allowable flaw sizes are then used to set the acceptance levels for flaws at the time of inspection or retesting the cylinders.

NTIS

*Steels; Aluminum Alloys; Criteria; Storage Tanks; High Pressure*

### 39

## STRUCTURAL MECHANICS

*Includes structural element design, analysis and testing; dynamic responses of structures; weight analysis; fatigue and other structural properties; and mechanical and thermal stresses in structure. For applications see 05 Aircraft Design, Testing and Performance and 18 Spacecraft Design, Testing and Performance.*

**20030002490** Universal Technology Corp., Dayton, OH USA

**High Cycle Fatigue (HCF) Science and Technology Program *Final Report, 1 Jan.-31 Dec. 2001***

Bartsch, Thomas M.; May 2002; 232p; In English; Original contains color images

Contract(s)/Grant(s): F33615-98-C-2807; Proj-APPL

Report No.(s): AD-A408071; AFRL-PR-WP-TR-2002-2060; No Copyright; Avail: CASI; A11, Hardcopy

This fifth annual report of the National Turbine Engine High Cycle Fatigue (HCF) Program is a brief review of work completed, work in progress, and technical accomplishments. This program is a coordinated effort with participation by the Air Force, the Navy, and NASA. The technical efforts are organized under seven action teams Materials Damage Tolerance Research, Forced Response Prediction, Component Analysis, Instrumentation, Passive Damping Technology, Component Surface Treatments, and Engine Demonstration and two Programs Test and Evaluation, and Transitions (ENSIP).

DTIC

*Damping; Fatigue (Materials); Damage; Tolerances (Mechanics)*

**20030002509** Materials Modification, Inc., Fairfax, VA USA

**High Stiffness High Damping Structure *Final Report, 1 Sep. 2001-31 Jan. 2002***

Radhakrishnan, R.; Kotha, S.; Sylvester, K.; Feb. 28, 2002; 9p; In English

Contract(s)/Grant(s): F49620-01-1-0491

Report No.(s): AD-A407965; MMI-02-003; AFRL-SR-AR-TR-02-0404; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This effort was an investigation on the preparation of a novel smart structure with tunable damping and stiffness properties. This structure was a Magneto-rheological (MR) fluid filled volumetrically stiff cylinder. The MR fluid contained magnetic

particles with various particle sizes ranging from nanometers (15-20 nm) to several microns (45 microns). An application of an external magnetic field would then alter the rheology of the MR fluid thereby resulting in variation in stiffness and damping properties of the cylinder. Fluids were prepared with various amounts of solids loading and filled in a tube. The behavior of the struts containing a mixture of nano and micron sized iron powders were strongly influenced by the weight fraction of the large particles.

DTIC

*Liquids; Stiffness; Damping*

**20030002647** Army Research Lab., Sensors Directorate, Adelphi, MD USA

**Stress in Rotating Disks and Cylinders Final Report, 1998-2000**

Bahder, Thomas B.; Oct. 2002; 34p; In English

Report No.(s): AD-A407981; ARL-TR-2576; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The solution of the classic problem of stress in a rotating elastic disk or cylinder, as solved in standard texts on elasticity theory, has two features: dynamical equations are used that are valid only in an inertial frame of reference, and quadratic terms are dropped in displacement gradient in the definition of the strain. I show that, in an inertial frame of reference where the dynamical equations are valid, it is incorrect to drop the quadratic terms because they are as large as the linear terms that are kept. I provide an alternate formulation of the problem by transforming the dynamical equations to a corotating frame of reference of the disk/cylinder, where dropping the quadratic terms in displacement gradient is justified. The analysis shows that the classic textbook derivation of stress and strain must be interpreted as being carried out in the corotating frame of the medium.

DTIC

*Stresses; Electron Guns*

**20030002651** Boeing Phantom Works, Open Systems Architecture, Seattle, WA USA

**Structural Technology and Analysis Program (STAP) Delivery Order 0004: Durability Patch Final Report, 1 May 1995-29 Jun. 2001**

Ikegami, Roy; Haugse, Eric; Trego, Angela; Rogers, Lynn; Maly, Joe; Jun. 2001; 142p; In English; Original contains color images; Prepared in collaboration with CSA Engineering

Contract(s)/Grant(s): F33615-95-D-3203; Proj-0AFF

Report No.(s): AD-A408003; AFRL-VA-WP-TR-2001-3037; No Copyright; Avail: Defense Technical Information Center (DTIC)

Structural cracks in secondary structure, resulting from a high cycle fatigue (HCF) environment, are often referred to as nuisance cracks. This type of damage can result in costly inspections and repair. The repairs often do not last long because the repaired structure continues to respond in a resonant fashion to the environment. Although the use of materials for passive damping applications is well understood, there are few applications to high-cycle fatigue problems. This is because design information characterization temperature, resonant response frequency and strain levels are difficult to determine. The Durability Patch and Damage Dosimeter Program addressed these problems by: (1) Developing a damped repair design process which includes a methodology for designing the material and application characteristics required to optimally damp the repair. (2) Designing and developing a rugged, small, and lightweight data acquisition unit called the damage dosimeter. This is a battery operated, single board computer, capable of collecting three channels of strain and one channel of temperature, processing this data by user developed algorithms written in the C programming language, and storing the processed data in resident memory. The dosimeter is used to provide flight data needed to characterize the vibration environment. The vibration environment is then used to design the damping material characteristics and repair. The repair design methodology and dosimeter were demonstrated on B-52, C-130, and F-15 aircraft applications.

DTIC

*Fighter Aircraft; Dosimeters; Cracks; Structural Analysis; C (Programming Language); Design Analysis; Data Storage*

**20030002801** NASA Langley Research Center, Hampton, VA USA

**Structural Response of Compression-Loaded, Tow-Placed, Variable Stiffness Panels**

Wu, K. Chauncey, NASA Langley Research Center, USA; Guerdal, Zafer, Virginia Polytechnic Inst. and State Univ., USA; Starnes, James H., Jr., NASA Langley Research Center, USA; [2002]; 23p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1512; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Results of an analytical and experimental study to characterize the structural response of two compression-loaded variable stiffness composite panels are presented and discussed. These variable stiffness panels are advanced composite structures, in which tows are laid down along precise curvilinear paths within each ply and the fiber orientation angle varies continuously throughout each ply. The panels are manufactured from AS4/977-3 graphite-epoxy pre-preg material using an advanced tow placement system. Both variable stiffness panels have the same layup, but one panel has overlapping tow bands and the other panel has a constant-thickness laminate. A baseline cross-ply panel is also analyzed and tested for comparative purposes. Tests performed on the variable stiffness panels show a linear prebuckling load-deflection response, followed by a nonlinear response to failure at loads between 4 and 53 percent greater than the baseline panel failure load. The structural response of the variable stiffness panels is also evaluated using finite element analyses. Nonlinear analyses of the variable stiffness panels are performed which include mechanical and thermal prestresses. Results from analyses that include thermal prestress conditions correlate well with measured variable stiffness panel results. The predicted response of the baseline panel also correlates well with measured results.

Author

*Panels; Stiffness; Compression Loads; Dynamic Structural Analysis; Composite Structures; Mathematical Models*

**20030002802** NASA Langley Research Center, Hampton, VA USA

**Buckling Load Calculations of the Isotropic Shell A-8 Using a High-Fidelity Hierarchical Approach**

Arbocz, Johann, Technische Hogeschool, Netherlands; Starnes, James H., NASA Langley Research Center, USA; [2002]; 28p; In English; 43rd AIAA/AMSE/ASCE/AHS Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAG1-2129

Report No.(s): AIAA Paper 2002-1513; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

As a step towards developing a new design philosophy, one that moves away from the traditional empirical approach used today in design towards a science-based design technology approach, a test series of 7 isotropic shells carried out by Aristocrat and Babcock at Caltech is used. It is shown how the hierarchical approach to buckling load calculations proposed by Arbocz et al can be used to perform an approach often called 'high fidelity analysis', where the uncertainties involved in a design are simulated by refined and accurate numerical methods. The Delft Interactive Shell DEsign COde (short, DISDECO) is employed for this hierarchical analysis to provide an accurate prediction of the critical buckling load of the given shell structure. This value is used later as a reference to establish the accuracy of the Level-3 buckling load predictions. As a final step in the hierarchical analysis approach, the critical buckling load and the estimated imperfection sensitivity of the shell are verified by conducting an analysis using a sufficiently refined finite element model with one of the current generation two-dimensional shell analysis codes with the advanced capabilities needed to represent both geometric and material nonlinearities.

Author

*Shells (Structural Forms); Critical Loading; Numerical Analysis; Structural Design; Mathematical Models; Buckling; Mechanical Properties; Defects; Applications Programs (Computers)*

**20030003720** NASA Glenn Research Center, Cleveland, OH USA

**Influence of Cooling Hole Geometry and Material Conductivity on the Thermal Response of Cooled Silicon Nitride Plate**

Abdul-Aziz, Ali, Cleveland State Univ., USA; Bhatt, Ramakrishna T., Army Research Lab., USA; Girgis, Morris, Central State Univ., USA; November 2002; 14p; In English; 26th Annual International Conference on Advanced Ceramics and Composites, 13-18 Jan. 2002, Cocoa Beach, FL, USA; Sponsored by American Ceramic Society, USA; Original contains color illustrations

Contract(s)/Grant(s): RTOP 708-31-13

Report No.(s): NASA/TM-2002-211688; E-13417; NAS 1.15:211688; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

To complement the effectiveness of ceramic materials and the applicability to turbine engine applications, a parametric study using the finite element method was carried out. This study conducted thorough analyses of a thermal-barrier-coated silicon nitride (Si<sub>3</sub>N<sub>4</sub>) plate specimen with cooling channels, where its thermal conductivity was verified in an attempt to minimize the thermal stresses and reach an optimal rate of stress. The thermal stress profile was generated for specimens with circular and square cooling channels. Lower stresses were reported for a higher magnitude of thermal conductivity and in particular for the circular cooling channel arrangement. Contour plots for the stresses and the temperature are presented and discussed.

Author

*Ceramics; Finite Element Method; Silicon Nitrides; Thermal Stresses; Turbine Engines; Coatings*

**20030003790** NASA Langley Research Center, Hampton, VA USA

**Buckling Design Studies of Inverted, Oblate Bulkheads for a Propellant Tank**

Smeltzer, Stanley S., III, NASA Langley Research Center, USA; Bowman, Lynn M., Lockheed Martin Engineering and Sciences Co., USA; [2002]; 13p; In English; 43rd AIAA/ASME/ASCE Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1525; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An investigation of the deformation and buckling characteristics of a composite, oblate bulkhead that has an inverted geometry and is subjected to pressure-only loading is presented for three bulkhead geometries and thicknesses. The effects of a stiffening support ring at the bulkhead to cylinder interface are also evaluated. Buckling analyses conducted using the axisymmetric shell code BOSOR4 are discussed for several bulkhead configurations. These results are analytically verified using results from the Structural Analysis of General Shells (STAGS) code for a selected bulkhead configuration. The buckling characterization of an inverted, oblate bulkhead requires careful attention as small changes in bulkhead parameters can have a significant effect on the critical buckling load. Comparison of BOSOR4 and STAGS results provided a very good correlation between the two analysis methods. In addition, the analysis code BOSOR4 was found to be an efficient sizing tool that is useful during the preliminary design stage of a practical shell structure. Together, these two aspects should give the design engineer confidence in sizing these stability critical structures. Additional characterization is warranted, especially for a composite tank structure, since only one bulkhead configuration was examined closely.

Author

*Bulkheads; Buckling; Cylindrical Shells; Propellant Tanks; Structural Analysis; Computer Programs*

## 42

### GEOSCIENCES (GENERAL)

*Includes general research topics related to the Earth sciences, and the specific areas of petrology, mineralogy, and general geology. For other specific topics in geosciences see categories 41 through 48.*

**20030002364** Massachusetts Inst. of Tech., Dept. of Earth, Atmospheric, and Planetary Sciences, Cambridge, MA USA

**Solar System Dynamics Final Report, 1 Oct. 1996 - 30 Sep. 2002**

Wisdom, Jack, Massachusetts Inst. of Tech., USA; Dec. 18, 2002; 6p; In English

Contract(s)/Grant(s): NAG5-3915; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In these 18 years, the research has touched every major dynamical problem in the solar system, including: the effect of chaotic zones on the distribution of asteroids, the delivery of meteorites along chaotic pathways, the chaotic motion of Pluto, the chaotic motion of the outer planets and that of the whole solar system, the delivery of short period comets from the Kuiper belt, the tidal evolution of the Uranian and Galilean satellites, the chaotic tumbling of Hyperion and other irregular satellites, the large chaotic variations of the obliquity of Mars, the evolution of the Earth-Moon system, and the resonant core-mantle dynamics of Earth and Venus. It has introduced new analytical and numerical tools that are in widespread use. Today, nearly every long-term integration of our solar system, its subsystems, and other solar systems uses algorithms that was invented. This research has all been primarily supported by this sequence of PGG NASA grants. During this period published major investigations of tidal evolution of the Earth-Moon system and of the passage of the Earth and Venus through non-linear core-mantle resonances were completed. It has published a major innovation in symplectic algorithms: the symplectic corrector. A paper was completed on non-perturbative hydrostatic equilibrium.

Derived from text

*Solar System; Tumbling Motion; Asteroids; Earth-Moon System; Galilean Satellites; Gas Giant Planets*

**20030003709** Lawrence Livermore National Lab., Livermore, CA USA

**MENA 1.1: An Updated Geophysical Regionalization of the Middle East and North Africa**

Walter, W. R.; Pasyanos, M. E.; Bhattacharyya, J.; O'Boyle, J.; Mar. 01, 2000; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-792771; UCRL-ID-138079; No Copyright; Avail: National Technical Information Service (NTIS)

This short report provides an update to the earlier LLNL paper entitled Preliminary Definition of Geophysical Regions for the Middle East and North Africa. This report is designed to be used in combination with that earlier paper. The reader is referred to Sweeney and Walter (1998) for all details, including definitions, references, uses, shortcomings, etc., of the regionalization process. In this report we will discuss only those regions in which we have changed the boundaries or velocity structure from that

given by the original paper. The paper by Sweeney and Walter (1998) drew on a variety of sources to estimate a preliminary, first-order regionalization of the Middle East and North Africa (MENA), providing regional boundaries and velocity models within each region. The model attempts to properly account for major structural discontinuities and significant crustal thickness and velocity variations on a gross scale.

NTIS

*Geophysics; Geology; Middle East; Africa; Monitors*

**20030003712** Lawrence Livermore National Lab., Livermore, CA USA

**Strength and Damage Model for Rock Under Dynamic Loading**

Yu Vorobiev, O.; Antoun, T. H.; Lomov, I. N.; Glenn, L. A.; Dec. 01, 1999; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-792018; UCRL-JC-134523-REV-1; No Copyright; Avail: National Technical Information Service (NTIS)

A thermodynamically consistent strength and failure model for granite under dynamic loading has been developed and evaluated. The model agrees with static strength measurements and describes the effects of pressure hardening, bulking, shear-enhanced compaction, porous dilation, tensile failure, and failure under compression due to distortional deformations. This paper briefly describes the model and the sensitivity of the simulated response to variations in the model parameters and in the inelastic deformation processes used in different simulations. Numerical simulations of an underground explosion in granite are used in the sensitivity study.

NTIS

*Dynamic Loads; Rock Mechanics; Tensile Strength; Rocks*

**20030003770** Geological Survey, Water Resources Div., Albuquerque, NM USA

**Water Resources Data New Mexico, Water Year 2001 Annual Report, 1 Oct. 2000 - 30 Sep. 2001**

Byrd, D.; Lange, K.; Beal, L.; Jul. 2002; 442p; In English

Report No.(s): PB2003-100162; USGS-WDR-NM-01-1; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

Water-resources data for 2001 water year for New Mexico consist of records of discharge and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and water levels and water quality in wells and springs. This report contains discharge records for 173 gaging stations; stage and contents for 24 lakes and reservoirs; water quality for 37 gaging stations, 43 wells, and 11 partial-record stations and miscellaneous sites; and water levels at 136 observation wells. Also included are 84 crest-stage, partial record stations. Additional water data were collected at various sites not involved in the systematic data-collection program and are published as miscellaneous measurements. One seepage investigation was made during the year. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating Federal, State, and local agencies in New Mexico.

NTIS

*New Mexico; Ground Water; Hydrology; Surface Water*

**20030003771** Geological Survey, Water Resources Div., Tallahassee, FL USA

**Water Resources Data for Florida, Water Year 2001, Volume 3A, Southwest Florida Surface Water Annual Report, 1 Oct. 2000 - 30 Sep. 2001**

Stoker, Y. E.; Kane, R. L.; Fletcher, W. L.; May 30, 2002; 422p; In English

Report No.(s): PB2003-100163; USGS-WDR-FL-01-Vol-3A; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

Water resources data for the 2001 water year in Florida consist of continuous or daily discharges for 406 streams, periodic discharge for 12 streams, continuous or daily stage for 142 streams, periodic stage for 12 streams, peak stage and discharge for 37 streams, continuous or daily elevations for 11 lakes, periodic elevations for 30 lakes; continuous ground-water levels for 424 wells, periodic ground-water levels for 1,426 wells, and quality-of-water data for 80 surface-water sites and 245 wells. The data for Southwest Florida include records of stage, discharge, and water quality of streams; stage, contents, water quality of lakes and reservoirs, and water levels and water quality of ground-water wells. These data represent the National Water Data System records collected by the U.S. Geological Survey and cooperating local, state, and federal agencies in Florida.

NTIS

*Florida; Surface Water; Hydrology*

**20030003772** Bureau of Reclamation, Technical Service Center, Denver, CO USA

**Harvests of Plenty: A History of the Yakima Irrigation Project, Washington**

Jun. 2002; 226p; In English

Report No.(s): PB2003-100210; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This document provides a history of the development of the Yakima Irrigation Project in Washington. The Yakima Project was one of the first undertaken by Reclamation and it also became a typical pattern whereby the Bureau of Reclamation intervened to help locals develop an irrigation project for the area. This was accomplished with the construction of 6 storage reservoirs to store, regulate and move water in a unified system.

NTIS

*Histories; Governments*

**20030003773** Geological Survey, Water Resources Div., Montgomery, AL USA

**Ground-Water Quality Beneath an Urban Residential and Commercial Area, Montgomery, Alabama, 1999-2000**

Robinson, J. L.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): PB2003-100993; USGS-WRI-02/4052; No Copyright; Avail: National Technical Information Service (NTIS)

The objectives of this report are to (1) describe the quality of ground water beneath an urban area in Montgomery, Alabama, and compare it to regional ground-water quality in the same aquifer system; and (2) describe selected environmental factors that may be influencing ground-water quality beneath the urban area. Hydrologic and geologic data collected during the drilling of 30 wells were used to describe the hydrogeology of the shallow aquifer underlying the urban area. Water quality was determined in samples collected from the 30 urban wells. Ground-water quality in the urban area was compared and contrasted to the water quality of samples collected from 30 wells completed in the same aquifer but located in rural (low-density residential to forested land use) settings in Mississippi and Alabama.

NTIS

*Ground Water; Water Quality; Water Pollution; Water Sampling; Pollution Monitoring*

**20030003774** Geological Survey, Austin, TX USA

**Computed and Estimated Pollutant Loads, West Fork Trinity River, Fort Worth, Texas, 1997**

McKee, P. W.; McWreath, H. C.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): PB2003-101064; USGS/WRI-01-4253; No Copyright; Avail: National Technical Information Service (NTIS)

Two models (described later in this report) have been developed to estimate the pollutant loads in storm runoff from urban basins in the Dallas-Fort Worth (DFW) metropolitan area, Texas. A deterministic model, the Watershed Management Model (WMM), estimates a total basin pollutant load by multiplying an event-mean concentration (EMC) by estimated runoff for each type of land use and then summing the loads for each land use (Rough River National Wet Weather Demonstration Project, 1998). A statistical model, developed by the U.S. Geological Survey (USGS), uses multi-variable regression equations to estimate pollutant loads in storm runoff. This report documents the derivation of estimated storm-runoff pollutant loads from the two models and compares the estimated loads with loads computed from measured data at USGS streamflow-gaging station 08048543 West Fork Trinity River at Beach Street, Fort Worth. The properties and constituents for which loads were computed are biochemical oxygen demand, chemical oxygen demand, suspended solids, dissolved solids, total nitrogen, total ammonia plus organic nitrogen (also known as total Kjeldahl nitrogen), total phosphorus, dissolved phosphorus, total recoverable copper, total recoverable lead, total recoverable zinc, and total diazinon.

NTIS

*Hydrology; Contaminants; Drainage; Water Runoff*

**20030003776** Federal Geographic Data Committee, Reston, VA USA

**Content Standard for Digital Geospatial Metadata Workbook, 2.0**

May 01, 2000; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM  
Report No.(s): PB2003-101444; No Copyright; Avail: National Technical Information Service (NTIS)

Table of Contents: Metadata; Content Standard for Digital Geospatial Metadata-Background; Content Standard for Digital Geospatial Metadata-Explanation; Graphical representation of the content standard for digital geospatial metadata; Graphical

representations and text of sections of the standard; Profiles; User defined extensions; Example: U.S. Geological Survey Digital Line Graph; Example: National Wetlands Inventory (NWI) wetlands data; Glossary and References.

NTIS

*Standards; Digital Systems*

**20030003778** Geological Survey, Upper Midwest Environmental Sciences Center, La Crosse, WI USA

**Recommended Investigations of Sediment Transport and Deposition for Predicting Future Configurations of Upper Mississippi River System Channels and Floodplain, Workshop Report. Long Term Resource Monitoring Program *Final Report***

Gaugush, R. F.; Wilcox, D. B.; Sep. 2002; 18p; In English

Report No.(s): PB2003-101509; LTRMP-2002-P001; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This document reviews the progress made in the study of sediment transport and geomorphology in the Upper Mississippi River System since the 1994 meeting of the working group that developed a description of activities needed. Identifies the work performed in the prescribed tasks and describes additional work to be performed, in particular the research and monitoring by the Long Term Resource Monitoring Program and the U.S. Army Corps of Engineers.

NTIS

*Sediment Transport; Flood Plains; Deposition*

**20030003833** Interagency Task Force on Floodplain Management, Washington, DC USA

**Natural and Beneficial Functions of Floodplains: Reducing Flood Losses by Protecting and Restoring the Floodplain Environment**

Jun. 2002; 104p; In English

Report No.(s): PB2003-100448; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

This report documents the findings and recommendations of the Task Force on the Natural and Beneficial Functions of the Floodplain (Task Force) established under Section 562 of the National Flood Insurance Reform Act (NFIRA) of 1994. Congress directed the Task Force to: identify the natural and beneficial functions of floodplains that reduce flood losses; and recommend how the nation can further reduce flood losses through the protection and restoration of the natural and beneficial functions of the floodplain.

NTIS

*Flood Plains; Hydrology*

**20030004227** Geological Survey, Water resources Div., Carson City, NV USA

**Probability Distributions of Hydraulic Conductivity for the Hydrogeologic Units of the Death Valley Regional Ground-Water Flow System, Nevada and California**

Belcher, W. R.; Sweetkind, D. S.; Elliott, P. E.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): PB2003-101508; USGS/WRI-02-4212; No Copyright; Avail: CASI; C01, CD-ROM

The probability distributions of hydraulic conductivity were estimated to support regional-scale simulation of groundwater flow in the Death Valley regional groundwater flow system. Fracturing appears to have the greatest influence on the permeability of bedrock hydrogeologic units, within this region. The degree of alteration and welding in the Tertiary volcanic rocks also influences hydraulic conductivity. As the degree of alteration increases, hydraulic conductivity decreases. Increasing welding appears to increase hydraulic conductivity because degrees of welding increases the brittleness of the volcanic rocks, thus increasing the amount of fracturing.

NTIS

*Ground Water; Hydrogeology; Hydraulics; Conductivity*

## EARTH RESOURCES AND REMOTE SENSING

*Includes remote sensing of earth features, phenomena and resources by aircraft, balloon, rocket, and spacecraft; analysis or remote sensing data and imagery; development of remote sensing products; photogrammetry; and aerial photographs. For instrumentation see 35 Instrumentation and Photography.*

**20030002405** Geological Survey, Gap Analysis Program, Moscow, ID USA

**GAP Analysis Bulletin Number 10 Annual Report**

Brackney, Elisabeth S.; Jennings, Michael D.; Gergely, Kevin J.; Brannon, Ree; Dec. 2001; 71p; In English  
Report No.(s): AD-A407826; NO 10; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The 2001 issue of the Gap Analysis Bulletin is the tenth in a series of annual publications produced by the National Gap Analysis Program. Gap Analysis Bulletin No. 10 features 13 articles on various aspects of gap analysis methods and results. Topics addressed include land cover mapping, animal distribution modeling and applications. The bulletin also includes a section on the current status of each GAP state project. This issue also contains summaries of two final reports from recently completed GAP state projects.

DTIC

*Landforms; Ecology; Soil Mapping*

**20030002463** NASA Marshall Space Flight Center, Huntsville, AL USA

**Mapping The Ancient Maya Landscape From Space**

Sever, Tom, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; International Space University, NASA Remote Sensing and Archeology Conference, 4 Nov. 2002, Strasbourg, France; No Copyright; Avail: Issuing Activity; Abstract Only

The Peten region of northern Guatemala is one of the last places on earth where major archeological sites remain to be discovered. It was in this region that the Maya civilization began, flourished, and abruptly disappeared. Remote sensing technology is helping to locate and map ancient Maya sites that are threatened today by accelerating deforestation and looting. Thematic Mapper and IKONOS satellite and airborne Star3-I radar data, combined with Global Positioning System (GPS) technology, are successfully detecting ancient Maya features such as cities, roadways, canals, and water reservoirs. Satellite imagery is also being used to map the bajos, which are seasonally flooded swamps that cover over 40% of the land surface. The use of bajos for farming has been a source of debate within the professional community for many years. But the recent detection and verification of cultural features within the bajo system by our research team are providing conclusive evidence that the ancient Maya had adapted well to wetland environments from the earliest times and utilized them until the time of the Maya collapse. The use of the bajos for farming is also an important resource for the future of the current inhabitants who are experiencing rapid population growth. Remote sensing imagery is also demonstrating that in the Preclassic period (600 BC- AD 250), the Maya had already achieved a high organizational level as evidenced by the construction of massive temples and an elaborate inter-connecting roadway system. Although they experienced several setbacks such as droughts and hurricanes, the Maya nevertheless managed the delicate forest ecosystem successfully for several centuries. However, around AD 800, something happened to the Maya to cause their rapid decline and eventual disappearance from the region. The evidence indicates that at this time there was increased climatic dryness, extensive deforestation, overpopulation, and widespread warfare. This raises a question that is relevant to the contemporary world--namely, how severe do internal stresses in a civilization have to become before relatively minor climate shifts can trigger a widespread cultural collapse?

Author

*Archaeology; Cultural Resources; Remote Sensing; Mapping*

**20030002757** NASA Goddard Space Flight Center, Greenbelt, MD USA

**GRACE: Gravity Recovery and Climate Experiment**

Ward, A.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): PB2002-108618; NASA-NP-2002-2-427-GSFC; NAS 1.83:2-427-GSFC; No Copyright; Avail: National Technical Information Service (NTIS)

While gravity is much weaker than other basic forces in nature, such as magnetism and electricity, its effects are ubiquitous and dramatic. Gravity controls everything from the motion of the ocean tides to the expansion of the entire Universe. To learn more about the mysteries of gravity, twin satellites named GRACE--short for the Gravity Recovery and Climate Experiment--are being launched to make detailed measurements of Earth's gravity field. This experiment could lead to discoveries about gravity and Earth's natural systems, which could have substantial benefits for society and the world's population. The GRACE mission will

be the inaugural flight of NASA's Earth System Science Pathfinder Program (ESSP). A component of NASA's Earth Science Enterprise (ESE), the ESSP missions are intended to address unique, specific highly focused scientific issues and provide measurements required to support Earth science research.

NTIS

*Earth Gravitation; Climate; Magnetic Properties; Earth Sciences*

**20030003900** Geological Survey, Water Resources Div., Tucson, AZ USA

**Water Resources Data Arizona: Water Year 2001 Annual Report, 1 Oct. 00 - 30 Sep. 01**

McCormack, H. F.; Fish, G. G.; Duet, N. R.; Evans, D. W.; Castillo, N. K.; Jul. 2002; 432p; In English

Report No.(s): PB2003-100158; USGS/WDR-AZ-01-1; No Copyright; Avail: CASI; A19, Hardcopy; A04, Microfiche

The Arizona District water data report includes records on both surface water and ground water in the State for water year 2001. Specifically, it contains: (1) Discharge records for 197 streamflow-gaging stations, for 29 crest-stage, partial-record streamflow stations, and 53 miscellaneous sites; (2) contents only records for 8 lakes and reservoirs; stage and (or) content records for 1 lake; (3) water-quality records for 16 continuous-record stations, 2 miscellaneous sites, and 155 wells; (4) ground-water levels and compaction values for 18 stations; and (5) water levels for 19 wells.

NTIS

*Arizona; Surface Water; Ground Water; Hydrology*

**20030003997** Geological Survey, Water Resources Div., New Cumberland, PA USA

**Water Resources Data for Pennsylvania, Water Year 2001, Volume 1, Delaware River Basin**

Durlin, R. R.; Schaffstall, W. P.; 2002; 558p; In English

Report No.(s): PB2003-100433; No Copyright; Avail: CASI; A24, Hardcopy; A04, Microfiche

Water resources data for the 2001 water year for Pennsylvania consist of records of discharge and water quality of streams; contents and elevations of lakes and reservoirs; and water levels and water quality of ground-water wells. This report, Volume 1 contains (1) discharge records for 77 continuous-record streamflow-gaging stations, 7 partial-record stations and 45 special-study and miscellaneous sites; (2) elevation and contents records for 13 lakes and reservoirs; (3) water quality records for 24 gaging stations and 13 ungaged streamsites; (4) water-quality records for 21 special-study stations; (5) water-level records for 55 network observation wells; and (6) water-quality analyses of ground water from 111 ground-water wells. Site locations are shown in figures 6-17. Additional water data collected at various sites not involved in the systematic data-collection program are also presented. These data together with the data in Volumes 2 and 3, represent that part of the National Water Data System operated by the U.S. Geological Survey and cooperating State, local, and Federal agencies in Pennsylvania.

NTIS

*Pennsylvania; Surface Water; Ground Water; Hydrology; Water Resources*

**20030003999** Geological Survey, Water Resources Div., Tampa, FL USA

**Water Resources Data for Florida: Water Year 2001, Volume 3B, Southwest Florida Ground Water**

Stoker, Y. E.; Kane, R. L.; Fletcher, W. L.; May 30, 2002; 246p; In English

Report No.(s): PB2003-100167; USGS/WDR/FL-01-03B; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

Water resources data for the 2001 water year in Florida consist of continuous or daily discharges for 406 streams, periodic discharge for 12 streams, continuous daily stage for 142 streams, periodic stage for 12 streams, peak stage and discharge for 37 streams, continuous or daily elevations for 11 lakes, periodic elevations for 30 lakes; continuous ground-water levels for 424 wells, periodic ground-water levels for 1,426 wells, and quality-of-water data for 80 surface-water sites and 245 wells. The data for Southwest Florida include records of stage, discharge, and water quality of streams; stage, contents, water quality of lakes and reservoirs, and water levels and water quality of ground-water wells. Volume 3B contains records for continuous ground-water elevations for 128 wells; periodic ground-water elevations at 33 wells; miscellaneous ground-water elevations at 347 wells; and water quality at 25 ground-water sites.

NTIS

*Florida; Hydrology; Surface Water; Ground Water*

**20030004000** Geological Survey, Water Resources Div., Tallahassee, FL USA

**Water Resources Data for Florida: Water Year 2001, Volume 1A, Northeast Florida Surface Water Annual Report, 1 Oct. 00 - 30 Sep. 01**

Jun. 13, 2002; 425p; In English

Report No.(s): PB2003-100166; USGS/WDR/FL-01/1A; No Copyright; Avail: CASI; A18, Hardcopy; A04, Microfiche

Water resources data for the 2001 water year in Florida consist of continuous or daily discharge for 404 streams, periodic discharge for 17 streams, continuous or daily stage for 105 streams, periodic stage for 1 stream, peak stage and discharge for 41 streams; continuous or daily elevations for 11 lakes, periodic elevations for 45 lakes; continuous ground-water levels for 424 wells, periodic ground-water levels for 1,326 wells; quality-of-water data for 79 surface-water sites and 114 wells. The data for northeast Florida include continuous or daily discharge for 150 streams, periodic discharge for 3 streams, continuous or daily stage for 22 streams, periodic stage for 0 streams; peak stage and discharge for 0 streams; continuous or daily elevations for 10 lakes, periodic elevations for 20 lakes; continuous ground water levels for 55 wells, periodic ground-water levels for 619 wells; quality-of-water data for 40 surface-water sites and 57 wells.

NTIS

*Florida; Hydrology; Surface Water; Ground Water; Water Resources*

**20030004001** Geological Survey, Water Resources Div., Miami, FL USA

**Water Resources Data for Florida: Water Year 2001, Volume 2B, South Florida Ground Water**

Prinos, S.; Overton, K.; Byrne, M.; 2002; 624p; In English

Report No.(s): PB2003-100165; USGS/WDR/FL-01-2B; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Water resources data for 2001 water year in Florida consists of continuous or daily discharge for 404 streams, periodic discharge for 15 streams, continuous or daily stage for 154 streams, continuous or daily stage for 154 streams, periodic stage for 12 streams, peak discharge for 37 streams, and peak-stage for 37 streams, continuous or daily elevations for 12 lakes, periodic elevations for 50 lakes, continuous ground-water levels for 426 wells, periodic ground-water levels for 1251 wells, quality of water data for 112 surface-water sites, and 235 wells. The data for South Florida included continuous or daily discharge for 89 streams, continuous or daily stage for 64 streams, no peak stage discharge for streams, 1 continuous elevation for lakes, continuous ground-water levels for 244 wells, periodic ground-water levels for 255 wells, water quality for 32 surface-water sites, and 166 wells. The data represent the National Water Data System records collected by the U.S. Geological Survey and cooperation with local, state, and federal agencies in Florida.

NTIS

*Florida; Hydrology; Surface Water; Ground Water*

**20030004002** Geological Survey, Water Resources Div., Troy, NY USA

**Water Resources Data for New York: Water Year 2001, Volume 1, Eastern New York Excluding Long Island Annual Report, 1 Oct. 00 - 30 Sep. 01**

Butch, G. K.; Murray, P. M.; Robideau, J. A.; Gardner, J. A.; 2002; 603p; In English

Report No.(s): PB2003-100161; USGS/WDR/NY-01-1; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Water resources data for the 2001 water year for New York consist of records of stage, discharge, and water quality of streams; stage, contents, and water quality of lakes and reservoirs; and ground-water levels. This volume contains records for water discharge at 144 gaging stations; stage only at 10 gaging stations; stage and contents at 4 gaging stations, and 18 other lakes and reservoirs; water quality at 34 gaging stations; and water levels at 7 observation wells. Also included are data for 34 crest-stage partial-record stations. Locations of all these sites are shown on figure 8. Additional water data were collected at various sites not involved in the systematic data-collection program, and are published as miscellaneous measurements and analyses. These data together with the data in volumes 2 and 3 represent that part of the National Water Data System operated by the U.S. Geological Survey in cooperation with State, Municipal, and Federal agencies in New York.

NTIS

*New York; Surface Water; Ground Water; Hydrology*

**20030004003** Geological Survey, Water Resources Div., Tacoma, WA USA

**Water Resources Data for Washington: Water Year 2001 Annual Report, 1 Oct. 00 - 30 Sep. 01**

Kimbrough, R. A.; Ruppert, G. P.; Wiggins, W. D.; Smith, R. R.; Knowles, S. M.; Aug. 2002; 622p; In English

Report No.(s): PB2003-100157; USGS/WDR/WA-01-1; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Water resources data for the 2001 water year for Washington consist of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and water levels of wells. This report contains: water discharge for 239 gaging stations on streams, canals and drains; stage only records for 9 gaging stations; discharge data for 453 partial-record and miscellaneous sites; stage and (or) contents for 36 lakes and reservoirs; water-quality data for 40 surface-water sites; water levels for 37 observation wells; and water-quality data for 11 observation wells.

NTIS

*Washington; Surface Water; Ground Water; Hydrology*

**20030004004** Geological Survey, Water Resources Div., Columbia, SC USA

**Water Resources Data South Carolina: Water Year 2001 Annual Report, 1 Oct. 00 - 30 Sep. 01**

Cooney, T. W.; Drewes, P. A.; Ellisor, S. W.; Lanier, T. H.; Melendez, F.; Jul. 2001; 688p; In English  
Report No.(s): PB2003-100156; USGS/WDR/SC-01-1; No Copyright; Avail: CASI; A99, Hardcopy; A06, Microfiche

Water Resources data for 2001 water year for South Carolina consists of records of stage, discharge, and water quality of streams; stage and contents of lakes and reservoirs; and levels of ground-water wells. This volume contains records for water discharge at 121 gaging stations, stage only at 44 gaging stations, stage and contents at 14 lakes and reservoirs, water quality and 47 gaging stations and one observation well, water levels at 47 observation wells, and precipitation at 5 gaging stations. Also included are data for 52 crest-stage partial-record stations and discharge measurement information at 7 locations. Locations of these sites are shown on figures 3, 4, 5, 6, and 7. Additional water data were collected at various sites not involved in the systematic data-collection program. These data represent that part of the National Water Data System collected by the U.S. Geological Survey and cooperating State and Federal agencies in South Carolina.

NTIS

*South Carolina; Surface Water; Ground Water; Sediments*

**44**

**ENERGY PRODUCTION AND CONVERSION**

*Includes specific energy conversion systems, e.g., fuel cells; and solar, geothermal, windpower, and waterwave conversion systems; energy storage; and traditional power generators. For technologies related to nuclear energy production see 73 Nuclear Physics. For related information see also 07 Aircraft Propulsion and Power; 20 Spacecraft Propulsion and Power, and 28 Propellants and Fuels.*

**20030002385** Aerospace Corp., Lab. Operations, El Segundo, CA USA

**Storage of Activated Nickel-Hydrogen Cells and Batteries**

Zimmerman, A. H.; Oct. 10, 2002; 16p; In English

Contract(s)/Grant(s): F04701-00-C-0009

Report No.(s): AD-A407682; TR-2002(8555)-9; SMC-TR-03-02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The preferred methods for storing activated nickel-hydrogen cells and batteries are described, along with the mechanisms for chemical and electrochemical processes that can occur during storage to influence the performance and dictate the optimum storage conditions.

DTIC

*Nickel Hydrogen Batteries; Electrochemical Cells; Energy Storage*

**20030002633** NASA Marshall Space Flight Center, Huntsville, AL USA

**Wireless Power Transmission Options for Space Solar Power**

Henley, M. W., Boeing Phantom Works, USA; Potter, Seth D., Boeing Phantom Works, USA; Howell, J., NASA Marshall Space Flight Center, USA; Mankins, J. C., NASA, USA; [2002]; 1p; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA

Contract(s)/Grant(s): NAS8-99140; NAS8-99147; No Copyright; Avail: Issuing Activity; Abstract Only

Space Solar Power (SSP), combined with Wireless Power Transmission (WPT), offers the far-term potential to solve major energy problems on Earth. In this paper WPT options using radio waves and light waves are considered for both long-term and near-term SSP applications. In the long-term, we aspire to beam energy to Earth from geostationary Earth orbit (GEO), or even from the moon. Accordingly, radio- and light- wave WPT options are compared through a wide range of criteria, each showing certain strengths. In the near-term, we plan to beam power over more moderate distances, but still stretch the limits of today's technology. For the near-term, a 100 kWe-class 'Power Plug' Satellite and a 10 kWe-class Lunar Polar Solar Power outpost are considered as the first steps in using these WPT options for SSP. By using SSP and WPT technology in near-term space science and exploration missions, we gain experience needed for sound decisions in designing and developing larger systems to send power from Space to Earth. Power Relay Satellites are also considered as a potential near- to mid-term means to transmit power from Earth to Space and back to distant receiving sites on Earth. This paper briefly considers microwave and laser beaming for an initial Power Relay Satellite system, and concludes that anticipated advancements in laser technology make laser-based concepts more attractive than microwave-based concepts. Social and economic considerations are briefly discussed, and a

conceptual description for a laser-based system is offered for illustrative purposes. Continuing technological advances are needed if laser-based systems are to become practical and efficient or near- and far-term applications.

Author

*Wireless Communication; Communication Satellites; Satellite Networks; Solar Generators; Microwave Power Beaming; Laser Power Beaming; Energy Conversion*

**20030002668** NASA Marshall Space Flight Center, Huntsville, AL USA

**Space Solar Power Technology Demonstration for Lunar Polar Applications**

Henley, M. W., Boeing Co., USA; Fikes, J. C., NASA Marshall Space Flight Center, USA; Howell, J., NASA Marshall Space Flight Center, USA; Mankins, J. C., NASA, USA; Howell, J., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; 53rd International Astronautical Congress, 10-19 Oct. 2002, Houston, TX, USA

Contract(s)/Grant(s): NAS8-99140; NAS8-99147; No Copyright; Avail: Issuing Activity; Abstract Only

A solar power generation station on a mountaintop near the moon's North or South pole can receive sunlight 708 hours per lunar day, for continuous power generation. Power can be beamed from this station over long distances using a laser-based wireless power transmission system and a photo-voltaic receiver. This beamed energy can provide warmth, electricity, and illumination for a robotic rover to perform scientific experiments in cold, dark craters where no other power source is practical. Radio-frequency power transmission may also be demonstrated in lunar polar applications to locate and recover sub-surface deposits of volatile material, such as water ice. High circular polarization ratios observed in data from Clementine spacecraft and Arecibo radar reflections from the moon's South pole suggest that water ice is indeed present in certain lunar polar craters. Data from the Lunar Prospector spacecraft's epi-thermal neutron spectrometer also indicate that hydrogen is present at the moon's poles. Space Solar Power technology enables investigation of these craters, which may contain a billion-year-old stratigraphic record of tremendous scientific value. Layers of ice, preserved at the moon's poles, could help us determine the sequence and composition of comet impacts on the moon. Such ice deposits may even include distinct strata deposited by secondary ejecta following significant Earth (ocean) impacts, linked to major extinctions of life on Earth. Ice resources at the moon's poles could provide water and air for human exploration and development of space as well as rocket propellant for future space transportation. Technologies demonstrated and matured via lunar polar applications can also be used in other NASA science missions (Valles Marineris, Phobos, Deimos, Mercury's poles, asteroids, etc.) and in future large-scale SSP systems to beam energy from space to Earth. Ground-based technology demonstrations are proceeding to mature the technology for such a near-term scientific mission to the moon. This paper reviews the progress to date in demonstrating this technology on Earth and details the plans for near-term applications, to meet NASA's needs, in the moon's polar regions.

Author

*Solar Generators; Laser Power Beaming; Lunar Exploration; Polar Regions; Lunar Roving Vehicles*

**20030003676** Argonne National Lab., IL USA

**Materials for Low-Temperature Solid Oxide Fuel Cells**

Krumpelt, M.; Ralph, J.; Cruse, T.; Bae, J. M.; Jul. 2002; 14p; In English

Report No.(s): DE2002-799806; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Solid oxide fuel cells (SOFCs) are one of the potentially most efficient and clean energy conversion technologies for electric utility applications. Laboratory cells have shown extraordinary durability, and actual utility-scale prototypes have worked very well. The main obstacle to commercialization has been the relatively high manufacturing cost. The U.S. Department of Energy has initiated the Solid State Energy Conversion Alliance (SECA) program for developing small modular stacks ranging in capacity from 5 to 10 kW(1). This size range meets the power requirements of auxiliary power units for heavy and perhaps even light-duty vehicles, and also for remote stationary applications. Argonne National Laboratory is engaged in developing new materials options for SECA applications, as discussed here.

NTIS

*Solid Oxide Fuel Cells; Solid State; Materials Science; Energy Technology; Low Temperature; Manufacturing*

**20030003713** Green Development, LLC, Golden, CO USA

**Development of Optimal SnO(2) Contacts for CdTe Photovoltaic Applications Progress Report, 18 Jun. 1997 - 17 Jun. 1999**

Sep. 1999; 76p; In English

Report No.(s): DE2002-770856; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Contents include the following: Title Sheet; Project Summary of Proposed Phase II Research Project; Table of Content; Organization of R&D Team; Summary of R&D Work and Results of Phase II; Further improvement of conventional SnO<sub>2</sub> films in the 4 inch wide APCVD furnace; Establishing more characterization techniques and evaluation of SnO<sub>2</sub> film properties;

Establishing processing technique of depositing SnO<sub>2</sub> type high resistive TCO (13R.T) coatings by APCVD and optimized the film property; Established the processing of depositing SiO<sub>2</sub> coatings by APCVD and optimized the film property; Develop tin doped indium oxide (ITO) TCO coating by APCVD method; Fabrication of CdS<sub>2</sub>Te Solar Cells; Design and Build 14 inch wide prototype APCVD system; Discussion of R&D Work of Phase II; Plan of Commercialization (Phase III) of the Resulted Technologies; Discussion of Further R&D Work; Thesis Work Resulted From The Project; Publication Resulted From The Project; Acknowledgement; References; Attachment: Subcontractor's Final Report.

NTIS

*Cadmium Tellurides; Tin Oxides; Photovoltaic Effect; Solar Cells; Fabrication; Technology Utilization*

**20030003741** Sandia National Labs., Albuquerque, NM USA

**Status and Needs of Power Electronics for Photovoltaic Inverters: Summary Document**

West, R.; Mauch, K.; Qin, Y. C.; Mohan, N.; Bonn, R.; May 2002; 38p; In English

Report No.(s): DE2002-800947; SAND2002-1085; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Photovoltaic inverters are the most mature of any DER inverter, and their mean time to first failure (MTFF) is about five years. This is an unacceptable MTFF and will inhibit the rapid expansion of PV. With all DER technologies, (solar, wind, fuel cells, and microturbines) the inverter is still an immature product that will result in reliability problems in fielded systems. The increasing need for all of these technologies to have a reliable inverter provides a unique opportunity to address these needs with focused R&D development projects. The requirements for these inverters are so similar that modular designs with universal features are obviously the best solution for a 'next generation' inverter. A 'next generation' inverter will have improved performance, higher reliability, and improved profitability. Sandia National Laboratories has estimated that the development of a 'next generation' inverter could require approximately 20 man-years of work over an 18- to 24-month time frame, and that a government-industry partnership will greatly improve the chances of success.

NTIS

*Inverters; Photovoltaic Cells; Research and Development; Electronic Equipment*

**20030003769** National Renewable Energy Lab., Golden, CO USA

**Wind-Diesel Hybrid Systems for Russia's Northern Territories**

Gevorgian, V.; Touryan, K.; Bezrukikh, P.; Karghiev, V.; Sep. 1999; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-751053; NREL/CP-500-27114; No Copyright; Avail: National Technical Information Service (NTIS)

This paper will summarize the DOE/Russian Ministry of Fuel and Energy (MF&E) activities in Russia's Northern Territories in the field of hybrid wind-diesel power systems over the last three years (1997-1999). The National Renewable Energy Laboratory (NREL) supplied technical assistance to the project, including resource assessment, system design, site identification, training and system monitoring. As a result, several wind-diesel systems have been installed and are operating in the Arkhangelsk/Murmansk regions and in Chukotka. NREL designed and provided sets of data acquisition equipment to monitor several of the first pilot wind-diesel systems. NREL's computer simulation models are being used for performance data analysis and optimizing of future system configurations.

NTIS

*Russian Federation; Energy Consumption; Energy Policy*

**20030003775** Minerals Management Service, Environmental Div., Herndon, VA USA

**Oil-Spill Analysis: Gulf of Mexico Outer Continental Shelf (OCS) Lease Sales, Eastern Planning Area, 2003-2007 and Gulfwide OCS Program, 2003-2042**

Sep. 2002; 74p; In English

Report No.(s): PB2003-101120; OCS-MMS-2002-069; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The Federal Government plans to offer U.S. Outer Continental Shelf (OCS) lands in the Eastern Planning Area of the Gulf of Mexico (GOM) for oil and gas leasing. This report summarizes results of that analysis, the objective of which was to estimate the risk of oil-spill contact to sensitive offshore and onshore environmental resources and socioeconomic features from oil spills accidentally occurring from the OCS activities.

NTIS

*Gulf of Mexico; Risk; Oil Pollution; Spilling; Drilling; Offshore Energy Sources*

**20030003792** Sandia National Labs., Albuquerque, NM USA

**Reactive Ion Etching for Randomly Distributed Texturing of Multicrystalline Silicon Solar Cells. Annual Report**

Zaidi, S. H.; May 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800948; SAND2002-1086; No Copyright; Avail: National Technical Information Service (NTIS)

The quality of low-cost multicrystalline silicon (mc-Si) has improved to the point that it forms approximately 50 % of the worldwide photovoltaic (PV) power production. The performance of commercial mc-Si solar cells still lags behind c-Si due in part to the inability to texture it effectively and inexpensively. Surface texturing of mc-Si has been an active field of research. Several techniques including anodic etching, wet acidic etching, lithographic patterning, and mechanical texturing have been investigated with varying degrees of success. to date, a cost-effective technique has not emerged. In recent years, maskless reactive ion etching texturing techniques have received significant attention. Reactive ion etching (RE) texturing techniques to produce randomly distributed texture take advantage of the extensive infrastructure developed for Si microelectronics, and as such can lead to significant savings in tool development efforts for the PV manufacturers.

NTIS

*Cost Effectiveness; Microelectronics; Solar Cells; Textures*

**45**

**ENVIRONMENT POLLUTION**

*Includes atmospheric, water, soil, noise, and thermal pollution.*

**20030002338** NASA Ames Research Center, Moffett Field, CA USA

**Optimization of A Neural Network Model Using A Genetic Algorithm: Predicting Salinity Intrusion in the San Francisco Bay Estuary**

Rajkumar, T., Science Applications International Corp., USA; Thompson, David E., NASA Ames Research Center, USA; [2002]; 1p; In English; No Copyright; Avail: British Library Lending (BLL) Division, Boston Spa, England; Abstract Only

The atmosphere, the watershed and the coastal ocean all contain a rich spectrum of spatial and temporal structure, much of which is incorporated into the variability of the bay/delta. The amount of water accumulated in the Sierra Nevada is the major contributor to the fresh water feeding to the bay/delta. Like all estuaries, bay/delta is linked to the coastal ocean and to the inland rivers, resulting in high variability at many scales. Also the estuary has undergone extensive human development over the past 150 years, as has its upstream watershed. In particular long-term changes in estuarine conditions provides a more complete picture of the estuary and its ever-changing climatic context. to understand the complex interactions between climatic conditions, hydrologic, and tidal effect, for a long term effect, requires substantial amount of computer models in various fields. We addressed this complex model using a neural network using Levenberg-Marquardt learning algorithm. We used a genetic algorithm to optimize the minimum number of training data set as well number of hidden neurons to faster convergence. The inputs for neural network range from flow and salinity data collected from monitoring instruments in and around bay/delta. The USGS has established a network of flow monitoring stations in the Delta. Using flow monitoring data from Rio Vista, Three Mile Slough, Jersey Point, and Dutch Slough, a direct estimate of Net Delta Outflow (NDO) is computed. NDO is an arithmetic summation of river inflows, precipitation, agricultural consumptive demand, and project exports. NDO characterizes the upstream watershed. Apart from hydrodynamic data, the stations collect physical and water quality data on a continuous basis monitored one meter below the surface. The parameters provided from the monitoring stations are water temperature, Potential hydrogen, dissolved oxygen, air temperature, electrical conductivity, wind speed, wind direction, solar radiation intensity and chlorophyll. The GA optimized neural network is trained to understand hydrodynamics, runoff and water quality of the bay/delta. This hybrid model is a good predictor for any variable in the bay/delta and it helps to understand the complexity very rapidly.

Author

*Neural Nets; Salinity; Intrusion; Accumulations; Chlorophylls; Computerized Simulation; Mathematical Models*

**20030002519** NASA Goddard Space Flight Center, Greenbelt, MD USA

**SORCE: Solar Radiation and Climate Experiment**

Cahalan, Robert, NASA Goddard Space Flight Center, USA; Rottman, Gary, Colorado Univ., USA; [2002]; 28p; In English; Original contains color illustrations

Report No.(s): NASA/NP-2002-9-482-GSFC; NAS 1.83:9-482-GSFC; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Contents include the following: Understanding the Sun's influence on the Earth; How the Sun affect Earth's climate; by how much does the Sun's radiation vary; Understanding Solar irradiance; History of Solar irradiance observations; The SORCE mission; How do the SORCE instruments measure solar radiation; Total irradiance monitor (TIM); Spectral irradiance monitor (SIM); Solar stellar irradiance comparison experiment (SOLSTICE); XUV photometer system (XPS).

CASI

*Solar Radiation; Climate; Irradiance; Spectral Emission; Sun*

**20030002529** Maryland Dept. of Natural Resources, Annapolis, MD USA

**Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond**

Therres, Glenn D., Editor, Maryland Dept. of Natural Resources, USA; [2001]; 360p; In English, 10-13 May 1998, Annapolis, MD, USA; Sponsored by Maryland Dept. of Natural Resources, USA; Also announced as 20030002530 through 20030002563; Copyright; Avail: Issuing Activity

When I was asked to give this keynote address, I suspect that nobody knew that I had a few connections with the State of Maryland. In fact, I think probably my first awareness of the natural world came when I was spending about a year on the Eastern Shore at the age of 4 going on 5, which has now become sort of legendary in the family, because apparently I interrupted the adults having a deep discussion on some world affairs issue by saying, "Let's talk about something interesting, like skunks and snakes and things." So that is why I am here to talk about skunks and snakes and all those things that we refer to under the term of biological diversity, or today, the contraction biodiversity. As a term, biological diversity is not even two decades old; it first appeared in 1980 and basically, as we all know, it is intended to describe the variety of life on earth at various levels of organization. Originally, it was thought of mostly in terms of numbers of species in a place or an ecosystem and that is still a convenient shorthand, because you can build in both directions to variety at the genetic level all the way up to species diversity at the landscape level. I wish to do three things in this paper: 1. Dwell a little bit on the importance of biodiversity and probably, for some of you, touch on some things you have heard many times, but hopefully with some new examples here and there. 2. Then talk a bit about the challenge of maintaining biological diversity in this modern day. 3. and finally, talk about what I think is the ultimate set of solutions we must be working on to conserve biodiversity.

Author

*Biological Diversity; Conservation; Dwell; Ecosystems; Genetics; Restoration*

**20030002530** Forest Service, Northeastern Forest Research Station, South Burlington, VT USA

**Cause and Consequence: The Social Dimensions of Ecosystem Restoration**

Grove, J. Morgan, Forest Service, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 27-41; In English; Also announced as 20030002529

Contract(s)/Grant(s): NSF DEB-97-14835; EPA-R-825792-01-0; Copyright; Avail: Issuing Activity

The social causes and consequences of ecosystem dynamics have not been discussed or studied systematically within a restoration ecology context. First, this paper presents a conceptual framework for a biosocial approach to ecological restoration in the context of dynamic interactions between social and biophysical systems at different scales over time and space. Second, it demonstrates how- social science concepts and theory can help us to understand better the social causes and consequences of ecological restoration by using the origins of the USDA Forest Service and the urban and community forestry management in Baltimore, Maryland as two examples.

Author

*Forest Management; Restoration; Ecosystems*

**20030002532** Pennsylvania Game Commission, Waynesburg, PA USA

**Integrating Wildlife Management and Agriculture: Conserving Biodiversity Through Long-Term Partnerships**

Belding, Richard, Pennsylvania Game Commission, USA; Giuliano, William M., California Univ. of Pennsylvania, USA; Putnam, David, Fish and Wildlife Service, USA; Taracido, Jose, California Univ. of Pennsylvania, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 48-51; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

An association of conservation organizations and private landowners, working collectively under the title of Partners for Wildlife, is implementing an innovative conservation and management program designed to protect biodiversity in the Chesapeake Bay ecosystem and throughout Pennsylvania. This program uses three approaches to address biodiversity issues. First, we are implementing habitat enhancement programs on hundreds of farms in 15 counties, including 5 counties in the Susquehanna River watershed. These programs include: (1) the establishment of native grasses in pastures and hay fields, (2) the restoration and protection of wetlands and streams in agricultural lands, and (3) the provision of edge manipulations on farm

woodlots. These habitat enhancement techniques are designed to improve biodiversity by providing improved water quality and quantity, and greater floral structure and diversity, which has led to a greater abundance and diversity of fauna. Second, we are conducting extensive research and monitoring to quantify the impacts of our habitat enhancement on biodiversity and farm economics. and third, we are educating landowners on the benefits, not only to the environment, but also to themselves economically. Because these habitat management techniques benefit landowners, many farmers have begun implementing them on their own. This provides not only a long-term solution to decreased biodiversity but also to the declining agricultural community, a win-win situation.

Author

*Management Methods; Agriculture; Biological Diversity; Conservation; Ecosystems; Restoration; Wildlife*

**20030002533** Maryland Dept. of Natural Resources, Annapolis, MD USA

**Maryland Partners in Flight: A Team Approach to Conserving Birds**

Therres, Glenn D., Maryland Dept. of Natural Resources, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 52-58; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Maryland Partners in Flight is a consortium of government agencies, conservation organizations, academia, and private citizens working collectively for the conservation of migratory landbirds. This working group is part of an international network called Partners in Flight, whose mission is the conservation of migratory landbirds on their breeding grounds in North America and their wintering grounds in the Caribbean, and Central and South America. The underlying goal of Partners in Flight is to bring all those interested in migratory bird conservation and those that can affect the habitats supporting these birds into a forum in which strategies for conservation are mutually developed and implemented. Not only are ornithologists and conservation biologists involved, but foresters, land-use planners, regulators, land managers, and others are active partners. Maryland Partners in Flight is committed to the conservation of migratory landbirds and their habitats through monitoring, management, research, and education. to achieve this goal, five working committees were formed to address these issues and enhance communication among the partners. A steering committee consisting of the chairs of each working committee, an overall chairman and a partner-at-large coordinate the business of Maryland Partners in Flight. A strategic plan was drafted to identify the issues needing attention and to guide the efforts. Accomplishments include developing a ranking system to identify species of concern, printed habitat management guidelines, International Migratory Bird Day celebrations, and an educational program in which bird art and information are exchanged between elementary students in Maryland and Latin American countries. Keys to the success of the partnership as well as deficiencies are discussed.

Author

*Birds; Breeding (Reproduction); Conservation; Regulators*

**20030002534** Virginia Dept. of Game and Inland Fisheries, Richmond, VA USA

**Wildlifemapping: Linking Resource Management with the Public**

Sausville, Lisa P., Virginia Dept. of Game and Inland Fisheries, USA; Wajda, Rebecca K., Virginia Dept. of Game and Inland Fisheries, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 59-62; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Changes in and implementation of new management strategies, such as ecosystem management, demand a greater knowledge of all facets of the natural system, including wildlife. WildlifeMapping, a new citizen Outreach and education program, helps meet these demands by providing ail opportunity for citizens, community groups, and schools to contribute their wildlife observations to the state's biological databases. Individuals are trained as WildlifeMappers and are provided with the tools to inventory and monitor these resources. These data are maintained as a public data layer by the Virginia Department of Game and Inland Fisheries (VDGIF) and are used to assist in the assessment of wildlife distributions by filling in the gaps where few data have been collected, provide information for Student research, and keep common animals common. Virginia's WildlifeMapping program, sponsored by VDGIF, is patterned after NatureMapping, a national outreach project developed by the University of Washington Gap Analysis Project and the Washington Department of Fish and Wildlife. to date, 135 teachers in Virginia have been trained as WildlifeMappers and are implementing the program in their classrooms Ail additional 50 private citizens have also been trained. A web page is maintained to facilitate the exchange of information and to allow participants to "Ask the Experts." The program provides ail excellent outreach tool for the department and offers the public ail opportunity to improve the management of their wildlife resources.

Author

*Wildlife; Resources Management; Inventories; Fisheries; Ecosystems; Data Bases*

**20030002535** Cornell Univ., Coll. of Agriculture and Life Sciences, Ithaca, NY USA

**Economic and Environmental Benefits of Biological Diversity in the State of Maryland**

Pimentel, David, Cornell Univ., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 63-75; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

To date, a complete inventory of the biological diversity in the State of Maryland has not been made. The number of species of plants, however, has been inventoried. There are an estimated 2,255 species of herbaceous plants, 235 species of trees, and 183 species of shrubs and vines. of the 2,673 plant species in Maryland (16% of the total U.S. plant species), more than 1,000 are introduced, nonindigenous species that include agricultural, ornamental, and weed species. The fairly high percentage of U.S. plant species that Maryland houses indicates the diverse biota present in this state--diversity that provides both economic and environmental benefits to the entire state. The primary contribution of natural biota to the economy of Maryland is through fishing and hunting, a contribution that totals more than \$600 million per year, and through outdoor recreation, which totals nearly as much. This paper assesses the total economic and environmental benefits of biodiversity in Maryland at approximately \$1.8 billion per year.

Author

*Agriculture; Biological Diversity; Inventories; Maryland*

**20030002536** World Wildlife Fund, Inc., Conservation Science Program, Washington, DC USA

**The Big Picture: The Biodiversity of Maryland in a Global and Continental Context**

Olson, D. M., World Wildlife Fund, Inc., USA; Dinerstein, E., World Wildlife Fund, Inc., USA; Hurley, P., World Wildlife Fund, Inc., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 85-88; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Recent World Wildlife Fund analyses of North American (i.e., Nearctic) and global biodiversity shed light on the importance of Maryland's biodiversity within the context of a global conservation strategy. Biogeographic units of biodiversity, or ecoregions, were assessed in terms of the distinctiveness of their biodiversity at different biogeographic scales and their level of threat. An evaluation of these features among and within ecoregions that occur in Maryland can help identify priorities for biodiversity conservation, particularly those that will most significantly contribute to global- and continental-scale conservation strategies. Recognition of priorities in this light, and ecoregion-based conservation in general, can enhance the long-term effectiveness of conservation action and policy within Maryland.

Author

*Wildlife; Maryland; Biological Diversity*

**20030002537** Maryland Dept. of Natural Resources, Annapolis, MD USA

**Maryland's Integrated Natural Resources Assessment: Establishing the Context for Biodiversity Conservation in Maryland**

Wolf, John, Maryland Dept. of Natural Resources, USA; Sloan, Anne, Maryland Dept. of Natural Resources, USA; Hill, George, Maryland Dept. of Natural Resources, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 89-96; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Maryland has a long history of innovative and successful approaches for addressing complex natural resources issues. However, the ongoing urbanization of natural and productive landscapes, coupled with static or decreasing fiscal resources, creates new challenges for conservation efforts. The Maryland Department of Natural Resources (DNR) is developing a statewide Integrated Natural Resources Assessment (INRA) that will provide an ecosystem-based framework for decisions affecting natural resources management. The assessment focuses on three major themes: (1) protecting a statewide network of natural and productive landscapes; (2) focusing the DNR's collective priorities and opportunities for ecosystem conservation and resource management based on ecosystem principles; and (3) promoting regional economic opportunities that support ecosystem integrity. INRA incorporates landscape assessment techniques utilizing environmental indicators depicting ecosystem conditions, human-induced landscape stresses, and agency response capabilities. This information can then help set priorities for biological diversity conservation initiatives.

Author

*Resources Management; Biological Diversity; Conservation; Ecosystems*

**20030002538** Maryland Dept. of Natural Resources, Annapolis, MD USA

**History, Management, and Status of Introduced Fishes in the Chesapeake Bay Basin**

Christmas, John, Maryland Dept. of Natural Resources, USA; Eades, Richard, Virginia Dept. of Game and Inland Fisheries, USA; Cincotta, Daniel, West Virginia Dept. of Natural Resources, USA; Shiels, Andrew, Pennsylvania Fish and Boat Commission,

USA; Miller, Roy, Delaware Div. of Fish and Wildlife, USA; Siemien, Jon, Department of Consumer and Regulatory Affairs, USA; Sinnott, Tim, New York Dept. of Environmental Planning, USA; Fuller, Pam, Geological Survey, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 97-116; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

In recent years, the introduction of nonindigenous species of fishes in the Chesapeake Bay basin, as well as throughout the USA, has become a matter of increasing concern. Intentional introduction have been undertaken for various purposes such as aquaculture, biological control, and enhancement of recreational fisheries. Unintentional introductions have resulted from ballast water discharge, aquarium release, bait-fish introductions, and escape from aquaculture facilities. Based on data provided by the U.S. Geological Survey (USGS) Nonindigenous Aquatic Species Program and a review by state biologists, we determined that 88 species and 3 hybrid fishes, belonging to 20 families, have been introduced into the Chesapeake Bay basin. This includes all species introduced into open waters within the basin since circa 1850, whether or not they became established. Of the 88 species, there are 13 exotic species (i.e., foreign), of which 6 have become established: common carp (*Cyprinus carpio*), goldfish (*Carassius auratus*), rudd (*Scardinius erythrophthalmus*), tench (*Tinca tinca*), ide (*Leuciscus idus*), and brown trout (*Salmo trutta*). Of the remaining 75 transplanted species, 40 are native to the USA but not to the basin; the other 35 are native to the basin but have been introduced beyond their native drainages. Most of the introduced fishes are in the families Cyprinidae (n=21), Centrarchidae (n = 15), and Salmonidae (n = 11). At the state level, Virginia has the most introductions of any jurisdiction within the basin (n=58), followed by Pennsylvania (n = 55). Delaware has the fewest (n = 9). Pennsylvania and Virginia also have the most exotic fish species (n=9 and n= 10, respectively), whereas Delaware has the least (n = 4). In general, most of the introductions are intra-basin transplants (i.e., native to one drainage in the basin and introduced into another). With the exception of six species of western salmonids, all the transplanted fishes are eastern species. Using the USGS Hydrologic Unit Code system of classifying drainages, the number of introduced species in the various drainages ranges from 11 to 57. The greatest number of fish has been introduced into the Chesapeake Bay basin in the Potomac River drainage (n = 57).

Author

*Aquaculture; Augmentation; Fisheries; Fishes; Geological Surveys*

**20030002539** Maryland Dept. of Natural Resources, Annapolis, MD USA

**Maryland's Heritage Conservation Fund: An Overview of Biodiversity Protected Through a Targeted Acquisition Approach**

McKegg, Janet S., Maryland Dept. of Natural Resources, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 117-126; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

The Maryland Department of Natural Resources' Heritage Conservation Fund (HCF) was created by the general assembly in 1986 for the purpose of acquiring property to protect rare, threatened, and endangered species habitat and high-quality natural areas. During the 11 years since the HCF's inception, more than 20 sites have been protected through acquisition. Included in these sites are federally and state-listed species, and high-quality forested, grassland, and wetland communities. This paper describes how acquisition sites are selected and assesses what elements of biodiversity have been protected. Case studies demonstrate how the program is implemented. This program has been effective in part because its purpose was well defined and supported by the department, properties meeting the stated purpose were carefully targeted, and acquisition was doggedly pursued.

Author

*Biological Diversity; Conservation; Endangered Species; Habitats*

**20030002540** Office of the Deputy Under Secretary of Defense, Washington, DC USA

**Ecosystem Management in the Department of Defense: Managing for Biodiversity Conservation and the Military**

Boice, L. Peter, Office of the Deputy Under Secretary of Defense, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 127-132; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

The Department of Defense (DOD) is the steward of 10 million ha (25 million acres), and is the third largest federal land management department in the USA. Many rich and varied natural and cultural resources are present on DOD installations. There is strong evidence that DOD managed lands are richer biologically than any other federal lands. The DOD's conservation goal is to support the military mission while managing these important resources for multiple uses for future generations. The DOD faces significant challenges in achieving this goal. Military mission demands on these resources are increasing. Various stakeholders have potentially conflicting ideas on how to manage and use these resources. And, downsizing may affect the DOD's ability to manage these resources effectively. One solution has been to emphasize regional ecosystem management. The DOD has made significant progress in establishing ecosystem management as the preferred approach to managing its natural and

cultural resources, in the Mojave Desert, on major bases such as Marine Corps Base Camp Pendleton, California; Eglin Air Force Base (AFB), Florida; Arnold AFB, Tennessee; Fort Hood, Texas; and Nellis AFB, Nevada; and on its installations in the Chesapeake Bay watershed.

Author

*Ecosystems; Land Management; Watersheds; Cultural Resources; Conservation*

**20030002541** Committee for the National Inst. for the Environment, Washington, DC USA

**A Strategic Approach for Conserving Biodiversity in the Chesapeake Bay Region**

Blockstein, David E., Committee for the National Inst. for the Environment, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 79-84; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

A strategic approach is necessary to conserve biodiversity. Piecemeal policy with conflicting or poorly stated goals coupled with uncoordinated management authority has led to fragmented ecosystems with pockets of biodiversity, but with declining trends in most components of biodiversity. A strategic approach needs to be implemented on several levels including national, regional, and ecosystem. It must begin with a shared goal and commitment to biodiversity conservation and policies consistent with that goal. Government leadership is necessary, but the citizenry, including the full range of stakeholders, must be involved in every step. At least five fronts must be attacked simultaneously: science, protected areas, multiple use areas, ecological and species restoration, and education. This approach begins with an assessment of the condition of the resource, activities that affect the resource, and needs for additional or different activities. The Chesapeake Bay ecosystem provides an ideal model for using this approach. This ecosystem is well recognized and many cooperative planning and management ventures are already under way that cut across jurisdictional boundaries. However, the general goal of "save the bay" must be made more explicit. Policies and strategies must be designed and carried out to provide the necessary elements for saving the bay and all of its parts.

Author

*Biological Diversity; Chesapeake Bay (US); Conservation; Restoration*

**20030002542** Maryland Dept. of Natural Resources, Annapolis, MD USA

**Maryland's Endangered Species Law as a Tool for Biodiversity Conservation**

Therres, Glenn D., Maryland Dept. of Natural Resources, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 133-137; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Maryland's Nongame and Endangered Species Conservation Act, enacted in 1971, serves as the cornerstone for biodiversity conservation in Maryland. The law authorized the state to establish a list of threatened and endangered species and to develop programs for the conservation of these plants and animals. In addition to endangered species, the law mandates the conservation of all wildlife species that are not hunted or trapped, commonly referred to as nongame. Currently, 458 species of plants and animals are listed as endangered, threatened, or species in need of conservation under the authority of this law. The law prohibits direct take of listed-species but does not clearly provide for habitat protection. Endangered species habitat, however, does receive protection through other environmental laws that mandate such considerations for the habitat of state-listed species. Technical guidance is provided by the Department of Natural Resources' endangered species ecologists to other government agencies to ensure that appropriate protection measures are incorporated into their mandated programs, such as the Chesapeake Bay Critical Area Program, nontidal wetlands programs and growth management efforts. Compared with other state endangered species laws, Maryland's is fairly comprehensive. However, improvements to the law, as well as increased funding and enhanced coordination, are recommended to bolster its ability to conserve biodiversity in Maryland.

Author

*Biological Diversity; Conservation; Earth Resources; Endangered Species; Environment Protection; Protection; Wildlife*

**20030002543** Apogee Research Corp./Hagler Baily, Arlington, VA USA

**Resource Significance: A Tool for Setting Priorities for Environmental Restoration**

Doll, Amy, Apogee Research Corp./Hagler Baily, USA; Nolton, Darrell, Corps of Engineers, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 138-143; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

This paper discusses a new planning and decision-making tool, "Resource Significance Protocol for Environmental Project Planning" (USACE 1997), which was developed under the U.S. Army Corps of Engineers Evaluation of Environmental Investments Research Program. It was developed primarily for use by Corps planners and decision makers in environmental restoration planning. The protocol and its supporting documents were developed to assist in the selection of the best or "most

significant” restoration projects from among a group of deserving projects competing for limited funds. It offers a tool for all environmental planners and managers who are facing funding constraints and setting priorities to develop restoration strategies that effectively allocate resources for environmental restoration and management.

Author

*Decision Making; Environment Management; Planning; Resources Management*

**20030002544** Environmental Resources Management, Inc., Annapolis, MD USA

**Biodiversity Issues in the Hydroelectric Development of the Me Kong River System in Southeast Asia**

Dwyer, Robert L., Environmental Resources Management, Inc., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 144-150; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Thailand and other Southeast Asian nations are attempting to encourage industrial development in rural provinces, in part to redirect the explosive growth of ”megacities” like Bangkok. In Thailand rural development closely depends on both new fossil and hydroelectric generating capacity. The Electricity Generating Authority of Thailand (EGAT) began the construction of Pak Mun Dam on the Mun River in Ubon Province, 5 km (3 mi) upstream of the Mun’s confluence with the Me Kong. Local and international nongovernmental organizations raised objections to the dam’s potential impacts on the fish diversity in the Mun. The Me Kong system supports more than 800 species of fish, many of which are unique to the river. After construction had begun with private funding, The World Bank made a loan to EGAT that required certain measures to mitigate several socioeconomic and ecological impacts of dam construction and operations. Specifically, the loan funded a fish ladder that is able to pass 30 commercially important species upstream. A fish hatchery was constructed and staffed by the Thai Department of Fisheries (DOF) to propagate species formerly abundant in the river upstream of the dam site. EGAT also funded the formation and operation of a fisheries conservation unit, that, among other activities, disseminated the technology for backyard (ponds and tanks) aquaculture of several catfish species. Finally, World Bank missions to the site documented heavy fishery activity in the lower river and the presence of a natural rapids area, both of which appeared to control upstream fish biodiversity to a greater extent than the new dam. Since the completion of The World Bank involvement in 1996, news reports have indicated that local fish stocks are fluctuating, and landings are decreasing. The DOF is revising its mitigation measures to preserve fish stocks and landings, but preservation of biodiversity is apparently a secondary consideration. The long-term outlook is uncertain.

Author

*Aquaculture; Biological Diversity; Conservation; Hydroelectricity; Thailand*

**20030002545** Maryland-National Capital Park and Planning Commission, Clinton, MD USA

**Saving the Suitland Bog Natural Area: A Coordinated Effort of Volunteers and Resource Managers**

Bierer-Garrett, Lisa, Maryland-National Capital Park and Planning Commission, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 151-155; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

The Suitland Bog is a managed natural area in heavily developed Prince George’s County, Maryland. It is home to a diverse and rare wetland plant community including carnivorous species. As the park naturalist, I have enlisted the help of scout groups, local native plant societies, and community volunteers. These volunteers have carried out plant rescues from nearby encroaching development, done plant location mapping, cleared brush, trimmed trees, led tours, and encouraged others in the Suitland community to take an active role in the protection of the natural area. The results have been excellent. Although an article from the early 1970s stated that the Bog would soon be gone (Shetler 1970), lost to encroaching trees and civilization, we can be sure now that the Suitland Bog will continue to survive into the next century. The coordinated effort has been successful in educating many citizens about the unique wetland and in slowing the losses due to succession, siltation, and encroaching development.

Author

*Protection; Brushes; Wetlands*

**20030002546** Wilfrid Laurier Univ., Dept. of Geography and Environmental Studies, Waterloo, Ontario Canada

**Biodiversity, Information, and Integrity: A Framework for Conservation and Management in the Chesapeake Bay Ecosystem**

McCarthy, Daniel, Wilfrid Laurier Univ., Canada; Slocombe, D. Scott, Wilfrid Laurier Univ., Canada; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 159-167; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

A holistic, systemic, and hierarchic perspective on biodiversity conservation is presented. This perspective derives from complex systems theory, especially self-organization theory, hierarchy theory, and information theory, and related systems

ecology concepts. Biodiversity as information analog in the context of maintaining ecological integrity is a flexible yet explicit and theoretically grounded framework for the conservation of biodiversity in the Chesapeake Bay ecosystem and beyond. Ecological integrity encompasses ecosystem health (i.e., the ability to maintain normal operations under normal conditions), the ability to cope with change or stress, and the ability to maintain self-organization. Biodiversity can be seen as the information required to maintain system health (i.e., mutual information) as well as to provide for adaptability and self-organization (i.e., overhead), which is ecological integrity. A conceptual framework for conserving biodiversity as information in the context of promoting ecological integrity is outlined using examples from the Chesapeake Bay ecosystem to provide insights for future conservation and management efforts.

Author

*Information Management; Integrity; Chesapeake Bay (US); Ecosystems; Conservation; Complex Systems*

**20030002547** Environmental Research Center, Edgewater, MD USA

**Overview of Biological Invasions in the Chesapeake Bay Region: Summary of Impacts on Native Biota**

Fofonoff, Paul W., Environmental Research Center, USA; Ruiz, Gregory M., Environmental Research Center, USA; Hines, Anson H., Environmental Research Center, USA; McCann, Linda, Environmental Research Center, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 168-180; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Human activities have resulted in the transfer and establishment of thousands of species of organisms outside their natural range. Although the rate of these biological invasions appears to be increasing in estuaries worldwide, the ecological impact of invasions on biodiversity in the Chesapeake Bay is poorly known. Using an intensive analysis of literature, we evaluated the impacts reported for 202 species of known, probable, or possible introductions (cryptogenic) to the Chesapeake Bay, including members of 17 phyla. Thirty-eight nonindigenous or cryptogenic species were considered to have probable impacts on native biota, but only 12 (34%) of these species have quantitative data available on their impacts. Furthermore, of the 38 species, 21 appear to have potentially threatening or serious impacts. Seven species appear to pose widespread threats to native species; and at least 14 more are believed to have serious local effects on native species or ecosystems. However, even among the 21 species with potentially serious or threatening impacts, quantitative data were available for only 8 of those species. The poor quality of existing information poses a significant problem for management of introduced species, since efficient management must evaluate trade-offs between impacts of exotic species and the cost and environmental disturbance associated with control methods.

Author

*Biological Diversity; Chesapeake Bay (US); Ecosystems*

**20030002548** Geological Survey, Patuxent Wildlife Research Center, Laurel, MD USA

**Estimation of Species Richness and Parameters Reflecting Community Dynamics Using Data from Ecological Monitoring Programs**

Nichols, James D., Geological Survey, USA; Sauer, John R., Geological Survey, USA; Hines, James E., Geological Survey, USA; Boulinier, Thierry, North Carolina State Univ., USA; Pollock, Kenneth H., North Carolina State Univ., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 181-187; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Although many ecological monitoring programs are now in place, the use of resulting data to draw inferences about changes in biodiversity is problematic. The difficulty arises because of the inability to count all animals present in any sampled area. This inability results not only in underestimation of species richness but also in potentially misleading comparisons of species richness over time and space. We recommend the use of probabilistic estimators for estimating species richness and related parameters (e.g., rate of change in species richness, local extinction probability, local turnover, local colonization) when animal detection probabilities are less than 1. We illustrate these methods using data from the North American Breeding Bird Survey obtained along survey routes in Maryland. We also introduce software to implement these estimation methods.

Author

*Animals; Biological Diversity; Estimating; Probability Theory; Management Planning*

**20030002549** Maryland Dept. of Natural Resources, Annapolis, MD USA

**The Mid-Atlantic Gap Analysis Project (Maryland, Delaware, and New Jersey)**

Rasberry, D. Ann, Maryland Dept. of Natural Resources, USA; McCorkle, Richard C., Fish and Wildlife Service, USA; Gorham, James N., Fish and Wildlife Service, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 188-194; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Following national guidelines, the Mid-Atlantic Gap Analysis Project (MID-A GAP) is developing geographic information system-based data layers that can be used by land managers, environmental planners, and others as tools to assist with a wide variety of natural resources-based projects. MID-A GAP consists of the states of Maryland, Delaware, and New Jersey. The first component of MID-A GAP is a land cover layer depicting vegetated, urban, water, and agricultural areas. The data layer was developed using LANDSAT Thematic Mapper imagery as a base along with other ancillary data such as airborne videography, aerial photography, and ground surveys. The second component of MID-A GAP is the development of models to predict distributions of all terrestrial vertebrates based on the land cover layer and other habitat features. MID-A GAP's third component is a land management status layer in which all lands are labeled in terms of their management of biological diversity. This enables assessments to be made relative to the current status of areas in terms of protection. Once the data sets are constructed, a series of analyses are conducted to determine which land cover types and fauna are unrepresented or underrepresented in those areas most protected against conversion of existing biological diversity. The data may be used for local, regional, and landscape-level environmental planning and assessment.

Author

*Aerial Photography; Agriculture; Animals; Biological Diversity; Environment Management; Imaging Techniques; Satellite Imagery; Thematic Mappers (LANDSAT)*

**20030002550** Versar, Inc., Columbia, MD USA

### **Freshwater Biodiversity Hot Spots in Maryland**

Southerland, Mark T., Versar, Inc., USA; Roth, Nancy E., Versar, Inc., USA; Patty, Sandra K., Maryland Dept. of Natural Resources, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 195-206; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

A critical step in biodiversity conservation is identifying hot spots with unique or important biological features. to aid in environmental planning and impact assessment, Maryland's Power Plant Research Program (PPRP) is developing techniques to identify areas that make the greatest contribution to regional and state biodiversity. As an initial research effort, PPRP is attempting to identify several types of freshwater biodiversity hot spots, by applying geographic information system technologies to data from the statewide Maryland Biological Stream Survey. Data from approximately 1,000 stream sites were used to describe the distribution of freshwater fish, amphibians and reptiles, and benthic macroinvertebrates. Methods were developed to depict six aspects of biological diversity: site (stream segment) diversity, area and watershed (collections of stream sites) diversity, areas of rare species, complementary watersheds to capture all species, composite diversity of different organism groups, and areas of high integrity with only native species. The species (or taxa) richness of sites varies substantially across the state and these patterns vary among organism groups. The number of species in an "area hot spot" increases slowly as more sites are added. Rather than an arbitrary radius for defining area diversity, watersheds appear to be the most appropriate units for assessing freshwater diversity. A set of only 11 complementary watersheds (8% of 138 watersheds in Maryland) was needed to capture 100% of the fish species sampled with a single watershed capturing 45% and the first three watersheds capturing 74%. Although these complementary watersheds effectively capture both species-rich and rare-species areas, they do not capture all areas worthy of protecting for high integrity and ecological processes. Future research will be conducted to refine statewide maps of aquatic diversity and add terrestrial diversity hot spots.

Author

*Biological Diversity; Conservation; Damage Assessment; Environment Management; Watersheds*

**20030002551** Geological Survey, Patuxent Wildlife Research Center, Laurel, MD USA

### **Effects of Urbanization on the Distribution of Area-Sensitive Forest Birds in Prince George's County, Maryland**

Dawson, Deanna K., Geological Survey, USA; Robbins, Chandler S., Geological Survey, USA; Darr, Lonnie J., Montgomery County Dept. of Environmental Protection, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 207-213; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Bird survey data from Prince George's County, Maryland, were used to evaluate the effects of urbanization on the distribution of forest bird species that are area sensitive We developed models that predict the probability of occurrence for species during the nesting season as a function of forest area and degree of urbanization All of the 21 bird species considered occurred in a higher proportion of forests in portions of the County with low or moderate urbanization than in forests in highly urbanized areas, but species differed in their response to urbanization. We calculated the predicted probability of occurrence for each species in each forest in Prince George's County, summed the probabilities to obtain an estimate of the expected number of area-sensitive species, and integrated the expected numbers with a geographic information system coverage of Prince George's County forests to map

patterns of species richness countywide. This information can be used to focus efforts to conserve habitat for area-sensitive forest birds, both in Prince George's County and throughout the Chesapeake Bay region.

Author

*Urban Development; Maryland; Habitats; Forests; Birds*

**20030002552** Virginia Univ., Dept. of Environmental Sciences, Charlottesville, VA USA

**Estuarine Biodiversity is Multi-Ordered: The Oyster Example**

McCormick-Ray, Jerry, Virginia Univ., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 214-224; In English; Also announced as 20030002529; Sponsored in part by Henry Foundation; Copyright; Avail: Issuing Activity

Biodiversity of estuaries is complex and subject to change. It may best be understood in an ecosystem context, with a focus on dominant biota that provide environmental structure and a degree of constancy across time and space. Although species richness is the most commonly used measure of biodiversity, the value of a single species and its life history in an ecosystem context merits consideration. The eastern oyster *Crassostrea virginica* in the Chesapeake Bay illustrates such a case. The voluminous data on the oyster provides evidence for a multi-scale focus on which to highlight ecological value and consider human impact on biodiversity. Although the oyster's biophysical role is well established at small scales, its functional presence in the Chesapeake Bay has been explored little. Seven scales are observed: direct associations; indirect associations; associations of an oyster bed assemblage; associations within a sub-watershed drainage system; associations of a fringing reef in the Chesapeake Bay watershed system; estuarine-dependent associations of the Mid-Atlantic-Virginian Biogeographical Province; and associations of a temperate oyster reef biome. Each scale contributes uniquely to biodiversity.

Author

*Ecosystems; Estuaries; Chesapeake Bay (US); Biological Diversity*

**20030002553** Maryland Univ., Appalachian Lab., Frostburg, MD USA

**The Evolutionary Significance of Maryland Brook Trout Populations**

Morgan, Raymond P., II, Maryland Univ., USA; Danzmann, Roy G., Guelph Univ., Canada; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 225-232; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

The commonly accepted hypothesis regarding native populations of brook trout (*Salvelinus fontinalis*) is that they were derived from a common ancestral gene pool within a recent time frame. The present study on southern brook trout populations was a derivative of work determining post-Wisconsinan recolonization patterns from postulated refugia by northern brook trout populations. Brook trout mitochondrial DNA (mtDNA) from liver and heart were analyzed from 17 southern populations, outside of northern glaciated regions. Results identified the presence of six major mtDNA clades in brook trout, with strong evidence for distinctness of Great Smoky Mountains brook trout. In addition, there was a high level of mtDNA differentiation in drainage basins of West Virginia and western Maryland. Understanding these distinct units is critical to the conservation biology of Appalachian brook trout throughout its range, and especially remnant populations of Maryland brook trout.

Author

*Conservation; Genetic Code; Maryland; Mitochondria; Populations; Protobiology; Fishes*

**20030002554** Staines (C. L.), Edgewater, MD USA

**The Leaf Beetles (Insecta: Coleoptera: Chrysomelidae): Potential Indicator Species Assemblages for Natural Area Monitoring**

Staines, C. L., Staines (C. L.), USA; Staines, S. L., Staines (S. L.), USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 233-244; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Chrysomelids are model herbivores. Most species are monophagous or narrowly oligophagous on a small number of plant families. In the tropics, the area most studied, chrysomelids have been found to be an excellent indicator of local species richness, due to not only their relative abundance but the ease of morphospecies sorting by a nonspecialist. The diversity of chrysomelids is exceptionally rich and a function of local plant diversity. These factors make chrysomelids an excellent candidate for indicator species assemblages for natural area monitoring. A project was started in 1997 on Plummers Island, Maryland, to determine whether chrysomelid species assemblages are indicators of plant diversity, site disturbance, and environmental heterogeneity. At this site we have the advantage of historical collection data dating back to 1901 that can be used as baseline information.

Author

*Heterogeneity; Beetles; Assemblies*

**20030002555** Smith (Richard H., Jr.), Columbia, MD USA

**Ongoing Projects to Conserve Endangered Butterfly Populations in Maryland and Other Eastern US States**

Smith, Richard H., Jr., Smith (Richard H., Jr.), USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 245-253; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

This paper provides a summary and update on promising and successful as well as disappointing efforts to conserve populations of locally and federally endangered butterfly species in Maryland, Delaware, Ohio, New York and the Great Lakes states, Pennsylvania, and Florida. In the first several states, ongoing efforts are focused on the conservation of barren forest-opening habitats harboring local accumulations of lupine, the larval host plant of endemic local populations of such rare butterfly species as the Kamer blue (*Lycaeides melissa samuelis*), frosted elfin (*Incisalia irus*), and Persius dusky wing (*Erynnis persius*). The two primary means of habitat maintenance in these cases are periodic cutting and clearing of selected small woodland parcels and rotation of occasional prescribed burns on larger land plots. Attempts to conserve remnant populations of the regal fritillary (*Speyeria idalia*) in Maryland and other states, notably Pennsylvania, by management of their dry grassland habitats are also discussed. In south Florida and the Keys, land development for residential and recreational purposes has confined the last large populations of the Schaus' swallowtail (*Papilio aristodemus ponceanus*) to a few closely situated sites that are extremely vulnerable to mosquito spraying and decimation by hurricanes. For this species, conservation researchers have resorted to the extreme measure of maintaining a reserve population of the butterfly species in a university laboratory for the purpose of reestablishing the natural population if deemed necessary after a weather disaster.

Author

*Conservation; Endangered Species; Forests; Grasslands; Habitats; Maintenance*

**20030002556** Virginia Univ., Dept. of Environmental Sciences, Charlottesville, VA USA

**Estuarine Biological Diversity Affects Shelf Fisheries**

Ray, G. Carleton, Virginia Univ., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 254-260; In English; Also announced as 20030002529; Sponsored in part by Henry Foundation; Copyright; Avail: Issuing Activity

This paper proposes that the biological diversity of the Chesapeake Bay has been dramatically affected by the decline of eastern oyster (*Crassostrea virginica*) reef's during the past 100 years, and that these effects may extend to fisheries. This proposal is based on the widespread observation that oyster reefs are important structural elements of the bay and that depletion of these reefs has altered estuarine patterns and functions. Effects on fish communities of the estuary-shelf is based on the fact that approximately one-fourth of the species of the Virginian and Carolinian provinces are estuary dependent. These fish communities maybe conceived of as assemblages of both estuarine and nonestuarine populations. It follows that alterations of estuaries that have major influences on estuarine-dependent species may extend to fisheries of the shelf as well. Such cascading effects remain poorly understood, and research on such relationships should receive high priority.

Author

*Biological Diversity; Estuaries; Fishes; Populations*

**20030002557** Patuxent Wildlife Research Center, Laurel, MD USA

**Biological Diversity of Created Forested Wetlands in Comparison to Reference Forested Wetlands in the Bay Watershed**

Perry, Matthew C., Patuxent Wildlife Research Center, USA; Osenton, Peter C., Patuxent Wildlife Research Center, USA; Stoll, Cindy S., Patuxent Wildlife Research Center, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 261-268; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Amphibians, reptiles, birds, and mammals were surveyed at six created forested wetlands in central Maryland and at six adjacent reference forested wetlands during 1993-1996 to determine comparative biological diversity of these habitats. Amphibians and reptiles were caught in pitfall and funnel traps associated with 15.4-m (50-ft) drift fences. Birds were Surveyed with a complete count while walking through each area. Mammals were surveyed by capture in live traps. More species and total individuals of amphibians were caught on the reference wetlands than on the created wetlands. The red-backed salamander (*Plethodon cinereus*), the four-toed salamander (*Hemidactylium scutatum*), the eastern spadefoot (*Scaphiopus holbrooki*), and the wood frog (*Rana sylvatica*) were captured on the reference wetlands, but not on the created sites. The wood frog was captured at all reference sites and may represent the best amphibian species to characterize a forested wetland. Reptiles were not caught in sufficient numbers to warrant comparisons. Ninety-two bird species were recorded on created sites and 55 bird species on the reference sites. Bird species on the created sites represented those typically found in nonforested habitats. Mammal species were similar on both sites, but overall the reference sites had three times the number caught on created sites. The meadow vole (*Microtus*

pennsylvanicus) was the dominant species captured on created sites, and the white-footed mouse (*Peromyscus leucopus*) was the dominant species on reference sites, with little habitat overlap for these two species. Although species richness and total number of animals were high for created forested wetlands, these survey results show major differences from species expected for a forested wet] and. The created forested wetlands appear to provide good habitat for wildlife, but are probably not providing the full functions and values of the forested wetlands that they were constructed to replace.

Author

*Biological Diversity; Wetlands; Animals; Forests; Watersheds; Wildlife*

**20030002558** Baltimore Gas and Electric Co., Baltimore, MD USA

**Effects of Mowing, Herbicides, and Burning on Plant Community Diversity and Woody Growth Suppression in a Wet Meadow Community**

Benassi, Thomas E., Baltimore Gas and Electric Co., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 269-273; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

A study was conducted from 1993 to 1995 to assess the effects of mowing, herbicides, and prescribed burning on plant community diversity and Suppression of woody growth in a wet meadow. The site was divided into twenty-four 5-sq m (16 - sq ft) plots. Eight plots received a mow treatment (control), eight received a herbicide treatment, and eight received a bum treatment. A one-time treatment of mowing, herbicides, and burning was applied in 1993 following the collection of baseline plant community data. Based on analysis of the data collected from 1993 to 1995, plant community diversity decreased in all the plots during the study period with the greatest short-term decrease in the plots treated with the herbicide Accord(R) (Glyphosate). Plots with the most species richness were those that had been mowed (control). Woody vegetation was best controlled within the plots treated with Accord(R), followed by mowing, and then burning.

Author

*Herbicides; Soils; Birds; Surface Treatment*

**20030002559** Stop That Infernal Road!, Rockville, MD USA

**It's Time for Bold Action: A Plan for Maryland**

Henn, Carl R., Stop That Infernal Road!, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 277-282; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

This paper argues that many aspects of Maryland's economy are unsustainable and that many elements of Maryland's environment are in decline. Furthermore, it argues that our current marginal and incremental reform efforts cannot successfully address these fundamental problems. Accordingly, this paper advocates more fundamental reform, including establishing urban growth boundaries around every city and town, banning further road construction, taxing fossil fuels instead of income and property, and adopting per-mile car insurance. This paper also presents a plan for moving toward a sustainable economy, based on actions that the State of Maryland can take.

Author

*Maryland; Construction; Roads*

**20030002560** Maryland Univ., Environmental Finance Center, College Park, MD USA

**Funding for Water Quality: Stream Corridor Restoration Projects**

Hickey, Elizabeth, Maryland Univ., USA; Haas, Jeremy, Maryland Univ., USA; Greer, Jack, Maryland Univ., USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 283-286; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

This project presents stream corridors as multimedia, multiprogram targets of activity and funding in order to provide planners and other decision makers with tools or ideas that help them better manage these important buffers and habitats. The University System of Maryland's Environmental Finance Center has inventoried sources of funding within Maryland to produce a matrix of funding options. Under the areas of planning, capital, maintenance, and education, the matrix highlights the range of program objectives that can be used for improving water quality. Terms including forest buffer creation, wetland restoration, drinking water source protection, greenways development, and citizen monitoring describe programs that Support biological conservation and can provide funding for water quality storm-water best management practices. Similarly, as the range of participants (e.g.. individuals, public agencies, and nonprofit organizations) in stream corridor restoration efforts increase, so do the pool and type of available funding resources. by using a broader collection of terms to describe storm-water and water quality management, we can therefore broaden Sources of funding for its support and implementation. Simultaneously pursuing

objectives of conserving biodiversity and improving water quality Will build the best opportunities for habitat restoration. This strategic approach can strengthen the overall restoration effort and lead to the common goal of protecting important stream corridors.

Author

*Biological Diversity; Conservation; Forests; Habitats; Protection; Restoration*

**20030002561** Community Coll. of Baltimore County, Essex, MD USA

**SAV: The Return of the Natives to Dundee Creek**

ReVelle, Penny, Community Coll. of Baltimore County, USA; Resau, Robert, Community Coll. of Baltimore County, USA; McCrone, E. J., Community Coll. of Baltimore County, USA; Hershey, James, Community Coll. of Baltimore County, USA; Reed, Wanda, Community Coll. of Baltimore County, USA; Savage-Moure, Janet, Community Coll. of Baltimore County, USA; Thorndill, David, Community Coll. of Baltimore County, USA; Toskes, Jane, Community Coll. of Baltimore County, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 287-290; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

From 1990 to 1997, we monitored the species composition and abundance of submerged aquatic vegetation (SAV) in Dundee Creek, which flows into the Gunpowder River in the upper Chesapeake Bay. During the same period we monitored Dundee Creek for concentrations of nitrates, phosphates, ammonia dissolved oxygen and salinity, water temperature, pH, and turbidity. SAV growth increased significantly in Dundee Creek over the study period. We also observed a change in species composition. Whereas the introduced species *Myriophyllum spicatum* dominated communities in 1991 and 1992, now native species such as *Vallisneria americana* have increased in abundance and distribution. Several native species once common in this area but not observed at all in the early 1990s have reappeared. These changes were accompanied by variable nitrate and phosphate concentrations. However, a better correlation is with spring water temperatures and spring turbidities. In this paper, we discuss other factors that may interact with nutrients and water temperatures.

Author

*Nitrates; Oxygen; pH; Salinity; Turbidity; Vegetation; Phosphates*

**20030002562** Corps of Engineers, Baltimore, MD USA

**Wetland Losses in Maryland's Coastal Bays Watershed Since the Beginning of the Twentieth Century and Their Implications for Wetlands Restoration**

Spaur, Christopher C., Corps of Engineers, USA; Nichols, Bruce E., Natural Resources Conservation Service, USA; Hughes, Thomas E., Corps of Engineers, USA; Noy, Peter M., Corps of Engineers, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 291-302; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Losses of salt marsh and forested wetlands to agriculture, development, and silviculture in the coastal bays watershed of Maryland from the beginning of the twentieth century through the 1980s were estimated through a review of soil, wetlands, and land-use maps and aerial photographs; and interpretive field surveys. Loss of salt marsh was estimated to be approximately 730 ha (1,810 acres), or 10% of the historic total. Losses were concentrated in the northern coastal bays, where approximately 620 ha (1,540 acres), or 37%, of the historic salt marshes were lost to development. Losses of forested wetlands by complete conversion to agriculture and development were estimated to be 10,000 ha (24,800 acres), or 44% of the historic total. Most of the remaining areas of historic forested wetlands Still under forest cover have been hydrologically degraded by drainage; Lip to an additional 10,700 ha (26,400 acres) may fall into this status. Combining these categories, up to 20,700 ha (51,200 acres), or 91%, of the historic forested wetlands of the watershed might have been lost or substantially degraded. Complete losses of forested wetlands are concentrated in the St. Martin River, Turville/Herring Creek, and Newport Bays subwatersheds. Efforts to restore and create salt marsh in the northern coastal bays should be undertaken wherever suitable sites exist, since losses have been substantial in this region, and the natural processes that create and maintain salt marsh are impaired. Salt marsh restoration efforts in the southern bays should focus on sites where losses have occurred. Loss of forested wetlands has occurred on such a large scale that restoration should be undertaken throughout the coastal bays watershed wherever suitable sites exist. to improve water quality in the coastal bays, restoration and creation of forested wetlands could be focused in the St. Martin River, Turville/Herring Creek, and Newport Bay subwatersheds.

Author

*Wetlands; Restoration; Marshlands; Drainage; Forests; Silviculture; Soil Mapping*

**20030002563** Alice Ferguson Foundation, Accokeek, MD USA

**Diversity of Maryland State Endangered, Threatened, and Rare Vascular Plants in Two Nontidal Baymouth Barrier Wetlands along the Chesapeake Bay**

Steuery, Brent W., Alice Ferguson Foundation, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 303-307; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

The flora of two nontidal freshwater baymouth barrier wetlands on the Chesapeake Bay of Maryland was surveyed for occurrences of state rare vascular plants. Forty-two state-ranked vascular plant species were recorded from 31 genera in 23 families at the two study sites in Calvert and Kent Counties, Maryland. Six of the state-ranked vascular taxa were found in both barrier wetlands. Of the 42 state-ranked taxa observed, 36 were associated with wetlands and 6 were found on the barrier dunes. Sixteen of the documented taxa are recognized as state endangered extirpated, endangered, or are first reports for the State of Maryland.

Author

*Plants (Botany); Organisms; Cardiovascular System*

**20030002634** NASA Marshall Space Flight Center, Huntsville, AL USA

**Convection and Easterly Wave Structure Observed in the Eastern Pacific Warm-Pool during EPIC-2001**

Peterson, Walter A., NASA Marshall Space Flight Center, USA; Cifelli, R., NASA Marshall Space Flight Center, USA; Boccippio, D., NASA Marshall Space Flight Center, USA; Rutledge, S. A., NASA Marshall Space Flight Center, USA; Fairall, C. W., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

During September-October 2001, the East Pacific Investigation of Climate Processes in the Coupled Ocean-Atmosphere System (EPIC-2001) ITCZ field campaign focused on studies of deep convection in the warm-pool region of the East Pacific. In addition to the TAO mooring array, observational platforms deployed during the field phase included the NOAA ship RN Ronald H. Brown, the NSF ship RN Horizon, and the NOAA P-3 and NCAR C-130 aircraft. This study combines C-band Doppler radar, rawinsonde, and surface heat flux data collected aboard the RN Brown to describe ITCZ convective structure and rainfall statistics in the eastern Pacific as a function of 3-5 day easterly wave phase. Three distinct easterly wave passages occurred during EPIC-2001. Wind and thermodynamic data reveal that the wave trough axes exhibited positively correlated U and V winds and a slight westward phase tilt with height. A relatively strong (weak) northeasterly deep tropospheric shear followed the trough (ridge) axis. Temperature and humidity perturbations exhibited mid-to upper level cooling (warming) and drying (moistening) in the northerly (trough and southerly) phase. At low levels warming (cooling) occurred in the northerly (southerly) phase with little change in the relative humidity, though mixed layer mixing ratios were larger during the northerly phase. When composited, radar, sounding, lightning and surface heat flux observations suggest the following systematic behavior as a function of wave phase: approximately zero to one quarter wavelength ahead of (behind) the wave trough in northerly (southerly) flow, larger (smaller) CAPE, lower (higher) CIN, weaker (stronger) tropospheric shear, higher (lower) conditional mean rain rates, higher (lower) lightning flash densities, and more (less) robust convective vertical structure occurred. Latent and sensible heat fluxes reached a minimum in the northerly phase and then increased through the trough, reaching a peak during the ridge phase (leading the peak in CAPE). From a radar echo coverage perspective, larger areas of light rain and slightly larger (10%) area averaged rain rates occurred in the vicinity of, and just behind, the trough axes in southerly flow. Importantly, the transition in convective structure observed across the trough axis when considered with the relatively small change in area mean rain rates suggests the presence of a transition in the vertical structure of diabatic heating across the easterly waves examined. The inferred transition in heating structure is supported by radar diagnosed divergence profiles that exhibit convective (stratiform) characteristics ahead of (behind) the trough.

Author

*Convection; Climatology; Meteorology; Ocean Dynamics; Pacific Ocean; Atmospheric Models; Troughs*

**20030002831** Georgia Inst. of Tech., Atlanta, GA USA

**Global Distribution of Tropospheric Aerosols: A 3-D Model Analysis of Satellite Data Annual Report, 1 Sep. 1999 - 31 Aug. 2000**

Chin, Mian, Georgia Inst. of Tech., USA; [2002]; 3p; In English

Contract(s)/Grant(s): NAG5-7682

Report No.(s): G-35-W84; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This report describes objectives completed for the GACP (Global Climatology Aerosol Project). The objectives included the analysis of satellite aerosol data, including the optical properties and global distributions of major aerosol types, and human contributions to major aerosol types. The researchers have conducted simulations and field work.

CASI

*Aerosols; Atmospheric Models; Optical Properties; Three Dimensional Models; Satellite Observation*

**20030003706** NASA Glenn Research Center, Cleveland, OH USA

**Measurement of Correlation Between Flow Density, Velocity, and Density\*Velocity(sup 2) With Far Field Noise in High Speed Jets**

Panda, Jayanta, Ohio Aerospace Inst., USA; Seasholtz, Richard G., NASA Glenn Research Center, USA; Elam, Kristie A., Akima Corp., USA; September 2002; 26p; In English; Eighth Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 708-90-43

Report No.(s): NASA/TM-2002-211791; E-13485; NAS 1.15:211791; AIAA Paper 2002-2485; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

To locate noise sources in high-speed jets, the sound pressure fluctuations  $p'$ , measured at far field locations, were correlated with each of radial velocity  $v$ , density  $\rho$ , and  $\rho v(\exp 2)$  fluctuations measured from various points in jet plumes. The experiments follow the cause-and-effect method of sound source identification, where  $\langle \rho v(\exp 2) - p' \rangle$  correlation is related to the first, and  $\langle \rho - p' \rangle$  correlation to the second source terms of Lighthill's equation. Three fully expanded, unheated plumes of Mach number 0.95, 1.4 and 1.8 were studied for this purpose. The velocity and density fluctuations were measured simultaneously using a recently developed, non-intrusive, point measurement technique based on molecular Rayleigh scattering. It was observed that along the jet centerline the density fluctuation spectra  $S(\text{sub } \rho)$  have different shapes than the radial velocity spectra  $S(\text{sub } v)$ , while data obtained from the peripheral shear layer show similarity between the two spectra. Density fluctuations in the jet showed significantly higher correlation, than either  $\rho v(\text{sub } 2)$  or  $v$  fluctuations. It is found that a single point  $\langle \rho - p' \rangle$  correlation from the peak sound emitting region at the end of the potential core can account for nearly 10% of all noise at 30 to the jet axis. The  $\langle \rho v(\exp 2) - p' \rangle$  correlation, representing the effectiveness of a longitudinal quadrupole in generating noise 90 to the jet axis, is found to be zero within experimental uncertainty. In contrast  $\rho v(\exp 2)$  fluctuations were better correlated with sound pressure fluctuation at the 30 location. The strongest source of sound is found to lie at the centerline and beyond the end of potential core.

Author

*Flow Measurement; Flow Velocity; Sound Pressure; Pressure Oscillations; Plumes; Jet Flow*

**20030003727** Argonne National Lab., IL USA

**Designing a Flexible Grid Enabled Scientific Modeling Interface**

Dvorak, M.; Taylor, J.; Mickelson, S.; 2002; 14p; In English

Report No.(s): DE2002-799789; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The Espresso Scientific Modeling Interface (Espresso) is a scientific model productivity tool developed for climate modelers. Espresso was designed to utilize existing Grid computing technology to perform climate simulations. Espresso is also a software tool that gives scientific model users the freedom to eliminate the mundane task of editing shell scripts and configuration files. It empowers the scientists to spend more time performing science and analyzing the output of climate simulations.

NTIS

*Mathematical Models; Computational Grids; Climate Models; Software Engineering*

**20030004258** Michigan Univ., Dept. of Atmospheric, Ocean, and Space Science, Ann Arbor, MI USA

**The Study of Biomass Emissions for Defining Radiative Forcing of Climate Final Report, 1 Feb. 2002 - 31 Jan. 2003**

Penner, Joyce, Michigan Univ., USA; [2003]; 11p; In English

Contract(s)/Grant(s): NAG5-11674; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Accurate quantification of the amounts of trace gases and particulate matter emitted from vegetation fires and other sources of biomass burning (agricultural waste and biofuels) on a regional and global basis is required by a number of users, including scientists studying a wide range of atmospheric processes, national governments who are required to report greenhouse gas emissions, and those interested in quantifying the sources of air pollution that affect human health at regional scales. Over the past decade, improvements in the ability to detect and map fires using a number of different satellite systems have been achieved, largely through efforts coordinated through working groups organized by the IGBP Data and Information System and Global Observation of Forest Cover (GOFC) projects. In addition, significant advances and improvement in or understanding of the

emissions factors for biomass burning in different biomes has resulted through efforts by the Biomass Burning Experiment (BIBEX) organized through the International Global Atmospheric Chemistry project. A number of satellite-based fire data products have been generated, and a number of new products will shortly be available. These new data products will provide the basis for estimating emissions from biomass burning on a global basis. However, a number of issues remain concerning the availability of other data sets needed to generate these estimates. Recognizing these issues, the GOFC-Fire Satellite Validation Workshop (held in Lisbon, Portugal on 9-11 July 2001), recommended that a workshop focusing on Improving Global Estimates of Atmospheric Emissions from Biomass Burning be organized. This workshop was held from 17- 19 July 2002 on the campus of the University of Maryland, College Park, Maryland. This workshop served as the annual meeting of the GOFC/GOLD-Fire Program. The overall goals of the meeting were to review the information products generated from satellite imagery and other sources that are currently available for developing emission estimates from biomass burning, evaluate areas where improved or additional products would be beneficial, and recommend products for use by the atmospheric science community.

Author

*Biomass Burning; Exhaust Emission; Atmospheric Chemistry; Trace Elements; Exhaust Gases; Atmospheric Composition*

## 46

### GEOPHYSICS

*Includes earth structure and dynamics, aeronomy; upper and lower atmosphere studies; ionospheric and magnetospheric physics; and geomagnetism. For related information see 47 Meteorology and Climatology; and 93 Space Radiation.*

**20030002452** Computational Physics, Inc., Fairfax, VA USA

**Long-Term Global Morphology of Gravity Wave Activity Using UARS Data Final Report, 18 Sep. - 18 Dec. 2000**

Eckermann, Stephen D., Computational Physics, Inc., USA; Dec. 18, 2000; 46p; In English; Original contains color illustrations  
Contract(s)/Grant(s): NAS5-98045

Report No.(s): NRA-97-MTPE-04; Rept-5090-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report provides a broad outline of the total body of research conducted during the past three years. We report on detailed model studies of the precise way in which infrared limb scanning satellites explicitly detect gravity waves, and use these insights to resolve earlier discrepant zonal mean estimates of gravity wave variances from satellite limb scanners. Detailed analysis of CRISTA temperature fluctuations are outlined, which provide new global information on long-wavelength stratospheric gravity waves generated by mountains, tropical convection and the mid-latitude jet stream- vortex system, as well as interactions higher in the mesosphere with the diurnal tide. The detailed insights gained from analyzing CRISTA data are applied to provide a multi-year analysis of stratospheric mountain waves over the Andes evident in MLS limb-track data. We also demonstrate for the first time that stratospheric temperature data from the CLAES instrument on UARS resolved gravity waves, and we highlight mountain wave information in a subset of these data. Final conclusions and recommendations are set forth, and the present findings are directly related to the original goals of the research contract. A full list of publications that resulted from this research is provided.

Author

*Gravity Waves; Infrared Scanners; Atmospheric Temperature; Convection; Diurnal Variations*

**20030002453** Naval Research Lab., Washington, DC USA

**Global Measurements of Stratospheric Mountain Waves from Space**

Eckermann, Stephen D., Naval Research Lab., USA; Preusse, Peter, Wuppertal Univ., Germany; Science; Nov. 19, 1999; Volume 286, pp. 1534-1537; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS5-98045; Copyright; Avail: Issuing Activity

Temperatures acquired by the Cryogenic Infrared Spectrometers and Telescopes for the Atmosphere (CRISTA) during shuttle mission STS-66 have provided measurements of stratospheric mountain waves from space. Large-amplitude, long-wavelength mountain waves at heights of 15 to 30 kilometers above the southern Andes Mountains were observed and characterized, with vigorous wave breaking inferred above 30 kilometers. Mountain waves also occurred throughout the stratosphere (15 to 45 kilometers) over a broad mountainous region of central Eurasia. The global distribution of mountain wave activity accords well with predictions from a mountain wave model. The findings demonstrate that satellites can provide the global data needed to improve mountain wave parameterizations and hence global climate and forecast models.

Author

*Stratosphere; Climate Models; Mathematical Models; Parameterization; Space Temperature; Cryogenics; Infrared Spectrometers*

**20030002454** Wuppertal Univ., Dept. of Physics, Germany

**Comparison of Global Distributions of Zonal-Mean Gravity Wave Variance Inferred from Different Satellite Instruments**

Preusse, Peter, Wuppertal Univ., Germany; Eckermann, Stephen D., Naval Research Lab., USA; Offermann, Dirk, Wuppertal Univ., Germany; Geophysical Research Letters; Dec. 01, 2000; ISSN 0094-8276; Volume 27, No. 23, pp. 3877-3880; In English; Original contains color illustrations

Contract(s)/Grant(s): NAS5-98045

Report No.(s): Paper-2000GL011916; Copyright; Avail: Issuing Activity

Gravity wave temperature fluctuations acquired by the CRISTA instrument are compared to previous estimates of zonal-mean gravity wave temperature variance inferred from the LIMS, MLS and GPS/MET satellite instruments during northern winter. Careful attention is paid to the range of vertical wavelengths resolved by each instrument. Good agreement between CRISTA data and previously published results from LIMS, MLS and GPS/MET are found. Key latitudinal features in these variances are consistent with previous findings from ground-based measurements and some simple models. We conclude that all four satellite instruments provide reliable global data on zonal-mean gravity wave temperature fluctuations throughout the middle atmosphere.

Author

*Variations; Gravity Waves; Mean; Variance (Statistics); Estimates*

**20030002494** Florida Inst. of Tech., Physics and Space Sciences Dept., FL USA

**Establishing A Geologic Baseline of Cape Canaveral's Natural Landscape: Black Point Drive**

Parkinson, Randall W., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

The goal of this project is to identify the process responsible for the formation of geomorphic features in the Black Point Drive area of Merritt Island National Wildlife Refuge/Kennedy Space Center (MINWR/KSC), northwest Cape Canaveral. This study confirms the principal landscape components (geomorphology) of Black Point Drive reflect interaction between surficial sediments deposited in association with late-Quaternary sea-level highstands and the chemical evolution of late-Cenozoic sub-surface limestone formations. The Black Point Drive landscape consists of an undulatory mesic terrain which dips westward into myriad circular and channel-like depression marshes and lakes. This geomorphic gradient may reflect: (1) spatial distinctions in the elevation, character or age of buried (pre-Miocene) limestone formations, (2) dissolution history of late-Quaternary coquina and/or (3) thickness of unconsolidated surface sediment. More detailed evaluation of subsurface data will be necessary before this uncertain0 can be resolved.

Author

*Geomorphology; Wildlife; Topography; Terrain; Chemical Evolution*

**20030002639** Alaska Univ., Geophysical Inst., Fairbanks, AK USA

**Diagnostics and Modeling of the Auroral Ionosphere Under the Influence of the Gakona HF Transmitter**

Sentman, Davis D.; Wescott, Eugene M.; Olson, John V.; Otto, Antonius; Bristow, William A.; Aug. 2001; 39p; In English  
Contract(s)/Grant(s): F19628-99-C-0059; AF Proj. 4266

Report No.(s): AD-A408040; AFRL-VS-TR-2001-1622; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This project comprises five separate elements that address science and education objectives of the HAARP program. These elements are: (1) to establish the characteristics of the ionospheric source region responsible for the ELF/VLF waves generated by modulation of HAARP HF emissions, and to measure the ELF radiation pattern. (2) to attempt to stimulate hydromagnetic waves in the ionospheric waveguide using the HAARP heater. (3) to develop a simulation model for the plasma physical and electromagnetic effects of localized ionospheric heating with the purpose of predicting outcomes of heating experiments and to guide the design of new experiments. (4) Using the SuperDARN instrument on Kodiak, to examine the formation of ionospheric irregularities within the heated volume and the relationship of the irregularities to other observations such as the generation of Stimulated Electromagnetic emissions. (5) to provide scientific education about HAARP and physical science in general to members of the local Copper Valley Community. In this report the results of research obtained to date in each of the five program elements are reviewed, and recommendations for follow up activities are presented.

DTIC

*Auroras; Ionospheres*

**20030002690** Space, Washington, DC USA

**Satellite Spots Turbulence Producing Mountain Waves in the Stratosphere**

Britt, Robert Roy, Space, USA; Space.com electronic article; Feb. 07, 2002, pp. 1-3; In English

Contract(s)/Grant(s): NAS5-98045; Copyright; Avail: Issuing Activity

When masses of air flow over massive mountains, invisible waves often roil high into the stratosphere, affecting weather and mixing the chemicals that contribute to ozone depletion. The waves also create turbulence that can be a danger to high-altitude research missions by NASA's lightweight ER-2 aircraft, as well as shuttle flights upon reentry. In Friday's issue of the journal *Science*, researchers report for the first time a technique that allows them to see temperature signatures from these invisible mountain waves. The method, involving high-resolution, satellite-based measurement of adjacent pockets of the atmosphere, is expected to aid in spotting turbulence and, one day, improve weather forecasts.

Author

*Weather Forecasting; Turbulence; Ozone Depletion; High Resolution; High Altitude; Air Flow; Wave Fronts*

**20030002691** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Pemanfaatan Sains Antariksa, Jakarta, Indonesia

**Existence of Planetary Waves in the Ionosphere *Eksistensi Gelombang Planeter di Ionosfer***

Muslim, Buldan, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Santoso, Anwar, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; *Majalah Lapan*; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 49-55; In Malay-Indonesian; Copyright; Avail: Issuing Activity

Data of foF2 from ionosonde observation at low, equatorial, middle and high latitude during low and high level of solar activity were used to study of existence planetary wave in the ionosphere. Based on spectrum analysis, the planetary wave with period about 2 days appeared in low latitude and could not be observed at high latitude. Signal strength of 2 days wave is increase as a geomagnetic latitude decrease.

Author

*Planetary Waves; Planetary Ionospheres; Ionosondes*

**20030003642** Cornell Univ., Dept. of Theoretical and Applied Mechanics, Ithaca, NY USA

**Sheet Flows, Avalanches, and Dune Migration on Earth and Mars**

Jenkins, James, Cornell Univ., USA; Hanes, D., Florida Univ., USA; Bideau, D., Rennes Univ., France; Berton, G., Rennes Univ., France; Rioual, F., Rennes Univ., France; Valance, A., Rennes Univ., France; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 370-385; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

We provide an overview of our research on sheet flows and avalanches of granular materials, primarily in terrestrial conditions. Sheet flows are relatively thin, highly concentrated regions of grains that flow near the ground under the influence of a strong turbulent wind. In them grains are suspended by interparticle collisions and the velocity fluctuations of the turbulent gas. Avalanches are flows of dry, cohesionless granular materials that are driven by gravity down inclines against the frictional and collisional resistance of the grains of the bed. In our study of sheet flows, we have extended existing theories that involve particle-particle and gas-particle interactions to apply to the conditions of a typical terrestrial sand dune during a sandstorm. This has involved the incorporation of both the viscous dissipation of the particle fluctuation energy due to the gas and the turbulent suspension of the grains due to velocity fluctuations of the gas. It has also involved an examination of several different boundary conditions at the bed and a more precise characterization of the conditions that apply at the top of a sheet flow, where the mean-free-path between collisions becomes comparable to the length of a ballistic trajectory. Solutions to the resulting differential equations have been obtained for both steady and unsteady fully-developed flow. The latter solutions provide information on the characteristic time to achieve a steady flow that plays a key role in dune formation. In support of this modeling effort, experiments have been undertaken to provide a better understanding of the interaction of particles colliding with the bed, and the energy of the rebounding particle and additional ejected particles has been measured in two-dimensional situations. The research on avalanches has focused on dense, frictional flows. Experiment and numerical simulations indicate that relatively thin dense flows, on the order of ten particle diameters, occur in layers. In these, momentum transfer occurs by rubbing between contacting particles and bumping between particles falling under gravity, rather than in collisions between freely flying particles. Thicker dense flows, on the other hand, do seem to involve collisional transfer of momentum. Theories based on the appropriated mechanisms of momentum transfer predict velocity profiles that are in agreement with those measured in experiment and numerical simulations, some of which have been carried out in the course of the research.

Author

*Avalanches; Dunes; Earth Surface; Mars Surface; Granular Materials; Particle Interactions; Friction Factor*

**20030003698** Smithsonian Astrophysical Observatory, Cambridge, MA USA

**Large Scale Deformation of the Western U.S. Cordillera Final Report, 1 Feb. - 31 Oct. 2002**

Bennett, Richard A., Smithsonian Astrophysical Observatory, USA; December 2002; 8p; In English  
Contract(s)/Grant(s): NAG5-11629; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Over the past couple of years, with support from NASA, we used a large collection of data from GPS, VLBI, SLR, and DORIS networks which span the Western U.S. Cordillera (WUSC) to precisely quantify present-day large-scale crustal deformations in a single uniform reference frame. Our work was roughly divided into an analysis of these space geodetic observations to infer the deformation field across and within the entire plate boundary zone, and an investigation of the implications of this deformation field regarding plate boundary dynamics. Following the determination of the first generation WUSC velocity solution, we placed high priority on the dissemination of the velocity estimates. With in-kind support from the Smithsonian Astrophysical Observatory, we constructed a web-site which allows anyone to access the data, and to determine their own velocity reference frame.

Author

*Earth Crust; Geodynamics; Data Processing; Geodetic Surveys; Plates (Tectonics); Deformation; Remote Sensing; Image Analysis*

**20030003818** Smithsonian Astrophysical Observatory, Cambridge, MA USA

**Large Scale Deformation of the Western U.S. Cordillera Annual Report, 1 Feb. - 31 Oct. 2002**

Bennett, Richard A., Smithsonian Astrophysical Observatory, USA; December 2002; 8p; In English  
Contract(s)/Grant(s): NAG5-11629; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Over the past couple of years, with support from NASA, we used a large collection of data from GPS, VLBI, SLR, and DORIS networks which span the Western U.S. Cordillera (WUSC) to precisely quantify present-day large-scale crustal deformations in a single uniform reference frame. Our work was roughly divided into an analysis of these space geodetic observations to infer the deformation field across and within the entire plate boundary zone, and an investigation of the implications of this deformation field regarding plate boundary dynamics. Following the determination of the first generation WUSC velocity solution, we placed high priority on the dissemination of the velocity estimates. With in-kind support from the Smithsonian Astrophysical Observatory, we constructed a web-site which allows anyone to access the data, and to determine their own velocity reference frame.

Author

*Geodetic Surveys; Plates (Tectonics); Remote Sensing; Image Analysis; Earth Crust; Geodynamics; Data Processing*

**20030003825** NASA Langley Research Center, Hampton, VA USA

**Retrieval of Kinetic Temperature and Carbon Dioxide Abundance from Non-Local Thermodynamic Equilibrium Limb Emission Measurements made by the SABER Experiment on the TIMED Satellite**

Mertens, Christopher J., NASA Langley Research Center, USA; Mlynczak, Martin G., NASA Langley Research Center, USA; Lopez-Puertas, Manuel, Instituto de Astrofísica de Andalucía, Spain; Wintersteiner, Peter P., Arcon Corp., USA; Picard, Richard H., Air Force Research Lab., USA; Winick, Jeremy R., Air Force Research Lab., USA; Gordley, Larry L., G and A Technical Software, Inc., USA; Russell, James M., III, Hampton Univ., USA; [2002]; 10p; In English; SPIE's 9th International Symposium on Remote Sensing, 23-27 Sep. 2002, Crete, Greece; Sponsored by International Society for Optical Engineering, USA; Original contains color illustrations

Contract(s)/Grant(s): F19628-96-C-0048; MCYT-PNE-017/2000-C; MCYT-REN2001-3249; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The Sounding of the Atmosphere using Broadband Emission Radiometry (SABER) experiment was launched onboard the TIMED satellite in December, 2001. SABER is designed to provide measurements of the key radiative and chemical sources and sinks of energy in the mesosphere and lower thermosphere (MLT). SABER measures Earth limb emission in 10 broadband radiometer channels ranging from 1.27 micrometers to 17 micrometers. Measurements are made both day and night over the latitude range from 54 deg. S to 87 deg. N with alternating hemisphere coverage every 60 days. In this paper we concentrate on retrieved profiles of kinetic temperature ( $T_{\text{sub k}}$ ) and CO<sub>2</sub> volume mixing ratio (vmr), inferred from SABER-observed 15 micrometer and 4.3 micrometer limb emissions, respectively. SABER-measured limb radiances are in non-local thermodynamic equilibrium (non-LTE) in the MLT region. The complexity of non-LTE radiation transfer combined with the large volume of data measured by SABER requires new retrieval approaches and radiative transfer techniques to accurately and efficiently retrieve the

data products. In this paper we present the salient features of the coupled non-LTE T(sub k)/CO2 retrieval algorithm, along with preliminary results.

Author

*Carbon Dioxide; Satellite Sounding; Remote Sensing; Radiometers; Abundance; Thermodynamic Equilibrium; Earth Limb; Kinetic Energy*

**20030004019** NASA Langley Research Center, Hampton, VA USA

**An Intercomparison of Cloud-Resolving Models with the Atmospheric Radiation Measurement Summer 1997 Intensive Observation Period Data**

Xu, Kuan-Man, NASA Langley Research Center, USA; Cederwall, Richard T., Lawrence Livermore National Lab., USA; Donner, Leo J., National Oceanic and Atmospheric Administration, USA; Grabowski, Wojciech W., National Center for Atmospheric Research, USA; Guichard, Françoise, Centre National de Recherches Meteorologiques, France; Johnson, Daniel E., NASA Goddard Space Flight Center, USA; Khairoutdinov, Marat, Colorado State Univ., USA; Krueger, Steven K., Utah Univ., USA; Petch, Jon C., Meteorological Office, UK; Randall, David A., Colorado State Univ., USA; Quarterly Journal of the Royal Meteorological Society; 2002; Volume 128, pp. 593-624; In English; Original contains color illustrations

Contract(s)/Grant(s): DE-FG03-95ER-61968; DE-FG03-94ER-61769; DE-FG02-98ER-62570; W-7405-eng-48; RR1BNC97; EVK2-CT199900051; NSF ATM-97-01950; Copyright; Avail: Issuing Activity

This paper reports an intercomparison study of midlatitude continental cumulus convection simulated by eight two-dimensional and two three-dimensional cloud-resolving models (CRMs), driven by observed large-scale advective temperature and moisture tendencies, surface turbulent fluxes, and radiative-heating profiles during three sub-periods of the summer 1997 Intensive Observation Period of the US Department of Energy's Atmospheric Radiation Measurement (ARM) program. Each sub-period includes two or three precipitation events of various intensities over a span of 4 or 5 days. The results can be summarized as follows. CRMs can reasonably simulate midlatitude continental summer convection observed at the ARM Cloud and Radiation Testbed site in terms of the intensity of convective activity, and the temperature and specific-humidity evolution. Delayed occurrences of the initial precipitation events are a common feature for all three sub-cases among the models. Cloud mass fluxes, condensate mixing ratios and hydrometeor fractions produced by all CRMs are similar. Some of the simulated cloud properties such as cloud liquid-water path and hydrometeor fraction are rather similar to available observations. All CRMs produce large downdraught mass fluxes with magnitudes similar to those of updraughts, in contrast to CRM results for tropical convection. Some inter-model differences in cloud properties are likely to be related to those in the parametrizations of microphysical processes. There is generally a good agreement between the CRMs and observations with CRMs being significantly better than single-column models (SCMs), suggesting that current results are suitable for use in improving parametrizations in SCMs. However, improvements can still be made in the CRM simulations; these include the proper initialization of the CRMs and a more proper method of diagnosing cloud boundaries in model outputs for comparison with satellite and radar cloud observations.

Author

*Atmospheric Models; Cloud Physics; Radiation Measurement; Atmospheric Radiation; Cumulus Clouds; Meteorological Parameters*

**20030004238** California Univ., Inst. of Geophysics and Planetary Physics, Los Angeles, CA USA

**Formation of Electrostatic Potential Drops in the Auroral Zone**

Schrifer, D., California Univ., USA; Ashour-Abdalla, M., California Univ., USA; Richard, R. L., California Univ., USA; Physics and Chemistry of the Earth; 2001; ISSN 1464-1917; Volume 26, Nos.1-3, pp. 65-70; In English

Contract(s)/Grant(s): NAG5-6689; NAG5-8085; UCRP-99-907; Copyright; Avail: Issuing Activity

In order to examine the self-consistent formation of large-scale quasi-static parallel electric fields in the auroral zone on a micro/meso scale, a particle in cell simulation has been developed. The code resolves electron Debye length scales so that electron micro-processes are included and a variable grid scheme is used such that the overall length scale of the simulation is of the order of an Earth radii along the magnetic field. The simulation is electrostatic and includes the magnetic mirror force, as well as two types of plasmas, a cold dense ionospheric plasma and a warm tenuous magnetospheric plasma. In order to study the formation of parallel electric fields in the auroral zone, different magnetospheric ion and electron inflow boundary conditions are used to drive the system. It has been found that for conditions in the primary (upward) current region an upward directed quasi-static electric field can form across the system due to magnetic mirroring of the magnetospheric ions and electrons at different altitudes. For conditions in the return (downward) current region it is shown that a quasi-static parallel electric field in the opposite sense

of that in the primary current region is formed, i.e., the parallel electric field is directed earthward. The conditions for how these different electric fields can be formed are discussed using satellite observations and numerical simulations.

Author

*Electric Fields; Electrostatics; Electric Potential; Auroral Zones; Simulation*

## 47

### METEOROLOGY AND CLIMATOLOGY

*Includes weather observation forecasting and modification*

**20030002286** Massachusetts Inst. of Tech., Lincoln Lab., Lexington, MA USA

#### **CSKETCH Image Processing Library**

Morgan, J.; Troxel, S.; Aug. 21, 2002; 196p; In English

Report No.(s): PB2003-100171; ATC-283; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The CSKETCH image processing library is a collection of C++ classes and global functions which comprise a development environment for meteorological algorithms. The library is best thought of as a 'tool-kit' which contains many standard mathematical and signal processing functions often employed in the analysis of weather radar data. A tutorial-style introduction to the library is given, complete with many examples of class and global function usage. Included is an in-depth look at the main class of the library, the SKArray class, which is a templated and encapsulated class for storing numerical data arrays of one, two, or three dimensions. Following the tutorial is a complete reference for the library which describes publicly-available class data members and class member functions, as well as all global functions included in the library.

NTIS

*Meteorological Radar; Image Processing; Libraries*

**20030002495** Florida Inst. of Tech., School of Aeronautics, FL USA

#### **GOES-Microburst Products Performance Analysis in the Cape Canaveral and Kennedy Space Center Areas**

Witiw, Michael R., Florida Inst. of Tech., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

In the past few years, the capabilities of NOAA Geostationary Operational Environmental Satellites (GOES) have increased dramatically. Hourly vertical sounder data is now generally available, but may be unavailable depending upon cloud conditions, satellite operations, and computer system problems at NOAA's National Environmental Satellite Display and Information Service (NESDIS). Meteorologists at NESDIS have used vertical sounder data to develop experimental products for forecasting the probability of convective downbursts. The two products of interest are the Microburst Day Predictive Index (MDPI), which provides an indication of microburst potential and the WINDEX which is a forecast of maximum winds assuming a microburst does occur. Data analyses were made for the central Florida convective season, that is, the period beginning May 1 and ending September 30. The MDPI showed significant potential as an aid in forecasting convective downbursts. MDPI calculated from GOES soundings were well correlated with those calculated from Cape Canaveral RAOBs.

Author

*Synchronous Platforms; Reliability Analysis; Data Processing; GOES Satellites*

**20030003679** Argonne National Lab., IL USA

#### **Characterization of Upper Troposphere Water Vapor Measurements during AFWEX using LASE**

Ferrare, R. A.; Browell, E. V.; Ismail, S.; Kooi, S.; Brasseur, L. H.; 2002; 10p; In English

Report No.(s): DE2002-799813; ANL/ER/CP-108187; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The agreement among the Lidar Atmospheric Sensing Experiment (LASE), Raman Lidar, and Microwave Radiometer (MWR), measurements demonstrates how LASE experiments can be used to characterize both profile and column water vapor measurements and that ARM Raman Lidar, when calibrated using the MWR, Precipitable Water Vapor (PWV) can provide accurate Upper Troposphere (UT) water vapor measurements.

NTIS

*Optical Radar; Troposphere; Water Vapor; Meteorological Instruments; Remote Sensing; Precipitation (Meteorology)*

**20030003751** Lawrence Livermore National Lab., Livermore, CA USA

**Description of the ARM Operational Objective Analysis System**

Zhang, M.; Xie, S.; Cederwall, R. T.; Yio, J. J.; May 01, 2001; 26p; In English

Report No.(s): DE2002-802094; UCRL-ID-144292; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This report describes the ARM (Atmospheric Radiation Measurement) operational variational objective analysis system. It is currently used to process the data collected from the ARM Intensive Operational Periods (IOPs) for driving and evaluating physical parameterizations in climate models. The analysis system was originally developed by Zhang and Lin (1997) at State University of New York at Stony Brook and was migrated to the Lawrence Livermore National Laboratory (LLNL) as the ARM operational objective analysis system in May 1999. In contrast with previous objective analysis, the ARM objective analysis used the constrained variational analysis method developed by Zhang and Lin (1997), in which the atmospheric state variables are forced to satisfy the conservation of mass, heat, moisture, and momentum through a variational technique. The purpose of this technical report is to provide an overview of the constrained variational analysis method, the architecture of the objective analysis system, along with in-depth information on running the variational analysis codes.

NTIS

*Atmospheric Models; Atmospheric Radiation; Radiation Measurement; Meteorological Parameters*

**20030003808** Argonne National Lab., IL USA

**Developing Grid Based Infrastructure for Climate Modeling**

Taylor, J.; Dvorak, M.; Mickelson, S.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799788; No Copyright; Avail: National Technical Information Service (NTIS)

In this paper we discuss the development of a high performance climate modeling system as an example of the application of Grid based technology to climate modeling. The climate simulation system at Argonne currently includes a scientific modeling interface (Espresso) written in Java which incorporates Globus middleware to facilitate climate simulations on the Grid. The climate modeling system also includes a high performance version of MM5v3.4 modified for long climate simulations on our 512 processor Linux cluster (Chiba City), an interactive web based tool to facilitate analysis and collaboration via the web, and an enhanced version of the Cave5D software capable of visualizing large climate data sets. We plan to incorporate other climate modeling systems such as the Fast Ocean Atmosphere Model (FOAM) and the National Center for Atmospheric Research's (NCAR) Community Climate Systems Model (CCSM) within Espresso to facilitate their application on computational grids.

NTIS

*Climate; Climate Models; Air Water Interactions; Atmospheric Models*

**20030003811** Lawrence Livermore National Lab., Livermore, CA USA

**Reduction of Tropical Cloudiness by Soot**

Ackerman, A. S.; Toon, O. B.; Stevens, D. E.; Heymsfield, A. J.; Ramanathan, V.; May 08, 2000; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-792796; UCRL-ID-138871; No Copyright; Avail: National Technical Information Service (NTIS)

Measurements and models show that enhanced aerosol concentrations can augment cloud albedo not only by increasing total droplet cross-sectional area, but also by reducing precipitation and thereby increasing cloud water content and cloud coverage. Aerosol pollution is expected to exert a net cooling influence on the global climate through these conventional mechanisms. Here we demonstrate an opposite mechanism through which aerosols can reduce cloud cover and thus significantly offset aerosol-induced radiative cooling at the top of the atmosphere on a regional scale. In model simulations the daytime clearing of trade cumulus is hastened and intensified by solar heating in dark haze (as found over much of the northern Indian Ocean during the northeast monsoon).

NTIS

*Aerosols; Cloud Cover*

**20030003814** Ohio State Univ., Columbus, OH USA

**Satellite and Model Analysis of the Atmospheric Moisture Budget in High Latitudes: High Resolution Precipitation Over Greenland Studied from Dynamic Method Final Report, 1 Jan. - 31 Dec. 2001**

Bromwich, David H., Ohio State Univ., USA; Chen, Qiu-shi, Ohio State Univ., USA; Dec. 10, 2002; 21p; In English; Original contains color illustrations

Contract(s)/Grant(s): NAG5-6001

Report No.(s): OSURF-740507; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Observations of precipitation over Greenland are limited. Direct precipitation measurements for the whole ice sheet are impractical, and those in the coastal region have substantial uncertainty but may be correctable with some effort. However, the analyzed wind, geopotential height and moisture fields are available for recent years, and the precipitation is retrievable from these fields by a dynamic method. Based on recent Greenland precipitation from dynamic studies, several deficiencies in the precipitation spatial distributions from these dynamic methods were evaluated by Bromwich et al.

Author

*Atmospheric Models; Atmospheric Moisture; Remote Sensing; Greenland; Numerical Analysis; Image Analysis; Precipitation (Meteorology)*

**20030003830** NASA Langley Research Center, Hampton, VA USA

**Numerical Study of a Convective Turbulence Encounter**

Proctor, Fred H., NASA Langley Research Center, USA; Hamilton, David W., NASA Langley Research Center, USA; Bowles, Roland L., AeroTech Research, Inc., USA; [2002]; 13p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-0944; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A numerical simulation of a convective turbulence event is investigated and compared with observational data. The specific case was encountered during one of NASA's flight tests and was characterized by severe turbulence. The event was associated with overshooting convective turrets that contained low to moderate radar reflectivity. Model comparisons with observations are quite favorable. Turbulence hazard metrics are proposed and applied to the numerical data set. Issues such as adequate grid size are examined.

Author

*Numerical Analysis; Convective Flow; Turbulence*

**20030003994** National Weather Service, Slidell, LA USA

**Partnership Between the Greater New Orleans Expressway Commission and the Weather Forecast Office (WFO) in Slidell, LA**

Johnson, A.; Trotter, P.; Zeigler, F.; 2002; 14p; In English

Report No.(s): PB2003-101312; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The 24-mile long Lake Pontchartrain Causeway is the longest bridge over water in the world (24 miles). Over 30,000 commuter vehicles make a round-trip crossing of the lake daily. The bridge connects the two Louisiana parishes of St. Tammany and Jefferson. The WFO in Slidell, Louisiana, developed a partnership with the Greater New Orleans Expressway Commission with the goal of providing the Causeway Commission more precise forecasts and advisories which would assist them in preparing for such significant weather events as strong winds across the lake, which impedes vehicles such as recreation vehicles, glass transporters and motorcycles as they try to make their way across the bridge. Other high impact weather factors are dense fog, severe thunderstorms, heavy rain, hailstorms, hurricane conditions, waterspouts and winter freezes.

NTIS

*Weather Forecasting; Bridges (Structures); Highways*

**20030003996** Alabama Univ., Huntsville, AL USA

**Bridging the Gap Between Research and Operations in the National Weather Service: Collaborative Activities Among the Huntsville Meteorological Community**

Darden, C.; Carroll, B.; Goodman, S.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): PB2003-100700; No Copyright; Avail: CASI; C01, CD-ROM

A major goal of the National Weather Service (NWS) is to provide improved service and products to our local communities and customers, consistent with the mission of the NWS as a federal agency. The rapid advancements in computer and communication technology have led to an explosion in the amount of weather information available to the public and private sectors. The NWS has always played a vital role in providing weather and hydrologic services, and to capitalize on new technology to further its mission it is incumbent on the NWS to 'think outside the box' for new and creative ways to further serve our customers. In an effort to achieve this goal, the new Weather Forecast Office (WFO) in Huntsville, Alabama has embarked upon a pro-active training, outreach and familiarization program geared towards assessing the needs and concerns of the local users.

NTIS

*Weather Stations; Meteorological Services*

**20030004226** National Oceanic and Atmospheric Administration, Office of Global Programs, Silver Spring, MD USA  
**Experiment in the Application of Climate Forecasts: NOAA-OGP Activities Related to the 1997-98 El Nino Event**  
Jan. 1999; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM  
Report No.(s): PB2003-101494; No Copyright; Avail: CASI; C01, CD-ROM

This document describes activities of the National Oceanic and Atmospheric Administration's Office of Global Programs (NOAA-OGP) during the 1997-98 El Nino event. El Nino, an episodic warming of waters in the equatorial Pacific, causes shifts in global climate patterns and can result in severe flooding and droughts in areas such as Latin America, Africa, and Southeast Asia. The document is divided into three major sections, including the Pilot Program for the Application of Climate Forecasts, Regional Climate Outlook Fora, and Related Activities. The overall intent of these activities was to make forecast information broadly available to potential users, and to foster a learning process on how forecast information related to seasonal-to-interannual climate variability could be incorporated into practical decision making.

NTIS

*Weather Forecasting; Climate; El Nino*

## 48

### OCEANOGRAPHY

*Includes the physical, chemical and biological aspects of oceans and seas; ocean dynamics, and marine resources. For related information see also 43 Earth Resources and Remote Sensing.*

**20030002241** Washington Univ., Applied Physics Lab., Seattle, WA USA  
**Dynamics and Thermodynamics of the North Pacific Ocean Final Report**  
Kelly, Kathryn A., Washington Univ., USA; 2002]; 6p; In English; Original contains color illustrations  
Contract(s)/Grant(s): NAG5-8296; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Observations from the TOPEX/POSEIDON (T/P) radar altimeter, along with other observations and meteorological products, were used to examine the relationship between ocean dynamics and thermodynamics in the Pacific Ocean.

Derived from text

*Ocean Dynamics; Pacific Ocean; Thermodynamics; Satellite Observation; Anomalies*

**20030002360** Ohio State Univ., Bryd Polar Research center, Columbus, OH USA  
**Determining Greenland Ice Sheet Accumulation Rates from Radar Remote Sensing Final Report**  
Jezek, Kenneth C., Ohio State Univ., USA; Nov. 12, 2002; 11p; In English  
Contract(s)/Grant(s): NAG5-10275; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An important component of NASA's Program for Arctic Regional Climate Assessment (PARCA) is a mass balance investigation of the Greenland Ice Sheet. The mass balance is calculated by taking the difference between the areally Integrated snow accumulation and the net ice discharge of the ice sheet. Uncertainties in this calculation include the snow accumulation rate, which has traditionally been determined by interpolating data from ice core samples taken from isolated spots across the ice sheet. The sparse data associated with ice cores juxtaposed against the high spatial and temporal resolution provided by remote sensing, has motivated scientists to investigate relationships between accumulation rate and microwave observations as an option for obtaining spatially contiguous estimates. The objective of this PARCA continuation proposal was to complete an estimate of surface accumulation rate on the Greenland Ice Sheet derived from C-band radar backscatter data compiled in the ERS-1 SAR mosaic of data acquired during, September-November, 1992. An empirical equation, based on elevation and latitude, is used to determine the mean annual temperature. We examine the influence of accumulation rate, and mean annual temperature on C-band radar backscatter using a forward model, which incorporates snow metamorphosis and radar backscatter components. Our model is run over a range of accumulation and temperature conditions. Based on the model results, we generate a look-up table, which uniquely maps the measured radar backscatter, and mean annual temperature to accumulation rate. Our results compare favorably with in situ accumulation rate measurements falling within our study area.

Author

*Greenland; Ice; Remote Sensing; Radar Data; Arctic Regions; Climatology; Accumulations*

**20030002392** NASA Ames Research Center, Moffett Field, CA USA  
**Clues to Coral Reef Health: Integrating Radiative Transfer Modeling and Hyperspectral Data**  
Guild, Liane, NASA Ames Research Center, USA; Ganapol, Barry, Arizona Univ., USA; Kramer, Philip, Miami Univ., USA; Armstrong, Roy, Puerto Rico Univ., Puerto Rico; Gleason, Art, Miami Univ., USA; Torres, Juan, Puerto Rico Univ., Puerto Rico;

Johnson, Lee, NASA Ames Research Center, USA; Garfield, Toby, San Francisco State Univ., USA; [2002]; 1p; In English; American Geophysical Union Fall Meeting, 6-10 Dec. 2002, San Francisco, CA, USA; Sponsored by American Geophysical Union, USA; No Copyright; Avail: Issuing Activity; Abstract Only

An important contribution to coral reef research is to improve spectral distinction between various health states of coral species in areas subject to harmful anthropogenic activity and climate change. New insights into radiative transfer properties of corals under healthy and stressed conditions can advance understandings of ecological processes on reefs and allow better assessments of the impacts of large-scale bleaching and disease events. Our objective was to examine the spectral and spatial properties of hyperspectral sensors that may be used to remotely sense changes in reef community health. We compare in situ reef environment spectra (healthy coral, stressed coral, dead coral, algae, and sand) with airborne hyperspectral data to identify important spectral characteristics and indices. Additionally, spectral measurements over a range of water depths, relief, and bottom types are compared to help quantify bottom-water column influences. In situ spectra were collected in July and August 2002 at the Long Rock site in the Andros Island, Bahamas coastal zone coral reef. Our primary emphasis was on *Acropora palmata* (or elkhorn coral), a major reef building coral, which is prevalent in the study area, but is suffering from white band disease. *A. palmata* is currently being proposed as an endangered species because its populations have severely declined in many areas of the Caribbean. In addition to the *A. palmata* biotope, we have collected spectra of at least seven other coral biotopes that exist within the study area, each with different coral community composition, density of corals, relief, and size of corals. Coral spectral reflectance was then input into a radiative transfer model, CORALMOD (CM1), which is based on a leaf radiative transfer model. In CM1, input coral reflectance measurements produce modeled reflectance through an inversion at each visible wavelength to provide the absorption spectrum. Initially, we imposed a scattering baseline that is the same regardless of the coral condition and that coral is optically thick and no light is transmitted through coral. Here we will focus on methodology, experimental design, and initial findings of the in situ spectral measurements and preliminary output from the radiative transfer model.

Author

*Coral Reefs; Spectral Reflectance; Spectrum Analysis; Algae; Experiment Design; In Situ Measurement; Man Environment Interactions*

## 51

### LIFE SCIENCES (GENERAL)

*Includes general research topics related to plant and animal biology (non-human); ecology; microbiology; and also the origin, development, structure, and maintenance, of animals and plants in space and related environmental conditions. For specific topics in life sciences see categories 52 through 55.*

**20030002224** California Univ., Los Angeles, CA USA

**Functional Analysis of Oncogene Akt: Its Role in Tumorigenesis In Vivo and Cell Cycle Progression In Vitro** *Annual Report, 4 Jun. 2001-3 Jun 2002*

Stiles, Bangyan; Wu, Hong; Jul. 2002; 18p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-01-1-0182

Report No.(s): AD-A407666; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Breast cancer is the most common malignancy in women. The recently identified tumor suppressor gene Pten has turned out to be a promising candidate for mammary tumorigenesis. Mice heterozygous for Pten develops mammary tumors starting from six weeks. The goal of this project is to determine the role of AKT, a major downstream target of PI3K pathway, in Pten mediated mammary tumor development. to study the function of AKT in breast cancer development, we have deleted Akt gene and are studying its role both in vivo and in vitro. In cell culture, we demonstrated that AKT is not only responsible for the survival phenotype but also important for the cell proliferation phenotype of Pten null ES cells. We are currently breeding mice to study the in vivo role of AKT in an genetically defined in vivo environment.

DTIC

*Mammary Glands; In Vivo Methods and Tests; Growth; Viruses; Cancer*

**20030002247** Brigham and Women's Hospital, Boston, MA USA

**Characterization of S-Phase Specific BRCA1-Containing Complex** *Annual Report, 1 Jun. 2001-31 May 2002*

Chiba, Natsuko; Parvin, Jeffrey D.; Jun. 2002; 13p; In English

Contract(s)/Grant(s): DAMD17-00-1-0164

Report No.(s): AD-A407727; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This study will fully characterize the function of a BRCA1-containing protein complex, which appears in cells following DNA replication arrest using hydroxyurea. The complex, originally referred to as the S-phase specific complex and now termed the Hydroxyurea Induced Complex (HUIC), was observed in HeLa and in 293 cells. Hydroxyurea treatment of cells results in the reduction of BRCA1 content in the RNA polymerase II holoenzyme complex with a complementary increase in the HUIC. We have begun to characterize both complexes, and we find that the HUIC does not contain the repair proteins RAD50/MRE11/NBS1 as originally surmised, but does contain BRCA1 and the BARD1 polypeptides. We model that the HUIC results from the proteolytic degradation of the RNA polymerase II holoenzyme following DNA damage. Work is continuing to identify the polypeptides which compose the HUIC and to determine its role in breast cancer.

DTIC

*Proteins; Genes; Mammary Glands; Cancer*

**20030002320** National Academy of Sciences - National Research Council, Washington, DC USA

**Roundtable on Biomedical Engineering Materials and Applications** *Final Report, 1 Sep. 1999-31 Aug. 2002*

Chait, Richard; Thorowgood, Teri; Marechaux, Toni; Sep. 2002; 5p; In English

Contract(s)/Grant(s): DAMD17-99-1-9576

Report No.(s): AD-A407761; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The National Materials Advisory Board (NMAB) held a BEMA Roundtable workshop on 07-08 February 2002 (postponed from 04-05 October 2001 due to issues pertaining to 9/11 terrorist attack) at the National Research Council (NRC), Washington, DC. The invited speakers were Dr. David Feigal, Director for the Center for Devices and Radiological Health, US Food and Drug Administration, Ron Greene, Wilmer, Cutler & Pickering; Barbara Rather, Dow Corning; Nelson Lazear, Bayer, James Harper, Policy Counsel. com; and George Brode, Integra LifeSciences. The speakers addressed the topic of pathways to innovation, including examining the current status and gauge the effects of biomaterials shortages, identifying key barriers to biomaterials availability, and discussing forging biomaterials supplier. The meeting provided opportunities to explore with key stakeholders and decision makers future options in assuring biomaterials availability. NMAB held the fourth BEMA meeting on 22-23 July 2002 at the NRC's J. Erik Jonsson Woods Hole Center, Woods Hole, MA. The technical speakers were Nancy Parenteau, Amaranth Bio, Inc.; Joshua Jacobs, Rash University Medical College; Eric Amis, NIST; Doyle Gantt, FDA, Center for Devices and Radiological Health; Anthony Ratchliffe, Advanced Tissue Sciences; Jack Lemons, University of Alabama - Birmingham, Rodney White, UCLA; John Watson, National Institutes of Health; and Michael Jaffe, Medical Device Concept Laboratory. The meeting goals were to continue planning for a "Science-Based Testing" workshop, now scheduled for 11-12 February of 2002, and to discuss issues of interest including implant retrieval (and associated logistics, database issues, privacy, etc); differentiation of biologics, devices, and combination products; industry perspective of where advanced biomedical materials are headed and their related testing requirements (e.g., nano, MEMS, tissue engineering), and current testing protocols.

DTIC

*Medicine; Bioengineering; Conferences*

**20030002321** Baylor Coll. of Medicine, Houston, TX USA

**Assessing the Efficacy of a CDSS for Breast Cancer** *Annual Report, 13 Apr. 2001-12 Apr 2002*

Jibaja-Weiss, Maria; May 2002; 66p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-98-1-8022

Report No.(s): AD-A407762; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The four-year project will develop and test a computer-based decision support system (CDSS) on breast cancer for low-income women who speak English or Spanish. The population that will be included in the study include predominantly African American and Hispanic women. Hispanic women will include a high proportion who speak only Spanish and have only limited English proficiency. Delivery of the educational message will involve use of CD-ROM technology and a personal computer to provide for an interactive learning experience. A unique feature of the project will be the use of decision analysis techniques to assess the effectiveness of the CDSS program in facilitating treatment choices that are most likely to lead to outcomes preferred by patients. The application of decision analysis methods will involve generation of patient-specific utilities that can be plugged into the analytical model for the purpose of comparing descriptive choices--those actually made by women with early stage breast cancer--against prescriptive choices--those that are determined to result in preferred outcomes for an individual patient as determined from application of the modeling program. We are currently conducting the clinical trial to evaluate the efficacy of the CDSS program.

DTIC

*Decision Support Systems; Mammary Glands; Cancer; Applications Programs (Computers); Females*

**20030002324** State Univ. of New York, Buffalo, NY USA

**Environmental Exposures at Birth and at Menarche and Risk of Breast Cancer Annual Report, 1 Jun. 2001-31 May 2002**

Freudenheim, Jo L.; Jun. 2002; 19p; In English

Contract(s)/Grant(s): DAMD17-00-1-0417

Report No.(s): AD-A407767; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This is a population-based study that examines location of residence at birth and menarche in relation to proximity to industrial sites, gasoline stations, toxic waste sites and heavily trafficked roadways as risk factors for subsequent breast cancer. It also examines estimated exposure to benzene and to PAHs as risk factors and evaluates genetic susceptibility in relation to these exposures and breast cancer. There are 15,969 individual addresses, representing 3,091 participants in Erie and Niagara counties, in the study. A validation study was conducted to assess the positional accuracy of addresses geocoded in the GDT enhance TIGER file using a Global Positioning System (GPS). Blood samples from all participants with samples have been sent for DNA extraction and genotyping. Standard Industrial Classification (SIC) directories are being used to categorize exposure groups and to geocode point sources of pollution. To date, 13 uranium processing sites and 8 steel mill sites have been geocoded and proximity to birth residence established. Clustering analysis was conducted to identify geographic patterns of residence for breast cancer cases and controls at critical time periods.

DTIC

*Birth; Mammary Glands; Cancer; Environment Effects*

**20030002326** National Rehabilitation Hospital, Washington, DC USA

**Assistive Technology Research Center Annual Report, 1 Feb. 2001-31 Jan. 2002**

Toerge, John; Feb. 2002; 50p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0056

Report No.(s): AD-A407770; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Assistive Technology Research Center, ATRC, is comprised of a set of interrelated research and development projects which apply modern technologies, in particular those which have been exploited in the military, to the practice of medical rehabilitation and technological support for independent living for individuals with disabilities. The Center seeks to work collaboratively to meet the particular mandates of the U.S. Army Medical Research and Materiel Command. Projects are physically conducted and administratively located in the departments of rehabilitation engineering and neuroscience at the National Rehabilitation Hospital. Individual researchers from several other hospital services and clinical professions are also involved. This annual report presents the status of eleven projects ranging from relatively small technology design & evaluation activities, scheduled to be completed within the new grant year, to the substantially larger, multi-part multi-center ANAM activity. Deliverables span the spectrum from new fundamental knowledge, for example on gaze behavior in individuals with stroke measured in a virtual visual environment, to new beta prototype products such as a wireless rollabout videophone for telerehabilitation applications. Activities address five overlapping themes: assessment and enhancement (a&e) of motor function, a&e of cognitive function, a&e of performance in activities of daily living, applications of Virtual Reality technologies, and telehealth.

DTIC

*Telemedicine; Medical Science*

**20030002328** California Univ., Los Angeles, CA USA

**Non-Invasive Gene Therapy of Experimental Parkinson's Disease Annual Report, 27 Aug. 2001-26 Aug 2002**

Pardridge, William M.; Sep. 2002; 43p; In English

Contract(s)/Grant(s): DAMD17-01-1-0773

Report No.(s): AD-A407779; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The present research has developed a non-viral gene targeting technology, whereby the effects of a neurotoxin on the brain can be reversed shortly after the intravenous injection of a therapeutic gene medicine without the use of viral vectors. The brain gene targeting technology developed in this work creates an "artificial virus" which is comprised of non-immunogenic lipids and proteins, wherein the therapeutic gene is packaged in the interior of the gene delivery vehicle, which is called a pegylated immunoliposome (PIL). The PIL carrying the gene is a 85 nm "stealth" nanocontainer, which is relatively invisible to the body's reticuloendothelial system, which normally removes nanocontainers from the blood. The surface of the nanocontainer is studded with a receptor-specific monoclonal antibody (MAb). This MAb acts as a molecular Trojan horse, and triggers the transport of the stealth nanocontainer across the 2 biological membrane barriers that separate the blood from the interior of brain cells. These barriers are the brain microvascular endothelial wall, which forms the blood-brain barrier in vivo, and the brain cell plasma membrane. Both barriers express the transferrin receptor, and the anti-receptor MAb enables the PIL to cross the membrane

barriers via normal physiological transport processes usually used for endogenous ligands such as transferrin. With this approach non-viral, non-invasive gene therapy of the brain is now possible.

DTIC

*Gene Therapy; Diseases; Actuators*

**20030002330** Northeastern Univ., Boston, MA USA

**A Structure Based, Solid-Phase Synthesis Approach to the Development of Novel Selective Estrogen Receptor Modulatory Steroids Final Report, 1 Jun. 1999-31 May 2002**

Hanson, Robert N.; Jul. 2002; 142p; In English

Contract(s)/Grant(s): DAMD17-99-1-9333

Report No.(s): AD-A407782; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

The overall objective of this project was the development of new chemotherapeutic agents for the treatment of hormone-responsive breast cancer. The specific aims included: (1) the preparation of polymer-bound steroidal starting materials; (2) elaboration via acylation/amidation reactions; (3) biological evaluation of the new compounds; and (4) identification of leads for subsequent optimization. We prepared the polymer-bound estradiol derivatives and prepared several preliminary series of derivatives. We compared the solid-phase and solution-phase methods and concluded that at this time solution-phase chemistry was more reliable and subsequent chemistry used this approach. Several series of 17- $\alpha$ -(substituted aryl)vinyl estradiols were evaluated for ER-hormone binding domain affinity and in vivo efficacy. Most compounds retained significant ER affinity (5-160% of estradiol) and all compounds so far were agonists. Evaluation using molecular modeling and molecular dynamics indicated that the arylvinyl substituents were interacting in the key helix-12 region. In summary, synthetic approaches to potent ER-ligands have been developed and the evaluation results indicated that further derivatives may lead to desired objectives. Follow on studies are now in progress.

DTIC

*Chemotherapy; Cancer; Mammary Glands*

**20030002334** Missouri Univ., Columbia, MO USA

**Summer Undergraduate Breast Cancer Research Program Annual Report, 15 May 2001-14 May 2002**

Folk, William R.; Blockus, Linda; Jun. 2002; 102p; In English

Contract(s)/Grant(s): DAMD17-01-1-0333

Report No.(s): AD-A407669; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

The Summer Undergraduate Breast Cancer Research Program (SUBCRP) at the University of Missouri-Columbia supported seven students in 2001. These students participated in faculty-mentored research projects for eight weeks and participated in seminars, brown-bag lunches, and specialty discussion on research, clinical trials, career opportunities, preparing for graduate school, communication skills, and ethics. The seven SUBCRP students joined the activities of the University's Life Sciences Undergraduate Research Opportunities Program, including 70 students from across the world involved in a wide variety of research experiences. The participating students included three African Americans, one Hispanic, and five females. Faculty from Biochemistry, Biological Sciences, Molecular Microbiology & Immunology, and Nursing served as mentors. Research projects included: 1) Sequence elements important for expression of urokinase plasminogen activator (uPA) in cancer cells; 2) An overview of post-breast cancer treatment for lymphedema; 3) Effectiveness of laser perometry for measuring limb volume in lymphedema; 4) Identification of Glc7 and its regulator Glc8 in *Saccharomyces cerevisiae*; Thermostability of murine Polyomavirus J domain mutants using circular dichroism; 6) Regulation of the putative estrogen receptor gamma by 17beta estradiol; 7) Cross-resistance to chemotherapeutic drugs: Does resistance to one drug confer resistance to other drugs?

DTIC

*Chemotherapy; Enzymes; Estrogens; Cancer; Clinical Medicine; Mammary Glands*

**20030002335** Medicine and Dentistry Univ. of New Jersey, Piscataway, NJ USA

**Autologous Tumor Vaccination Final Report, 21 Jun. 2001-21 Jun 2002**

Stein, Stanley; Leibowitz, Michael J.; Jul. 2002; 37p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-01-1-0657

Report No.(s): AD-A407668; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The concept was to implant, subcutaneously, breast cancer cells in syngeneic rats, inject immune system stimulators entrapped in a sustained release gel into the tumor and observe a short term and a long term immune response to the tumor. Tumors appeared about eight days after injecting 1,000,000 cells. As soon as we injected 100 ug of N-formyl-Met-Leu-Phe and 0.1 ug of IL-12 in 0.3 ml of gel, an anti-tumor immune response ensued. Tumor growth halted for about four days and then resumed at

the rate of untreated control cells. If the tumor was re-injected a second and then a third time, tumor growth halted and resumed. However, three consecutive injections was not sufficient to induce a long term response. These results were reproducible and encouraging, considering it was a first attempt. Either stimulant alone or both in combination gave the same results. If continued, we would have to develop a gel formulation that would release the stimulants more slowly than the half time of about one day with the present gel.

DTIC

*Mammary Glands; Cancer*

**20030002340** NASA Ames Research Center, Moffett Field, CA USA

**The M2 Proton Channel of Influenza Virus: How Does It Work?**

Pohorille, Andrew, NASA Ames Research Center, USA; Wilson, Michael, NASA Ames Research Center, USA; Schweighofer, Karl, NASA Ames Research Center, USA; Aug. 23, 2002; 1p; In English; Yangze Conference on Fluids and Interfaces, 20021015, Nanjing, China

Contract(s)/Grant(s): RTOP 344-38-22-06; No Copyright; Avail: Issuing Activity; Abstract Only

The transport of protons across membranes is an essential process for both bioenergetics of modern cells and the origins of cellular life. All living systems make use of proton gradients across cell walls to convert environmental energy into a high-energy chemical compound, adenosine triphosphate (ATP), synthesized from adenosine diphosphate. ATP, in turn, is used as a source of energy to drive many cellular reactions. The ubiquity of this process in biology suggests that even the earliest cellular systems were relying on proton gradient for harvesting environmental energy needed to support their survival and growth. In contemporary cells, proton transfer is assisted by large, complex proteins embedded in membranes. The issue addressed in this study was: how the same process can be accomplished with the aid of similar, but much simpler molecules that could have existed in the protobiological milieu? The model system used in the study contained a bilayer membrane made of phospholipid, dimyristoylphosphatidylcholine (DMPC), which is a good model of the biological membranes focusing cellular boundaries. Both sides of the bilayer were surrounded by water which simulated the environment inside and outside the cell. Embedded in the membrane was a fragment of the Influenza-A M2 protein and enough sodium counterions to maintain system neutrality. This protein has been shown to exhibit remarkably high rates of proton transport and, therefore, is an excellent model to study the formation of proton gradients across membranes. The Influenza M2 protein is 97 amino acids in length, but a fragment 25 amino acids long, which contains a transmembrane domain of 19 amino acids flanked by 3 amino acids on each side, is sufficient to transport protons. Four identical protein fragments, each folded into a helix, aggregate to form small channels spanning the membrane. Protons are conducted through a narrow pore in the middle of the channel in response to applied voltage. This channel is large enough to contain water molecules, and is normally filled with water. In analogy to the mechanism of proton transfer in some other channels, it has been postulated that protons are translocated along the network of water molecules filling the pore of the channel. This mechanism, however, must involve an additional, important step because the channel contains four histidine amino acid residues, one from each of the helices, which are sufficiently large to occlude the pore and interrupt the water network. The histidine residues ensure channel selectivity by blocking transport of small such as sodium or potassium. They have been also implicated in gating protons due to the ability of each histidine to become positively charged by accepting an additional proton. Two mechanisms of gating have been proposed. In one mechanism, all four histidines acquire an additional proton and, due to repulsion between their positive charges, move away from one another, thus opening the channel. The alternative mechanism relies on the ability of protons to move between different atoms in a molecule (tautomerization). Thus, a proton is captured on one side of the gate while another proton is released from the opposite side, and the molecule returns to the initial state through tautomerization. The simulations were designed to test these two mechanisms. Large-scale, atomic-level molecular dynamics simulations of the channel, in which the histidine residues were in different protonation states revealed that all intermediate states of the system involved in the tautomerization mechanism are structurally stable and the arrangement of water molecules in the channel is conducive to the proton transport. In contrast, in the four-protonated state, postulated to exist in the gate-opening mechanism, the electrostatic repulsion between the histidine residues appears to be so large that the channel loses its structural integrity and one helix moves away from the remaining three. This result indicates that such a mechanism of proton transport is unlikely. The simulations revealed that translocation along a network of water molecules in the channel and tautomerization of the histidine residues in the M2 proteins is the most likely mechanism of proton transport. The results not only explain how a remarkably simple protein system can efficiently aid in the formation of proton gradients across cell walls, but also suggest how this system can be genetically re-engineered to become a directional, reversible proton pump. Such a pump can provide energy to laboratory-built models of simple cellular systems. If they were successfully constructed it would greatly advance our understanding of the beginnings of life and find important applications in medicine and pharmacology.

Author

*Adenosine Diphosphate; Adenosine Triphosphate; Biological Evolution; Cells (Biology); Electric Potential; Influenza; Membranes; Molecular Dynamics; Viruses*

**20030002341** NASA Ames Research Center, Moffett Field, CA USA

**Neural Correlates of Birth: Labor Contractions Induce C-Fos Expression In Newborn Rat Brain**

Ronca, A. E., NASA Ames Research Center, USA; Daly, M. E., NASA Ames Research Center, USA; Baer, L. A., NASA Ames Research Center, USA; Hills, E. M., NASA Ames Research Center, USA; Conway, G., NASA Ames Research Center, USA; [2002]; 1p; In English; Society of Neuroscience Meeting, USA

Contract(s)/Grant(s): NIMH-MH46485; RTOP 121-10-40; No Copyright; Avail: Issuing Activity; Abstract Only

At birth, the newborn mammal must make rapid adaptations to the extrauterine environment to survive. We have previously shown that labor contractions augment the appearance of adaptive responses at birth, viz., postpartum breathing and the onset of suckling. Since neuronal activity has been shown to upregulate the activity of immediate early genes (IEGs) in the brain, we analyzed the neural distribution of c-Fos protein expression in newborn rats using immunohistochemistry. Previous studies have reported a burst of c-Fos mRNA expression in mouse and rat brain at birth however relationships to labor and delivery have not been examined. In the present study, we exposed near-term rat fetuses to elements of the vaginal birth process: 1) Simulated labor contractions. 2) Postpartum cooling (22 deg C). 3) Umbilical cord occlusion. and 4) Stroking to mimic postpartum licking by the dam. Cardinal delivered newborns (VG) were compared with those delivered by cesarean section following either prenatal exposure to compressions (C) [simulated labor contractions], or no compressions (NC) [no labor contractions]. Similar patterns of c-fos activation were observed throughout hypothalamic and thalamic nuclei, hippocampus and cerebral cortex in VG and C newborns that were not apparent in NC newborns. Our results indicate that labor contractions play a role in the induction of widespread neural activation in the newborn brain.

Author

*Birth; Brain; Contraction; Exposure; Genes; Mammals; Neurophysiology*

**20030002343** Mount Sinai School of Medicine, New York, NY USA

**Cardiovascular Responsivity, Physical and Psychosocial Job Stress, and the Risk of Preterm Delivery *Final Report, 1 Oct. 1996-1 Nov. 2001***

Hatch, Maureen C.; Dec. 2001; 38p; In English

Contract(s)/Grant(s): DAMD17-96-2-6019

Report No.(s): AD-A407704; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

We recruited a cohort of over 600 active-duty military women attending the prenatal clinic at Wilbur Hall Medical Center and followed them until delivery to assess associations between stress, cardiovascular responsivity and risk of preterm delivery. In spite of universal access to prenatal care, rates of preterm delivery were more than twice as high among black women (14.0%) as among white women (6.4%), both overall and within each military rank. The Relative Risk (RR) of preterm delivery for black women, adjusted for relevant covariates, was 2.0 (95% Confidence Interval (CI) 0.9, 4.4). of the job stressors we studied, including long hours, only a High Workload and Low Job Satisfaction had elevated relative risks for preterm delivery. The adjusted RRs for Workload and Job Satisfaction were 1.9, CI 0.8, 4.1 and 1.7, (CI 0.8, 3.9) respectively. However, neither job stressors nor perceived stress accounted for the black/ white disparity in rates of prematurity. Over 400 participants agreed to be tested for cardiovascular reactivity. Mean levels of blood pressure reactivity were higher among black women, and only the subgroup of black women showed adjusted gestational age differences associated with stress reactivity. Although, reactivity was not associated with spontaneous preterm delivery, there were too few cases to analyze separately by race.

DTIC

*Cardiovascular System; Females; Stress (Psychology); Workloads (Psychophysiology)*

**20030002345** Fox Chase Cancer Center, Philadelphia, PA USA

**Fox Chase Cancer Center Institutional Breast Cancer Training Program (FCCC-IBCTP) *Annual Report, 1 Jul. 2001-30 Jun. 2002***

Russo, Jose; Jul. 2002; 195p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0249

Report No.(s): AD-A407698; No Copyright; Avail: CASI; A09, Hardcopy; A03, Microfiche

The present report covers the work performed by four different trainees working in: i. - The functional role of chromosomes 11, 13, 14 and 17 in the process of immortalization, transformation and tumorigenesis of human breast epithelial cells. This study has concluded that the chromosome 17 (p13.1-13.2) region may contain gene/s controlling programmed cell death, and that the

tumorigenic phenotype is associated with alterations at different loci of chromosome 13. ii. - Lymphedema Prevention in Breast Cancer Survivors. This study has developed guidelines related to lymphedema prevention among early stage breast cancer survivors to determine the feasibility of the study questionnaire and to determine the most appropriate and effective recruitment approach. iii - Roles of gamma-synuclein in breast cancer progression and metastasis. The data indicate that gamma-synuclein may promote tumorigenesis by enhancing cell motility through modulating Rho/Rac/CDC42 and ERK pathways, and promoting cell survival and inhibiting apoptosis through modulating ERK cell survival and JNK-mitochondria-caspase9/3. iv. Polymorphisms of Human UGT1A6 and UGT1A9 Genes and Functional Differences of the Variant Gene Products. This study is aimed at defining whether these putative SERM inactivating enzymes have genetic variations that result in predictable phenotypes at both the molecular level and in the patient.

DTIC

*Cancer; Genetics; Mammary Glands; Polymorphism; Chromosomes*

**20030002348** Texas Univ., Medical Branch, Galveston, TX USA

**Repletion of Zinc and Iron Deficiencies Improve Cognition of Premenopausal Women** *Final Report, 22 Sep. 1995-31 Dec. 2001*

Sandstead, Harold H.; Dec. 2001; 63p; In English

Contract(s)/Grant(s): DAMD17-95-C-5112

Report No.(s): AD-A407694; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Zinc and iron deficiencies are common among young women who seldom consume red meat. It seemed likely that iron stores (measured by serum ferritin concentration) were related to zinc nutriture (measured by metabolically active zinc pools), and that food frequency would reflect these relationships. Zinc and iron are essential for brain function. It therefore, seemed likely that the low zinc and iron nutriture would adversely affect neuropsychological performance. To test these hypotheses, iron deficient young women without anemia were recruited for measurements of zinc kinetics, and for participation in a double blind randomized controlled trial of zinc and iron treatment on neuropsychological function. Serum ferritin and the rapidly exchangeable tissue zinc pool correlated significantly, as did plasma zinc and the rapidly exchangeable zinc, and serum ferritin and exchangeable zinc were predicted by a focused food frequency questionnaire. Zinc and iron repletion were both efficacious for aspects of neuropsychological function. Zinc was especially efficacious for eyehand coordination, reasoning and short-term visual memory. The neuropsychological findings were consistent with observations in other populations.

DTIC

*Females; Iron; Zinc; Neurology; Cognitive Psychology*

**20030002365** NASA Ames Research Center, Moffett Field, CA USA

**Tracking Avian Reservoirs of Arboviruses using Remote Sensing and Radiotelemetry**

Beck, L., NASA Ames Research Center, USA; Wright, S., Sac-Yolo Mosquito and Vector Control District, USA; Schmidt, C., California State Univ., USA; Lobitz, B., California State Univ., USA; Bell, D., California State Univ., USA; Brown, D., Sac-Yolo Mosquito and Vector Control District, USA; [2002]; 1p; In English; Pecora 15 + Land Satellite Information Conference, 8-15 Nov. 2002, Denver, CO, USA

Contract(s)/Grant(s): RTOP 279-52-01-79; No Copyright; Avail: Issuing Activity; Abstract Only

Encephalitis is caused by a virus that is transmitted by mosquitoes between mammalian hosts. The virus is closely related to the West Nile virus (WNV), which started in New York in 1999, and has since spread to 25 states. Like encephalitis, WNV is vectored by mosquitoes, and the primary hosts are birds; humans are accidental, or 'dead-end' hosts. Very little is understood about the behavior of these bird populations, and how they intersect - both in time and in space - with mosquito populations. Exploring these relationships is the first step in developing models for encephalitis and WNV transmission risk. This project combines remotely sensed data with radiotelemetry to create a spatiotemporal map of encephalitis viral activity in bird and mosquito populations in the Sacramento Valley of California. Specifically, remote sensing (RS) and geographic information system (GIS) technologies were used to characterize habitats utilized by both avian viral reservoirs and the mosquitoes that vector encephalitis. Radiotelemetry and serosurveys (blood) were then used to spatially and temporally track the patterns of infection. The project uses LANDSAT ETM+ multitemporal satellite data to characterize habitats utilized by both birds and the mosquito vectors. Mist nets were used to sample members of individual flocks of blackbirds and cowbirds over a period of several months; these birds were then bled to assess their viral status, banded, and fitted with transmitters. Radiotelemetry was used to spatially and temporally track the distribution of banded birds and their associated flocks. The movement of these indicator flocks were compared with the location of remotely sensed (adult and larval) mosquito habitats to determine the intersection of bird's and vectors; this is key

in understanding where and when transmission occurs from bird to bird, as well as from bird to mammal, via mosquito. The relationships found during the project are being used to generate a model of encephalitis transmission risk in California.

Author

*Birds; Blood; Encephalitis; Infectious Diseases; Remote Sensing; Reservoirs*

**20030002370** NASA Ames Research Center, Moffett Field, CA USA

**Behavioral and Physiological Analyses of Parturition In Pregnant Rats: Insights Derived from Intrauterine Telemetry**

Villareal, J., San Jose State Univ., USA; Mallery, E., Stanford Univ., USA; Lynch, A., Rhodes Coll., USA; Mills, N., California Univ., USA; Baer, L., NASA Ames Research Center, USA; Wade, C., NASA Ames Research Center, USA; Ronca, A., NASA Ames Research Center, USA; [2002]; 1p; In English; International Society for Developmental Psychobiology, USA; Sponsored by National Inst. of Health, USA

Contract(s)/Grant(s): NIMH-MH46485; RTOP 121-10-40; RTOP 121-10-50; No Copyright; Avail: Issuing Activity; Abstract Only

During labor and birth, fetuses are exposed to considerable physical stimulation associated with labor contractions and expulsion from the womb. These forces are important for the neonates' adaptation to the extrauterine environment. To further our understanding of the relationship between labor and postpartum outcome, we developed a novel method for measuring intrauterine pressure (IUP) in freely-moving, late pregnant and parturient rats that enables us to make precise, reliable measures of the forces experienced by rat fetuses during parturition. A small (1.25 x 4 cm) telemetric blood pressure sensor was fitted within a fluid-filled balloon, similar in size to a full term rat fetus. On Gestational day (G) 19 of the rats' 22/23 day pregnancy, each dam was anesthetized and a balloon/sensor unit surgically implanted within the uterus following removal of two fetuses. Comparisons were made between sensor-implanted dams (IMPL) and a control conditions: 1) LAP-R, laparotomy with two fetuses removed or 2) LAP-NR, laparotomy with no fetuses removed. IUP signals were sampled at 10s intervals from the IMPL dams during labor and birth. Dams in all three conditions were videorecorded enabling us to analyze the effect of the implant on behavioral expressions of parturition. Contraction frequency, duration, pup-to-pup birth intervals and pup-oriented activities of the dams measured from one hour prior to the first pup birth until the birth of the third pup were unaffected by the sensor implant. Intrauterine telemetry of freely-moving dams offers significant advantages over conventional hardwired IUP measurement techniques. These findings establish and validate intrauterine telemetry as a reliable, non-invasive technique for quantifying pressures associated with parturition.

Author

*Birth; Blood Pressure; Dams; Fetuses; Pregnancy; Rats; Uterus*

**20030002377** State Univ. of New York, Buffalo, NY USA

**Organic Isothiocyanates: Dietary Modulators of Doxorubicin Resistance in Breast Cancer** *Annual Report, 1 Jun. 2001-31 May 2002*

Morris, Marilyn E.; Jun. 2002; 126p; In English

Contract(s)/Grant(s): DAMD17-00-1-0376

Report No.(s): AD-A407743; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Drug resistance is the main cause for therapeutic failure and death in breast cancer. Our goal is to evaluate dietary organic isothiocyanates (ITCs) as inhibitors of MDR. The first two specific aims of our proposal are: 1) To determine the concentration-dependent effects of benzyl ITC (BITC), phenethyl ITC (PEITC) and naphthyl ITC (NITC) on the accumulation of 3H-daunomycin (DNM) in sensitive and resistant human breast cancer cell lines; and 2) to evaluate the pharmacokinetics and toxicity of NITC, PEITC and BITC in the rat following oral and intravenous administration. NITC, PEITC and BITC significantly increased the cellular accumulation of DNM and vinblastine (VBL) in resistant human breast cancer MCF-7 cells at 20-100 micrometers concentrations, without affecting accumulation in MCF-7 sensitive cells. Cytotoxicity studies revealed that PEITC and BITC inhibited the growth of both the MCF-7 and normal mammary MCF-12A cell lines. Assays to determine PEITC, BITC and NITC in biological fluids were developed, and stability studies demonstrated limited stability of NITC in biological fluids at RT, while PEITC and BITC degraded with half-lives of 36 and 40 h, respectively, at pH 7.4. Characterization of the pharmacokinetics of NITC in rats revealed a high clearance (2.29+/-0.81 L/kg/h) and large volume of distribution (16.8+/-3.6 L/kg). The ITCs may represent a new class of inhibitors of MDR in breast cancer.

DTIC

*Drugs; Mammary Glands; Cancer*

**20030002378** Fox Chase Cancer Center, Philadelphia, PA USA

**Pharmacogenetic Factors Contributing to Variation in Response to Tamoxifen and Raloxifene Annual Report, 1 Jul. 2001-30 Jun. 2002**

Raftogianis, Rebecca B.; Jul. 2002; 10p; In English

Contract(s)/Grant(s): DAMD17-00-1-0248

Report No.(s): AD-A407742; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The purpose of these studies is to elucidate the pharmacogenetic factors that contribute to variation in human response to tamoxifen (TAM) and raloxifene (RAL). We had previously identified and partially characterized common genetic polymorphisms in two human drug-metabolizing genes, *SULT1A1* and *UGT1A6*. We hypothesized that these polymorphisms contributed to variation in TAM or RAL metabolism. These studies were divided into three aims with the purpose of: 1) biochemically characterizing the contribution of these enzymes to the metabolism of TAM and RAL; 2) developing cell model systems to study allele-specific differences in cellular response to these molecules and; 3) perform a clinical pharmacogenetic study to evaluate the association of common genetic polymorphisms in drug metabolizing genes with variable clinical response to TAM. Thus far we have determined that *SULT1A1* and *UGT1A6* contribute to the inactivation of 4-hydroxytamoxifen (OHT), the active metabolite of TAM, and that a separate enzyme, *UGT1A9* catalyzed the glucuronidation of RAL. We have determined genotype/phenotype correlation for *UGT1A6* alleles in a bank of human liver tissue and have generated HEK 293 cell lines that stably express each of the four *UGT1A6* allozymes. The *UGT1A6* \*2 allozyme, when expressed homozygously, is associated with high *UGT1A6* activity. We established MCF-7 breast cancer cell lines stably expressing the wild type and variant *SULT1A1* alleles and have measured allele-specific differences in the response of these cells to estrogens and OHT. These studies suggest that pharmacogenetic factors might contribute to variable cellular response to antiestrogens.

DTIC

*Genes; Mammary Glands; Cancer*

**20030002381** Army Inst. of Surgical Research, Fort Sam Houston, TX USA

**Special Medical Emergency Evacuation Device Platform Final Report, 1 Apr. 2000-7 Oct. 2002**

Smeed, Eric; Van Putte, William; Drew, Guy A.; Cancio, Leopoldo; Oct. 07, 2002; 38p; In English; Original contains color images

Report No.(s): AD-A407712; ISR-2002-02; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The US Army Institute of Surgical Research (USAISR) has developed a Special Medical Emergency Evacuation Device (SMEED) platform (US patent pending), designed to secure commercial, off-the-shelf monitors, infusion pumps, ventilators, and similar equipment to the standard NATO litter. This system fits the most commonly used equipment in the US military inventory, and is easily customized to fit other devices. The need for such a system was evident during a mass-casualty training exercise for burns conducted by the USAISR Special Medical Augmentation Response Team (SMART Team) aboard a C 17 USAF aircraft in March 2000: there is no quick and efficient way to secure vital equipment to litters. The following requirements were established for such a product: rugged, lightweight, inexpensive, compatible with current and future commercial devices; customizable to meet individual customer and patient needs and approved for in-flight use aboard military aircraft. ISR designed the first prototype platform and directed its fabrication at the Air Force Research Laboratory machine shop at Brooks AFB, TX. The SMART Team rigorously tested it aboard a broad range of vehicles during field training exercises at the Soldier-Medic Training Site, Camp Bullis, TX; Ft. Hood, TX; and the Florida Ranger Camp. The platform underwent further revision at the USAISR and has been transitioned to advanced product development by the US Army Medical Materiel Development Agency (USAMMDA). The new version (Model IV SMEED) has successfully undergone USAF AFMED testing. The SMEED passed all of the tests successfully and was approved for use during all phases of flight on all USAF Aircraft.

DTIC

*Emergencies; Medical Services; Fabrication; Military Technology; Evacuating*

**20030002388** Beth Israel Deaconess Medical Center, Boston, MA USA

**The Non-Classical Secretion of Thioredoxin from Breast Cancer Cells Annual Report, 1 Jun. 2001-31 May 2002**

Chuck, Steven L.; Jun. 2002; 38p; In English

Contract(s)/Grant(s): DAMD17-01-1-0150

Report No.(s): AD-A407677; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Thioredoxin is a small protein with a catalytic site for redox reactions that is involved in several physiologic and pathophysiologic processes in humans. A ubiquitous cytosolic protein, thioredoxin also is secreted by some types of cells including cells derived from leukemia, lung, colon, and breast cancers. Extracellular thioredoxin acts as an autocrine growth factor and can potentiate the action of other cytokines on these tumor cell lines. The novel pathway by which thioredoxin is secreted has not been elucidated. Our specific aims are to: identify the amino acid sequence within thioredoxin that directs its secretion

from cells, and to identify the cellular gene products that secrete thioredoxin from breast cancer cells. We aim to develop a molecular view of the non-classical process by which thioredoxin is secreted. Armed with a thorough understanding of this export process, it may be possible to slow the growth of breast cancers in humans in an entirely new way by inhibiting the release of thioredoxin.

DTIC

*Proteins; Cancer; Mammary Glands*

**20030002390** Albany Medical Coll., NY USA

**AFP-Derived Peptides Which Stop Breast Cancer Growth** *Annual Report, 1 Jul. 1999-30 Jun. 2002*

Mesfin, Fassil B.; Jul. 2002; 58p; In English

Contract(s)/Grant(s): DAMD17-99-1-9054

Report No.(s): AD-A407675; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

AFP is a glycoprotein produced during pregnancy by fetal yolk sac and by fetal liver. A fetal physiological level of human AFP inhibits estrogen-stimulated growth of human breast cancer. This antiestrogenic activity of AFP is localized in a 34-mer peptide (AFP 447-480). Studies suggest that this 34-mer peptide tends to aggregate upon storage, concomitant with loss of activity. A series of parsing and amino acids substitutions in the AFP (447-480) sequence was intended to identify the shortest analog which retained antiestrogenic activity. The data suggested that an octapeptide (AFP472-479) is the minimal sequence required for the antiestrogenic activity found with the full-length AFP. AFP(472-479) aggregated during storage to form inactive species. Thus, a number of octapeptide analogs were produced with intent of minimizing aggregation and enhancing structural stability. Two octapeptide AFP472-479 analogs exhibited superior stability and retained biological activity during prolonged storage.

DTIC

*Peptides; Cancer; Mammary Glands*

**20030002393** Duke Univ., Medical Center, Durham, NC USA

**The Role of the Polypyrimidine Tract Binding Protein on CD44 Alternative Splicing in Breast Cancer** *Annual Report, 1 Jun. 2001-31 May 2002*

Wagner, Eric J.; Garcia-Blanco, Mariano A.; Baraniak, Andrew; Jun. 2002; 49p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0236

Report No.(s): AD-A407787; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The cytogenetic and nuclear changes that occur during tumor progression in the breast have been well documented, but the causes of these alterations are poorly understood. Changes in estrogen receptor status, loss of responsiveness to conventional chemotherapy, gain in metastatic potential, accumulation of PNCs, and differential splicing of numerous genes are examples of changes seen in breast cancer cells during tumor progression. Thus far, a strong connection between the splicing machinery and these subtle, yet significant, changes in gene expression has yet to be documented. Likely candidates are the alternative splicing factors most notably the Polypyrimidine Tract Binding Protein (PTB). PTB is a known repressor of exon definition. During breast cancer progression, we believe, the ability of PTB's ability to repress exons is altered. In order to understand the changes in PTB function as cancer cells de-differentiate, a clear understanding of PTB mechanism must be attained. We are using the regulation of FGF-R2 exon IIIb as a model system to study PTB mediated exon repression. Thus far, we have mapped numerous binding sites for PTB and found them to be important in the repression of this exon. Furthermore overexpression of PTB and heterologous recruitment of PTB result in the repression of this exon. RNAi mediated PTB depletion results in the increase in exon IIIb inclusion.

DTIC

*Splicing; Mammary Glands; Gene Expression; Chemotherapy; Cancer*

**20030002395** Washington Univ., Saint Louis, MO USA

**Education and Outreach for Breast Imaging and Breast Cancer Patients** *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Farria, Dione M.; Jul. 2002; 19p; In English

Contract(s)/Grant(s): DAMD17-99-1-9435

Report No.(s): AD-A407789; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

During the past year, we obtained IRB approval from the DOD to begin data collection in December, 2001. However, the practice of the Breast Health Center, where the study was planned, had changed. Because randomization of patients according to core biopsy scheduling was no longer, we had a series of meetings with the Breast Health Center and Siteman Cancer Center administrators. At these discussions, we decided to revise the protocol. The revised protocol is submitted. Patients will still be randomized into different groups based on the informed consent process, but the timing of the core biopsy would not be

manipulated. We still plan to collect observational data on this variable, however. Currently, we are seeking IRB approval of the revised protocol. Once this protocol is approved by the IRB's of both Washington University and DOD, we can begin data collection. The revision of the protocol has led to significant delays in the second phase of this project.

DTIC

*Cancer; Education; Imaging Techniques; Mammary Glands*

**20030002401** Mount Sinai School of Medicine, New York, NY USA

**Post-Doctoral Training Program in Bio-Behavioral Breast Cancer Research Annual Report, 1 May 2001-1 May 2002**

Bovbjerg, Dana; Jun. 2002; 579p; In English

Contract(s)/Grant(s): DAMD17-99-1-9303

Report No.(s): AD-A407804; No Copyright; Avail: CASI; A25, Hardcopy; A06, Microfiche

Accumulating evidence indicates that the "biobehavioral model" of health and disease may have considerable relevance for cancer generally, and breast cancer in particular. Broadly stated, this model proposes that what people think and feel affects the state of their health in two basic ways: by affecting their behavioral choices (e.g., smoking) and by affecting biological processes (e.g., cortisol levels) that affect risk and response to disease. Given the complexity of the interactions postulated by the biobehavioral model, to fully explore its implications for breast cancer it will be important to increase the number of researchers with the broad-based training that allows them to conduct truly interdisciplinary research addressing issues that transcend traditional disciplinary boundaries. Our ongoing Postdoctoral Training Program in Biobehavioral Breast Cancer Research is designed to provide trainees with advanced degrees in relevant areas (e.g., epidemiology, medicine, psychology, public health) with the necessary intellectual background needed to "speak the language" of the multiple relevant disciplines and with the "hands-on" experience under the tutelage of experienced mentors necessary to do interdisciplinary research and become independent investigators.

DTIC

*Activity (Biology); Cancer; Psychology*

**20030002404** Georgetown Univ., Washington, DC USA

**IKK and Beta-Catenin in Breast Cancer Annual Report, 1 Jul. 2001-30 Jun. 2002**

Teo, Marissa; Jul. 2002; 23p; In English

Contract(s)/Grant(s): DAMD17-01-1-0248

Report No.(s): AD-A407807; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The wnt signaling pathway activates oncogene, beta-catenin. It associates with an APC, GSK-3b and axin complex which targets it for phosphorylation and ubiquitin-mediated degradation. NFkB transcription factor is associated with inhibitory IkbA. Its activation occurs through targeted degradation of IkbA by Ikb kinase complex (IKK). The same phosphorylation consensus sequence on IkbA and beta-catenin target them for ubiquitination. Since the degradation pathway is similar, similar kinases may be involved. It is shown that IKKb plays a major role in NFkB activation. On the other hand, IKKa knockout mice have a phenotype characterized by hyperproliferation of basal cells. This is characteristic of elevated beta-catenin signaling in epithelial stem cells. Thus IKKa may have a role in the differentiation of breast epidermal tissue by modulating the activity of beta-catenin. Cytokine tumor necrosis factor(TNFa) and EDAR activate the IKK complex. EDAR(ectodysplasin receptor) is a member of the TNF family involved in differentiation of ectodermal tissues such as the breast and represents an appropriate model to study cytokine regulation of beta-catenin in breast tissue development. Our results have shown that the effects of beta-catenin signaling is mediated by IKK and independent of APC. This project further characterizes the interaction between cytokines and beta-catenin and investigates the role that cytokines may play in breast cancer.

DTIC

*Cancer; Cells (Biology); Oncogenes; Modulation; Degradation*

**20030002467** Massachusetts Univ., Plant and Soil Sciences Dept., MA USA

**Designing Extraterrestrial Plant Growth Habitats with Low Pressure Atmospheres**

Corey, Kenneth A., Massachusetts Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

In-situ resource utilization, provision of human life support requirements by bioregenerative methods, and engineering constraints for construction and deployment of plant growth structures on the surface of Mars all suggest the need for plant growth studies at hypobaric pressures. Past work demonstrated that plants will likely tolerate and grow at pressures at or below 10 kPa. Based upon this premise, concepts are developed for the design of reduced pressure atmospheres in lightweight, inflatable

structures for plant growth systems on Mars with the goals of maximizing design simplicity and the use of local resources. A modular pod design is proposed as it could be integrated with large-scale production systems. Atmospheric modification of pod clusters would be based upon a pulse and scrub system using mass flow methods for atmospheric transport. A specific modification and control scenario is developed for a lettuce pod to illustrate the dynamics of carbon dioxide and oxygen exchange within a pod. Considerations of minimal atmospheric crop requirements will aid in the development of engineering designs and strategies for extraterrestrial plant growth structures that employ rarefied atmospheres.

Author

*Atmospheric Circulation; Carbon Dioxide; Gas Exchange; Life Support Systems; Low Pressure; Regeneration (Physiology)*

**20030002469** Long Island Jewish Medical Center, Hillside Medical Center, New Hyde Park, NY USA

**Omega-3 Fatty Acids and a Novel Mammary Derived Growth Inhibitor Fatty Acid Binding Protein MRG in Suppression of Mammary Tumor** *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Liu, Yiliang E.; Jul. 2002; 10p; In English

Contract(s)/Grant(s): DAMD17-00-1-0309

Report No.(s): AD-A408070; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A mammary derived growth inhibitor related gene (MRG) was previously identified and characterized. MRG induces differentiation of mammary epithelial cells in vitro and its expression is associated with mammary differentiation. Overexpression of MRG in human breast cancer cells induced differentiation with changes in cellular morphology and a significant increase in the production of lipid droplets. Treatment of mouse mammary gland in organ culture with MRG protein resulted in a differentiated morphology and stimulation of beta-casein expression. Treatment of human breast cancer cells with omega-3 PUFA DHA resulted in a differential growth inhibition proportional to their MRG expression. MRG transfected cells or MRG protein treated cells were much more sensitive to DHA-induced growth inhibition compared with MRG negative or control non-treated cells.

DTIC

*Mammary Glands; Cancer; Fatty Acids; Proteins*

**20030002470** Baylor Coll. of Medicine, Houston, TX USA

**Ubiquitin Pathway Enzymes: Coactivators of Nuclear Hormone Receptors and Their Role in the Development of Breast Cancer** *Annual Report, 15 Jun. 2001-14 Jun 2002*

Nawaz, Zafar; Jul. 2002; 44p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0142

Report No.(s): AD-A408069; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Steroid hormones, estrogen and progesterone, and their intracellular receptors play an important role in the development and progression of breast cancer. Coactivator proteins modulate the biological activity of these hormone receptors. We have cloned an E3 ubiquitin-protein ligase enzyme, E6-associated protein (E6-AP) and E2 ubiquitin-conjugating enzyme, UbcH7 as coactivators of steroid hormone receptors. The purpose of this research is to explore the possibility that the altered expression of E6-AP and UbcH7 may contribute to the development of breast cancer. We have examined this possibility by studying the expression patterns of E6-AP, UbcH7 and estrogen receptor-alpha (ER) in various human breast cancer cell lines and breast tumor biopsy samples. Additionally, we have correlated the expression profile of E6-AP and UbcH7 with that of ER in breast tumor biopsies. To date, we have examined 56 advanced stage human breast cancer biopsy samples for the expression profile of E6-AP, UbcH7 and ER. We found an inverse correlation between the expression of E6-AP and the expression of ER in these tumors. The Spearman Rank Correlation Coefficient is 0.38 and the p value is 0.004, indicating that this correlation is statistically significant. These data suggest a possible role of E6-AP in mammary gland development and tumorigenesis. However, we did not find any statistically significant correlation between the expression profile of UbcH7 and ER in these tumor samples. Presently, we are studying the expression profile of E6-AP, UbcH7 and ER in early and intermediate stage tumors. Another goal of this project is to create novel in vitro models in stable cell lines, which will overexpress coactivator proteins, E6-AP and UbcH7. In order to achieve this goal, we have already constructed the expression vectors for stable cell lines.

DTIC

*Enzymes; Mammary Glands; Cancer; Hormones*

**20030002477** Rochester Univ., NY USA

**Role of PTPase LAR in EGF Receptor Signaling in Mammary Gland Annual Report, 1 Jun. 2001-31 May 2002**

Mooney, Robert A.; Jun. 2002; 20p; In English

Contract(s)/Grant(s): DAMD17-00-1-0423

Report No.(s): AD-A408090; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The epidermal growth factor receptor (EGFR) is an important mediator of breast cancer tumorigenesis and metastasis. While much is known about EGFR signal transduction related to its tyrosine kinase activity, less is known about the protein tyrosine phosphatases (PTPs) which must be present to modulate the cellular effects of the EGFR by dephosphorylating the receptor and its substrates. Evidence derived from several approaches suggests that the transmembrane PTP LAR may be involved in EGFR signaling in mammary gland development and tumorigenesis. The hypothesis to be tested in this proposal is that LAR plays an important role in EGFR-dependent mammary gland development and tumorigenesis through negative modulation of EGFR signal transduction. Work in the second year has supported this hypothesis. LAR expression is also shown to be regulated by cell density, with concentrations increasing markedly as cell density increases. Functional E-cadherin complexes are necessary for this effect.

DTIC

*Mammary Glands; Cancer; Enzymes; Proteins*

**20030002478** Sloan-Kettering Inst. for Cancer Research, New York, NY USA

**Radiolabeled Herceptin to Increase Treatment Efficacy in Breast Cancer Patients with Low Tumor HER-2/neu Expression Annual Report, 15 Jun. 2001-14 Jun 2002**

Sgouros, George; Jul. 2002; 13p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0429

Report No.(s): AD-A408089; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The primary objective of the proposal is to evaluate the efficacy and feasibility of using radio labeled Herceptin antibody to target rapidly accessible breast carcinoma cells or micrometastases. by using Herceptin to specifically deliver radiation we anticipate that the efficacy of Herceptin will be extended to include breast cancer cells that are not high-HER-2/neu antigen expressors. This hypothesis will be tested using the spheroid model to simulate rapidly accessible micrometastases. An alpha-particle emitting radionuclide will be used to enhance tumor cell kill. Completion of tasks 1 and 2 was reported in the previous annual report. Cell kill experiments using Herceptin labeled with an alpha-particle emitter have been carried out; dose-response studies have been completed(task 3). Examination of alpha-emitter and radio sensitizer combinations has begun (task 4: months 21-24) and preliminary work on an animal model to investigate radio labeled Herceptin targeting of HER2/neu positive disease has been completed (task 5).

DTIC

*Mammary Glands; Cancer; Metastasis; Antibodies*

**20030002479** Arizona Univ., Tucson, AZ USA

**A Molecular Model for Repression of BRCA-1 Transcription by the Aryl Hydrocarbon Receptor Annual Report, 1 Jul. 2001-30 Jun. 2002**

Romagnolo, Donato F.; Jul. 2002; 32p; In English

Contract(s)/Grant(s): DAMD17-00-1-0130

Report No.(s): AD-A408088; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this project is to investigate whether or not regulation of expression of the BRCA-1 gene in breast epithelial cells exposed to polycyclic aromatic hydrocarbons (PAHs) is mediated by the aryl hydrocarbon receptor (AhR). The scope of the project is to examine whether or not the AhR complexed with the AhR-nuclear transporter (ARNT) protein, binds to several xenobiotic responsive elements (XRE) strategically located at -539 bp (CCGTGGAA=Cyp1A1-like) and +20base pairs (bp) (GCGTG=XRE-1) from the transcription start site on exon-1A.

DTIC

*Mammary Glands; Cancer; Genes*

**20030002488** Long Island Jewish Medical Center, Lake Success, NY USA

**Neural Protein Synuclein Gamma (SNCG) in Breast Cancer Progression Annual Report, 1 Jul. 2001-30 Jun. 2002**

Jiang, Yangfu; Jul. 2002; 8p; In English

Contract(s)/Grant(s): DAMD17-01-1-0352

Report No.(s): AD-A408074; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Synucleins are emerging as a central player in the fundamental neural processes and in the formation of pathologically insoluble deposits characteristic of Alzheimer's (AD) and Parkinson's (PD) diseases. Most studies of this group of proteins have been directed to the elucidation of their role in the formation of depositions in brain tissue. However, the normal cellular function of this highly conserved synuclein family remains largely unknown. In addition, synucleins have also been implicated in non-neural diseases particularly in the hormone-responsive cancers of breast and ovary. Using differential cDNA sequencing approach, we first identified a breast cancer specific gene, BCSG1, which was expressed abundantly in metastatic breast cancer cDNA library but scarcely in normal breast cDNA library. Interestingly, BCSG1 revealed no homology to any other known growth factors or oncogenes; rather, BCSG1 revealed extensive sequence homology to neurotic proteins of alpha synuclein and beta synuclein, and thus was also named as gamma Synuclein (SNCG). SNCG expression is highly associated with breast cancer and ovarian cancer progression.

DTIC

*Mammary Glands; Cancer; Nervous System; Proteins*

**20030002489** Beth Israel Deaconess Medical Center, Boston, MA USA

**Integrin-Mediated Stimulation of HIF-1 alpha and Angiogenesis in Breast Cancer** *Annual Report, 1 Jun. 2001-31 May 2002*

Mercurio, Arthur M.; Jun. 2002; 16p; In English

Contract(s)/Grant(s): DAMD17-01-1-0154

Report No.(s): AD-A408072; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Understanding the mechanisms involved in the progression from carcinoma in situ to metastatic disease is one of the most important problems in breast cancer research. To this end, studies by our group and others have implicated a critical role for the alpha 6 integrins in breast cancer progression. The goal of this IDEA proposal is to define the mechanism by which an integrin, such as the alpha 6 integrins contributes to the survival of metastatic breast carcinoma cells. We postulated that these integrins regulate the expression of HIF-1 alpha, a key regulator of VEGF expression and angiogenesis in breast and other cancers. During the first year of this grant, we have made considerable progress that substantiates our hypothesis. The first finding was unexpected but significant.

DTIC

*Mammary Glands; Cancer*

**20030002522** NASA Marshall Space Flight Center, Huntsville, AL USA

**Crystallization and Preliminary X-ray Analysis of Der f 2, a Potent Allergen Derived from the House Dust Mite**

Roeber, Dana, NASA Marshall Space Flight Center, USA; Achari, Aniruddha, NASA Marshall Space Flight Center, USA; Takai, Toshiro, Asahi Breweries, Ltd., Japan; Okumura, Yasushi, Asahi Breweries, Ltd., Japan; Scott, David L., Massachusetts General Hospital, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Although a number of allergens have been identified and isolated, the underlying molecular basis for the potent immune response is poorly understood. House dust mites (*Dermatophagoides* sp.) are particularly ubiquitous contributors to atopy in developed countries. The rhinitis, dermatitis, and asthma associated with allergic reactions to these arthropods are often caused by relatively small (125-129 amino acids) mite proteins of unclear biological function. Der f 2, a major allergen from the mite *Dermatophagoides farinae*, has been recombinantly expressed and characterized. The Der f 2 protein has been crystallized in our laboratory and a native data set collected at a synchrotron source. The crystals belong to the orthorhombic space group I422 with unit cell parameters of  $a = 95.2$  Angstroms,  $b = 95.2$  Angstroms, and  $c = 103.3$  Angstroms. An essentially complete (97.2%) data set has been collected to 2.4 Angstroms. Attempts to solve the crystal structure of Der f 2 by molecular replacement using the available NMR coordinates for either Der f 2 or Der p 2 (the homologous protein from *D. pterovssinus*) failed to reveal a creditable solution.

Author

*Allergic Diseases; Crystallization; Dust; X Ray Analysis; Proteins*

**20030002659** Army Research Inst. of Environmental Medicine, Natick, MA USA

**Assessment of Bone Health in Men and Women Comparing DXA to Calcaneal Ultrasound**

Murphy, M. M.; Nindl, B. C.; Schneider, G. A.; Scheehan, K. M.; Evans, R. K.; Nov. 2002; 30p; In English

Report No.(s): AD-A408014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The purpose of this study was to compare bone densitometry to quantitative ultrasound (QUS) and to assess gender differences in a young healthy population. Seventy-five active, aged-matched ( $\approx 29$  yrs) men ( $N = 29$ ) and women ( $N = 46$ ) were assessed for bone mineral density (BMD, g/sq cm) and broadband ultrasound attenuation (BUA, db/MHz). BMD of the total body,

regional and lumbar spine was measured via dual-energy X-ray absorptiometry (DXA), and BUA was measured using the QUS-2TM ultrasonometer. Data analysis included Pearson product-moment to compare DXA to QUS, and receiver operating characteristic (ROC) curves and Kappa coefficients for discrimination of the two procedures. There was no significant gender difference in lumbar spine (LS) BMD. Regional and total body BMD and BUA were greater for men than women. Total body BMD (mean +/- SD) for men was 1.29 +/- 0.09 g/sq cm and for women was 1.22 +/- 0.07 g/sq cm. BUA (mean +/- SD) was 107.0 +/- 16.7 db/MHz vs. 97.8 +/- 11.6 db/MHz for men and women, respectively. All BMD sites except LS and pelvis were significantly correlated to BUA for men ( $r = 0.46-0.48$ ), but only LS ( $r = 0.32$ ) and arms ( $r = 0.30$ ) were significantly correlated to BUA for women. Kappa coefficients ranged from - 0.09 to 0.17 for men, none of which were significant, and the range for women was 0.09 to 0.25 with pelvis and legs attaining significance. There was low percent agreement between QUS and DXA (28%-45% for men and 41%-50% for women), and the area under the curve (AUC) derived from ROC analysis resulted in little discrimination (AUC = 0.60-0.64). Our results showed little agreement between DXA and QUS; therefore, QUS would not be a surrogate indicator for the measurement of BMD by DXA. These results indicate that QUS measures different aspects of bone health and may complement the use of DXA.

DTIC

*Ultrasonics; Bones; Densitometers; Bone Mineral Content; Broadband*

**20030002677** Cancer Inst. of New Jersey, New Brunswick, NJ USA

**Type I Receptor Kinase Inhibitors: A Novel Treatment for Breast Cancer Annual Report, 1 Jun. 2001-31 May 2002**

Reiss, Michael; Jun. 2002; 9p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-00-1-0510

Report No.(s): AD-A408030; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Transforming Growth Factor-Betas (TGF beta) are polypeptides that are constitutively secreted and activated by many breast carcinomas. They contribute to the tumor's ability to invade and metastasize, to induce angiogenesis and to escape from immune destruction. These circumstances raise the question whether blocking the effects of tumor-derived TGF beta on normal tissue (stroma, blood vessels and immune cells) could be developed as a novel approach to the treatment of breast cancer. We propose to block TGF beta action by developing small molecules that inhibit the type I TGF beta receptor kinase, which is the key molecule that initiates and mediates TGF beta signaling. We plan to develop a cell free ELISA-type assay for high-throughput screening for selective inhibitors of T beta R-I kinase activity by using an antibody that specifically detects the phosphorylated form of its substrate, Smad2. Combinatorial libraries of small molecules will then be screened for potent and highly selective for the T beta R-I kinase. These will then be tested against normal cells in vitro using a number of different assays for TGF beta's biological effects. Promising compounds will then be tested for their antitumor activity against highly metastatic, - angiogenic and immunogenic varieties of transplantable breast cancers in mice.

DTIC

*Mammary Glands; Cancer; Polypeptides; Therapy*

**20030002678** Australasian Coll. of Tropical Medicine, Cairns, Australia

**6TH Asia-Pacific Congress on Animal, Plant and Microbial Toxins & 11th Annual Scientific Meeting of the Australasian College of Tropical Medicine**

Jul. 2002; 210p; In English; Pres: 11th Annual Scientific Meeting of the Australasian College of Tropical Medicine, 8-12 Jul 2002, Cairns, Australia

Report No.(s): AD-A408029; No Copyright; Avail: CASI; A03, Microfiche; A10, Hardcopy

On behalf of the International Society for Toxinology and the Australasian College of Tropical Medicine, we have great pleasure in welcoming you to this, the 6th Asia-Pacific Congress on Animal, Plant, and Microbial Toxins and the 11th Annual Scientific meeting of the Australasian College of Tropical Medicine, at the Cairns Colonial Club Resort, Cairns, Australia. This conference brings together experts in fields ranging from molecular toxinology to clinical studies of envenomation to tropical medicine. It comes at a time of many exciting developments in our respective fields. Our understanding of how toxins function is being enhanced by the tools developed for the rapidly growing fields of genomics and proteomics, while structural biology is making major advances in defining the structures of both toxins and their molecular targets. The same holds true for the toxins and antigens underlying viral, bacterial and parasitic diseases. The Northern Australian locality for this meeting proved very appropriate considering recent tragic events surrounding Irukandji envenomation. It also emphasizes the potency of our uniquely Australian venomous fauna and their direct and continuing role in human health. Clearly much remains to be learned about the composition and mode of action of many venoms, as well as the biology of venomous species. and while the world has come to fear toxins associated with bio-terrorism, concurrently it is embracing other toxins as therapeutics. The intersections of toxinology

and tropical health are many and varied. We thought it was particularly timely to address the challenges of emerging and re-emerging infectious diseases and biodefense.

DTIC

*Medicine; Tropical Regions; Diseases; Health; Conferences*

**20030002681** University of South Florida, Tampa, FL USA

**Improved Breast Cancer Research Through Automated Matching of Patients to Clinical Trials Annual Report, 3 Jul. 2001-2 Jul 2002**

Hall, Lawrence O.; Goldgof, Dmitry B.; Krischer, Jeffrey; Aug. 2002; 19p; In English

Contract(s)/Grant(s): DAMD17-00-1-0244

Report No.(s): AD-A408023; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

An enhanced Web based prototype intelligent agent/expert system for matching breast cancer patients to clinical trials has been built. It allows for cost preferences to be entered. Therefore, the system user can choose to rule patients out of trials as quickly as possible without regard to the cost of tests necessary to do this. They can choose have questions appear so that the patient is ruled out of the trial with the minimal set of costs (tests) or can choose some combination of approaches. The system has been tested with 12 protocols and designed for maximal responsiveness and scalability as new protocols are added. The files of 178 former patients have been used to test the accuracy of the system. Additionally, the files of 57 current patients have been tested for eligibility. Patients for each of the protocols were correctly found eligible for one or more trials. We have also developed a prototype system to quickly add new clinical trials. This has been successfully used by novices to enter new trials.

DTIC

*Patients; Cancer; Mammary Glands*

**20030002761** North Carolina Univ., Chapel Hill, NC USA

**Characterization of p120ctn, an Adherens Junction Protein with a Potential Role in Tumorigenesis and Cancer Metastasis Annual Report, 1 Jul. 1998-30 Jun. 2002**

Swanhard, Lisa; Peifer, Mark; Jul. 2002; 15p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-98-1-8220

Report No.(s): AD-A407500; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

One of the deadliest and least understood aspects of cancer is metastasis; Before a tumor can metastasize, individual cells must acquire mutations which down-regulate adhesion to neighboring cells. Down-regulating components of the adherens junctions causes increased invasiveness and metastatic potential of tumors. Adherens junctions form around cadherins that interact homotypically to cadherins on neighboring cells. The cytoplasmic domain of cadherins interacts with a set of accessory proteins called catenins, which anchor cadherins to the acting cytoskeleton. p120, which was discovered in vertebrates, seems to be playing a regulatory rather than a structural role in adherens junctions. Before we can understand the role p120ctn is playing in cancer, we must understand its normal cellular function. We are studying p120 in the fruitfly, *Drosophila melanogaster*. The objective of this research project is to characterize the role of p120 by generating flies mutant for the p120 gene and characterizing them phenotypically and biochemically. We mutations in p120ctn. to our surprise thee are viable and fertile. We are testing them for genetic interactions with genes encoding other junctional proteins. We are using anti-p120ctn antisera, and myc-and GFP-tagged p120ctns to examine p120 localization.

DTIC

*Structures; Metastasis; Cancer; Cells (Biology); Mammary Glands; Tumors; Fertility*

**20030002842** Pennsylvania Univ., Wistar Inst., Philadelphia, PA USA

**Structure and Function of AIB1 (Amplified in Breast Cancer-1) Protein Annual Report, 1 Jul. 2001-30 Jun. 2002**

Marmorstein, Ronen; Jul. 2002; 8p; In English

Contract(s)/Grant(s): DAMD17-01-1-0461

Report No.(s): AD-A408058; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The overexpression or amplification of the AIB1 gene is observed in the majority of primary breast tumors, and is also correlated with a large percentage of hereditary and sporadic ovarian carcinomas. The AIB1 protein is a member of the steroid receptor coactivator family of transcriptional regulatory proteins that contain a conserved C-terminal histone acetyltransferase domain, and an N-terminal bHLH-PAS domain. We hypothesize that the HAT and bHLH-PAS domains of AIB1 play critical roles in mediating elevated transcriptional activation levels in AIB1-mediated cancers. The goal of this proposal is to determine the

three dimensional structure of the HAT and bHLH-PAS domains of AIB1 to facilitate the structure-based design of small molecule inhibitors to specifically target AIB1 for therapeutic application.

DTIC

*Mammary Glands; Cancer; Proteins*

**20030002845** Baylor Coll. of Medicine, Houston, TX USA

**Identification of Genes Regulated by Proteolysis** *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Harper, Jeffrey; Jul. 2002; 17p; In English; Original contains color images

Contract(s)/Grant(s): DAMD17-01-1-0135

Report No.(s): AD-A408062; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Substrate selection in ubiquitination reactions is achieved by ubiquitin ligases, which simultaneously bind both the target protein and a ubiquitin conjugating enzyme. While recent data indicates that there are a large number of distinct ubiquitin ligases that are responsible for the destruction of hundreds or perhaps thousands of proteins, there are currently no general methods to identify proteins whose levels are controlled by this mechanism. The development of general methods to systematically identify proteins whose abundance is regulated has major implications for: (1) elucidating proteolytic components of signaling pathways such as those activated in response to oncogenes and growth inhibitory factors, (2) identifying candidate drug targets whose altered destruction leads to therapeutic benefit, and (3) identifying genes that are required for the proper destruction of particular proteins of interest.

DTIC

*Mammary Glands; Cancer; Gene Expression; Enzymes*

**20030002846** Fox Chase Cancer Center, Philadelphia, PA USA

**Estrogens and Breast Cancer** *Annual Report, 1 Jul. 2001-30 Jun. 2002*

Russo, Jose; Hu, Yun-Fu; Jul. 2002; 93p; In English

Contract(s)/Grant(s): DAMD17-00-1-0247

Report No.(s): AD-A408065; No Copyright; Avail: CASI; A05, Hardcopy; A01, Microfiche

In the present work we demonstrate that estradiol and its metabolites mainly 4-OH estradiol are able to induce transformation phenotypes in the human breast epithelial cells (HBEC) MCF-10F. This cell line is a spontaneously immortalized HBEC that does not contain measurable level of ER alpha or ER beta. Short-term treatment of these cells with physiological doses of 17-beta estradiol induces anchorage independent growth, colony formation in agar methocel, and reduces ductulogenic capacity in collagen gel, all phenotypes whose expression is indicative of neoplastic transformation. Physiological doses of 4-OH-E2 (0.007nM) induces transformation phenotypes that are not abrogated by the pure antiestrogen ICI.

DTIC

*Mammary Glands; Cancer; Estrogens*

**20030003656** Pennsylvania Univ., Dept. of Bioengineering and Chemical Engineering, Philadelphia, PA USA

**Microgravity Effects on Transvascular Transport and Vascular Control**

Kim, M., Pennsylvania Univ., USA; Civelek, M., Pennsylvania Univ., USA; Ainslie, K., Pennsylvania Univ., USA; Garanich, J., Pennsylvania Univ., USA; Harris, N. R., Pennsylvania Univ., USA; Tarbell, J. M., Pennsylvania Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 658-679; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Microgravity alters transvascular pressure differential and transmural flow across blood vessel walls. We have hypothesized that changes in transmural flow alter fluid shear stress on vascular smooth muscle cells (SMC) and this in turn affects the state of contraction or "tone" of SMC. Since the cardiovascular system relies on SMC contraction in arterioles in response to changes in pressure ("myogenic response") to regulate blood flow to tissue beds which in turn affects transvascular exchange, we have investigated the effects of fluid flow shear stress on SMC contraction using both in vitro and in vivo models.

Author

*Blood Vessels; Microgravity; Cardiovascular System; Blood Flow; In Vitro Methods and Tests*

**20030003659** Brandeis Univ., Martin Fisher School of Physics, Waltham, MA USA

**Protein Virial Coefficients from Size Exclusion Chromatography**

Fraden, Seth, Brandeis Univ., USA; Bloustine, Joshua, Brandeis Univ., USA; Berejnov, Viatcheslav, Brandeis Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 745-768; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

An improved method is presented for measuring protein virial coefficients from retention time measurements in size exclusion chromatography (SEC). Second virial coefficients for the self-interaction of lysozyme have been determined by analyzing the concentration dependence of the partition coefficient obtained from SEC studies on silica beads. Our SEC results show agreement with virial coefficients obtained by light scattering.

Author

*Virial Coefficients; Light Scattering; Liquid Chromatography; Proteins; Time Measurement; Lysozyme; Concentration (Composition)*

**20030003660** Michigan Univ., Dept. of Chemical Engineering, Ann Arbor, MI USA

**Micro-Fluid Dynamics in an Evaporating Sessile Droplet: Application to DNA Optical Gene Mapping**

Hu, Hua, Michigan Univ., USA; Larson, Ronald, Michigan Univ., USA; Li, Lei, Michigan Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 769-799; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The flow field proposed by a drying, sessile droplet has been used to stretch and adhere DNA molecules to derivatized glass substrate. as a preparation for optical gene analysis using restriction enzymes. We have carried out experimental, analytical, and numerical analysis of the flow field in an evaporating droplet, and combined this flow field with a Brownian dynamics analysis of polymer deformation to predict the conformations of DNA molecules adhered to the substrate in this flow. We have compared these predictions to experimental observations and measurements of the DNA configurations, obtaining excellent agreement. The results indicate that combined hydrodynamic/Brownian dynamic analyses can be used to design flows for micro-manipulation of DNA, for gene analysis. The flow fields in the evaporating droplet, obtained from a finite element analysis and from an analytic lubrication analysis are similar qualitatively. However there are some quantitative differences that can be traced to the boundary condition at the air-fluid interface, which reduces to a zero axial gradient in radial velocity in the case of the lubrication approximation, but which does not quite hold in the numerical analysis, due to the radial gradient in evaporation rate. The analytic flow field is then combined with a Brownian dynamics method to predict the stretching and deposition of DNA molecules to a glass substrate treated with 3-aminopropyltri ethoxysi lane (APTES) to induce irreversible adsorption of DNA. In the Brownian dynamics simulation, the DNA molecule is represented as a bead-spring chain, with parameters chosen from known elastic and hydrodynamic properties of lambda-phage DNA. Any bead coming into contact with the substrate due to a combination of flow and Brownian motion is 'frozen' to the surface. The agreement is very good, indicating that analysis of DNA molecular dynamics and surface adhesion in complex flows is now possible. We are extending this work to flow in a channel, and to electrostatic manipulations of DNA molecules, with the aim of developing tools for manipulation of DNA single molecules in microfabricated devices. Such devices are of growing interest in the biomedical community and for space applications, including space flight.

Author

*Flow Distribution; Drops (Liquids); Deoxyribonucleic Acid; Molecular Dynamics; Genetics; Fluid Dynamics; Brownian Movements; Surface Properties*

## 52

### AEROSPACE MEDICINE

*Includes the biological and physiological effects of atmospheric and space flight (weightlessness, space radiation, acceleration, and altitude stress) on the human being; and the prevention of adverse effects on those environments. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science. For the effects of space on animals and plants see 51 Life Sciences.*

**20030002760** Air Command and Staff Coll., Maxwell AFB, AL USA

**Fatigue Management for Aerospace Expeditionary Forces Deployment and Sustained Operations**

LeClair, Michael A.; Apr. 2001; 53p; In English; Original contains color images

Report No.(s): AD-A407468; No Copyright; Avail: CASI; A04, Hardcopy

Under the new Expeditionary Aerospace Force (EAF) concept, the US Air Force is capable of deploying and employing in 72 hours or less. Furthermore, the US mission frequently requires 24-hour activities to meet operational demands. Because of its commitment to project power with such a rapid fighting force, aviators on contingency operations will regularly face fatigue-related challenges inherent in sustained and continuous operations, as well as those from rapid, transmeridian travel. The purpose of this research paper is to extract all relevant materials pertaining to fatigue and aircrews in order to provide a plan for equipping Aerospace Expeditionary Forces (AEF) commanders and personnel with a historical per perspective, critical information, and new technologies to enable effective fatigue management. This information was attained via an extensive literature search and review, primarily utilizing the Internet and the Air University Library. Existing comprehensive scientific

literature provides important physiological information about aviators that can be used to guide operations and policy. Many alertness management strategies aid aircrews and deployed personnel as well as help them to cope with the challenges of sleep loss and circadian disruption. Both pharmaceutical and nonpharmaceutical countermeasures are presented. Although valuable, the challenge is for the scientific information to make its way down from the books to the cockpit and be incorporated into flight/duty/rest regulatory considerations. Additionally, new means to combat fatigue can give AEF commanders insight into future benefits of fatigue research. Commanders, safety officers, and aviators are well advised to familiarize themselves with the causes of impaired alertness and countermeasures that can keep chronic fatigue from becoming a problem.

DTIC

*Circadian Rhythms; Sleep Deprivation; Pilots (Personnel); Fatigue (Biology)*

**20030003627** California Univ., Dept. of Medicine, San Diego, CA USA

**Biofluids of Living in Space**

Prisk, Kim, California Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 24-89; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A04, Hardcopy; A10, Microfiche

This paper is a viewgraph presentation on the biofluids of living in space and gas mixtures contained in the periphery of the lung. The topics include: 1) Lung overview; 2) Gravity and the lung; 3) Specific examples; and 4) Other areas of interest.

CASI

*Body Fluids; Lungs; Gas Mixtures; Space Flight*

**20030003657** Alabama Univ., Dept. of Mathematics, Tuscaloosa, AL USA

**Capillary Instabilities in the Microgravity Environment**

Halpern, David, Alabama Univ., USA; Grotberg, James B., Michigan Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 680-713; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

The lung consists of a network of bifurcating tubes that are coated with a thin viscous film. In the case of disease, the liquid film can form a meniscus which plugs the tube, thus obstructing gas exchange. The formation of the liquid meniscus is due to capillary driven instabilities which arise in the lining causing it to close up. Airflow can also be obstructed if the airway tube collapses in on itself. This occurs when the elastic forces of the tube are not large enough to sustain the negative fluid pressures inside the tube caused by surface-tension, and the tube collapses. Closure of the airway can be due to either, or a combination of, these mechanisms. In any case the instability is dependent on the surface tension of the liquid lining and the presence, or lack of, surfactants. Premature babies, whose lungs have not developed sufficient surfactant to maintain the surface tension of the lung at a sufficiently low level for healthy functioning, are especially predisposed to problems caused by airway closure. In such cases, the patients can be treated with high frequency ventilation machines or surfactant replacement therapy or both. Adults also are treated with ventilators for a variety of pulmonary conditions which can involve airway closure. For mechanical ventilation, the frequency of the breathing cycle, as well as the tidal volume, are two control parameters at the disposal of the clinician. Little is known, however, of the effect that these two parameters can have on the occurrence of airway closure. Indeed, if airways can be kept open by using some given machine frequency or amplitude, thus causing mechanical perturbations to the unstable interface, then this would be important in the treatment of such patients. In normal gravity, airway closure tends to occur in the lower regions of the lung, due to the weight of the lung above, and at the end of expiration when the lung volume, and hence airway radii, are smallest. The transient blockage of gas exchange in the affected tubes occurs in only part of the lung, the other portions remaining open. In the microgravity environment, airway closure is a potentially significant issue since ventilation and airway closure are more homogeneous, leaving less of the lung to be open during end expiration. Prevention of airway closure in this setting may be useful. We model the phenomenon of airway closure by considering the stability of a thin film coating the inner surface of a rigid cylindrical tube. An oscillatory air (core) flow exerts tangential and normal stresses on the air-liquid interface. The core flow is determined independently of the film flow by assuming that the core perceives the highly viscous film as a rigid boundary. We also consider the effects of a surfactant monolayer present at the air-liquid interface. Lubrication theory is used to derive an evolution equation for the position of the air-liquid interface which includes the effects of the core flow. This equation is coupled to a surfactant transport equation. Scaling analysis reveals several dimensionless parameters involving the frequency and amplitude of the periodic core pressure gradient, the thickness of the film, the tube radius, the viscosities of the fluids, the surface tension and surface-tension gradients due to the presence of the surfactant. When the core is passive, closure is possible provided the ratio of the unperturbed film thickness to tube radius exceeds a certain critical value. For the non-zero frequency case, it is

shown that the core flow can stabilize the capillary instability and prevent closure. We find that there is a critical frequency above which closure does not occur, and that this critical frequency increases as the amplitude of the core flow decreases.

Author

*Lungs; Pulmonary Functions; Air Flow; Core Flow; Microgravity; Models; Film Thickness; Fluid Films*

**20030003658** Tulane Univ., Dept. of Biomedical Engineering, New Orleans, LA USA

**The Importance of Interfacial Stresses During Pulmonary Airway Reopening in Microgravity**

Gaver, Donald P., Tulane Univ., USA; Bilek, Anastacia M., Tulane Univ., USA; Jacob, Anne-Marie, Tulane Univ., USA; Dee, Kay C., Tulane Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 714-744; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Pulmonary airway closure is a potentially dangerous event that can occur in microgravity environments and may result in limited gas exchange for flight crew during long-term space flight. Repetitive airway collapse and reopening subjects the pulmonary epithelium to large, dynamic, and potentially injurious mechanical stresses. During ventilation at low lung volumes and pressures, airway instability leads to repetitive collapse and reopening. During reopening, air must progress through a collapsed airway, generating stresses on the airway walls, potentially damaging airway tissues. The normal lung can tolerate repetitive collapse and reopening. However, combined with insufficient or dysfunctional pulmonary surfactant repetitive airway collapse and reopening produces severe lung injury. Particularly at risk is the pulmonary epithelium. As an important regulator of lung function and physiology, the degree of pulmonary epithelial damage influences the course and outcome of lung injury. Two companion studies, an experimental investigation and computational fluid dynamic simulation, are presented that address the hypothesis that the mechanical stresses associated with airway reopening inflict injury to the pulmonary epithelium.

Author

*Lungs; Pulmonary Functions; Blocking; Epithelium; Computational Fluid Dynamics; Computerized Simulation; Cells (Biology); Interfacial Tension*

**20030003661** NASA Glenn Research Center, Cleveland, OH USA

**Non-Invasive Health Diagnostics using Eye as a 'Window to the Body'**

Ansari, Rafat R., NASA Glenn Research Center, USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 800-830; In English; Also announced as 20030003624; Sponsored in part by John Glenn Biomedical Engineering Consortium; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

As a 'window to the body', the eye offers the opportunity to use light in various forms to detect ocular and systemic abnormalities long before clinical symptoms appear and help develop preventative/therapeutic countermeasures early. The effects of space travel on human body are similar to those of normal aging. For example, radiation exposure in space could lead to formation of cataracts and cancer by damaging the DNA and causing gene mutation. Additionally, the zero-gravity environment causes fluid shifts in the upper extremities of the body and changes the way blood flows and organ system performs. Here on Earth, cataract, age-related macular degeneration (AMD), diabetic retinopathy (DR), and glaucoma are major eye diseases and are expected to double in next two decades. To detect, prevent, and treat untoward effects of prolonged space travel in real-time requires the development of non-invasive diagnostic technologies that are compact and powerful. We are developing fiber-optic sensors to evaluate the ocular tissues in health, aging, and disease employing the techniques of dynamic light scattering (cataract, uveitis, Alzheimer's, glaucoma, DR, radiation damage, refractive surgery outcomes), auto-fluorescence (aging, DR), laser-Doppler flowmetry (choroidal blood flow), Raman spectroscopy (AMD), polarimetry (diabetes), and retinal oximetry (occult blood loss). The non-invasive feature of these technologies integrated in a head-mounted/goggles-like device permits frequent repetition of tests, enabling evaluation of the results to therapy that may ultimately be useful in various telemedicine applications on Earth and in space.

Author

*Aerospace Medicine; Eye Diseases; Radiation Dosage; Biological Effects; Deoxyribonucleic Acid; Cells (Biology); Bioinstrumentation; Space Flight*

**20030003758** Howard Univ., Washington, DC USA

**The Hematopoietic Stem Cell Therapy for Exploration of Space**

Roach, Allana Nicole, Howard Univ., USA; Brezo, Jelena, Howard Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 55-66; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

Astronauts experience severe/invasive disorders caused by space environments. These include hematological/cardiac abnormalities, bone and muscle losses, immunodeficiency, neurological disorders and cancer. While the cause of these symptoms

are not yet fully delineated, one possible explanation could be the inhibition of hematopoietic stem cell (HSC) growth and hematopoiesis in space. HSCs differentiate into all types of blood cells, and growing evidence indicates that the HSCs also have the ability to transdifferentiate to various tissues, including muscle, skin, liver, neuronal cells and possibly bone. Therefore, a hypothesis was advanced in this laboratory that the hematopoietic stem cell-based therapy, herein called the hematopoietic stem cell therapy (HSCT), could mitigate some of the disorders described above. Due to the magnitude of this project our laboratory has subdivided it into 3 sections: a) HSCT for space anemia; b) HSCT for muscle and bone losses; and c) HSCT for immunodeficiency. Toward developing the HSCT protocol for space anemia, the HSC transplantation procedure was established using a mouse model of beta thalassemia. In addition, the NASA Rotating Wall Vessel (RWV) culture system was used to grow HSCs in space condition. to investigate the HSCT for muscle loss and bone loss, donor HSCs were genetically marked either by transfecting the beta-galactosidase-containing plasmid, pCMV.SPORT-beta-gal or by preparing from b-galactosidase transgenic mice. The transdifferentiation of HSCs to muscle is traced by the reporter gene expression in the hindlimb suspended mice with some positive outcome, as studied by the X-gal staining procedure. The possible structural contribution of HSCs against muscle loss is being investigated histochemically.

Author

*Hematopoietic System; Space Exploration; Cell Division; Anemias; Immunology; Musculoskeletal System*

**20030004244** Defence and Civil Inst. of Environmental Medicine, Toronto, Ontario Canada

**An Overview of Sleep Deprivation and the Ameliorative Effects of Modafinil**

Pigeau, Ross A., Defence and Civil Inst. of Environmental Medicine, Canada; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 2-1 - 2-26; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A03, Hardcopy

An overview of total sleep deprivation is offered that attempts to sample the broad array of studies conducted in the area. A distinction is made between sleepiness and fatigue as explanations for the behavioural effects attributed to sleep loss. The first, sleepiness, concerns itself with the pressure to fall asleep that is moderated by circadian pressures, while the second, fatigue, addresses a hypothesized monotonic (more or less) degradation in capability in the pre-frontal cortex. It is shown that both effects can be influenced by a number of modifier variables each of which can interact with each other to exaggerate or moderate cognitive declines due to sleep loss. The second part of the paper discusses a new pharmaceutical substance known as modafinil and its ability to ameliorate sleep deprivation effects. It is suggested that modafinil may be beneficial for counteracting sleepiness, but that it may not be as successful for counteracting fatigue effects, suggesting that modafinil should be used with caution for tasks requiring high-level cognition.

Author

*Alertness; Pharmacology; Sleep Deprivation; Human Factors Engineering*

**20030004248** Army Aeromedical Research Lab., Fort Rucker, AL USA

**Placebo-Controlled Studies of Sustaining the Alertness and Flight Performance of Aviators with Dexedrine(Registered Trademark)**

Caldwell, J. A., Army Aeromedical Research Lab., USA; Hall, K. K., Army Aeromedical Research Lab., USA; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 7-1 - 7-8; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A02, Hardcopy

Dextroamphetamine (Dexedrine) is a stimulant capable of temporarily reversing many of the effects of sleep deprivation. This report substantiates the efficacy of Dexedrine for aviation sustained operations. Specifically, it is shown that this countermeasure maintains flight skills, psychological mood, and physiological activation in sleep-deprived pilots. Dexedrine's positive impact is not offset by marked disruptions in recovery sleep, although "lighter sleep" was noted after the drug than after placebo. It is concluded that Dexedrine is a viable remedy for fatigue in aviation sustained operations, but it is not a substitute for proper crew-rest scheduling. There is no replacement for adequate restful sleep.

Author

*Aircraft Pilots; Alertness; Drugs; Flight Characteristics; Physiology*

**20030004249** Delegation Generale de l'Armement, France

**Wakening Substances: Caffeine Substance Eveillante: La Cafeine**

Lagarde, Didier, Delegation Generale de l'Armement, France; Sicard, Bruno, Nestle Research Centre, Switzerland; Chauffard, Françoise, Etat-Major de la Marine, France; Beaumont, Maurice, Institut de Medicine Aerospatiale Armee, France; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 8-1 - 8-10; In French; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A02, Hardcopy

Caffeine is the most widely used psychostimulant, whose acceptance, tolerance and side effects are well known. The development of a slow released (SRC) formulation optimizes caffeine as a fatigue and sleep deprivation counter-measure. Due to its pharmacokinetic properties (delayed T max and reduced C max), a single 300 mg SRC oral dose per day is effective to maintain alertness and performance, up to 45 hours in a total sleep deprivation situation. Compared to other psychostimulants like amphetamines or modafinil, slow released caffeine offers the best ratio effectiveness/tolerance-acceptance. Therefore SRC potential use in the military is wider than these "exotic" drugs, and could benefit to military personnel submitted to sustained or continuous operations.

Author

*Alertness; Caffeine; Wakefulness; Pharmacology*

**20030004250** QinetiQ Ltd., Centre for Human Sciences, Farnborough, UK

### **Sleep Promoting Substances**

Stone, Barbara M., QinetiQ Ltd., UK; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 9-1 - 9-20; In English; Also announced as 20030004241; Original contains color illustrations; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A03, Hardcopy

Adequate sleep is essential to the maintenance of alertness during continuous and sustained operations, and sleep promoting substances or hypnotics have been used successfully in support of demanding scenarios extending over many weeks. The rest periods during such operations are limited in duration and occur at intervals throughout the 24-hour cycle. There are many hypnotics now available, but the necessary profile is limited to a few drugs. These are temazepam (10-20mg), zolpidem (10mg) and brotizolam (0.125-0.25mg). With each drug there is evidence of efficacy and limited duration of actions with the dose range recommended. Melatonin (5mg) also possesses hypnotic activity, with efficacy during the day similar to 20mg temazepam. However, whereas the benzodiazepines and relate drugs possess hypnotic activity throughout the 24 hour cycle, it would appear that melatonin is only effective when the endogenous plasma levels of naturally occurring melatonin are low, and that ingestion at certain times of day may lead to sleep disturbance. The need to be aware of the constraints on the use of melatonin mitigates against its effectiveness in operations when missions will be required at all times of the day and night with rest periods scattered throughout the 24 hour cycle. As far as military operations are concerned the UK used the hypnotic temazepam (10-20mg) in Royal Air Force personnel during the South Atlantic campaign and during the liberation of Kuwait. It still remains the drug of choice for the Royal Air Force. The recent availability of ultra short acting hypnotics such as zaleplon (10mg) has raised the possibility of using hypnotics for shorter sleep periods than 6 hours.

Author

*Alertness; Drugs; Sleep Deprivation; Pharmacology*

**20030004251** Delegation Generale de l'Armement, France

### **How to Alleviate Jet Lag: The Chronobiotic Substances *Comment Reduire les Effets du Decalage Horaire: Les Substances Chronobiotiques***

Lagarde, Didier, Delegation Generale de l'Armement, France; Beaumont, Maurice, Institut de Medicine Aerospatiale Armees, France; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 10-1 - 10-13; In French; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A03, Hardcopy

The current operational concept relies upon sustained or continuous operations that demand 24-hour round-the-clock capability so that they need a high level of performances overnight and a good quality of sleep during short rest periods before working. Otherwise, numerous missions need air transportation across multiple time zones, making the personnel exposed to jet-lag desynchronization. This results in sleep disturbances, daytime sleepiness and performance impairment that tend to increase the hazard of mission failure and of casualties. Therefore, alleviating these disturbances appears to be of major interest. It can be proposed at first organizational methods consisting of adapting workload to individual's skill and of relieving personnel as much as possible, regarding mission's scheduling. Physiological methods are known to alleviate jet lag syndrome by taking naps of at least 30 min of duration at anytime in the nycthemeron and to hasten resynchronization by exposure to bright light or darkness according to an appropriate schedule, by taking meals and practicing physical exercises according to appropriate schedule. If all these methods cannot be applied due to environmental conditions, it can be proposed a pharmacological help using (i) hypnotic agents to promote sleep after the flight to assist in sleep timed to coincide with the nocturnal rest period at the destination or (ii) psychostimulant agents to maintain vigilance and performance during the flight and the following recovery period or (iii) melatonin to hasten the resynchronization of the circadian system. We performed a real world study on jet lag called "operation Pegasus" that confirmed the hastening effect of melatonin on resynchronization in a subjective rather than in an objective point of view but this study also brought some evidence of the positive effects of a new formulation of caffeine, slow release caffeine, in maintaining performance and vigilance during 10-12 hours following intake and also in speeding up the resynchronization of

biological rhythms. Therefore, we think that slow release caffeine could be included in a scheme of sleep/wakefulness management during continuous operations.

Author

*Circadian Rhythms; Desynchronization (Biology); Jet Lag; Pharmacology; Workloads (Psychophysiology)*

## 53

### BEHAVIORAL SCIENCES

*Includes psychological factors; individual and group behavior; crew training and evaluation; and psychiatric research.*

**20030004241** Research and Technology Organization, Human Factors and Medicine Panel, Neuilly-sur-Seine, France  
**Sleep/Wakefulness Management in Continuous/Sustained Operations** *La Gestion des Rythmes Veille/Sommeil Lors des Operations Continues/Soutenues*

Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002; 146p; In English; In French; Sleep/Wakefulness Management in Continuous/Sustained Operations, 17-18 Jun. 2002, Fort Rucker, AL, Warsaw, Paris, USA, Poland, France; Also announced as 20030004242 through 20030004251; Original contains color illustrations  
Report No.(s): RTO-EN-016; AC/323(HFM-064)TP/39; ISBN 92-837-1073-8; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A07, Hardcopy

To preserve a good level of vigilance and performance, we have to respect our sleep-wakefulness cycle. The sustained and continuous operations induce disturbances of this biological rhythm, such as sleep loss, jet-lag. There is an antinomy between the physiological requirement and the operational requirement. To be able to continue the mission but also to preserve our security and the security of the crew we need an appropriate sleep-wakefulness management. This Lecture Series presents the physiological, ergonomic and pharmacological possibilities to reach these goals.

Author

*Sleep; Wakefulness; Human Factors Engineering; Pharmacology; Circadian Rhythms; Military Operations*

**20030004242** Delegation Generale de l'Armement, Dept. Facteurs Humains et Sciences Medicales, Paris, France

**Introduction-Overview: The Sleep-Wakefulness Cycle and the SUSOPS/CONOPS**

Lagarde, Didier, Delegation Generale de l'Armement, France; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. I-1 - I-6; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A02, Hardcopy

Military operations in general and air operations in particular, are characterized by the need to maintain constant high levels of performance. Human performance is modified negatively by changes in schedule, sleep loss, transmeridian flights and continuous or sustained operations. Flight surgeons and other medical staff need to know how to assess and manage these challenges to operational efficiency. A recent NATO/RTO/HFM meeting identified the advances made in sleep-wakefulness management. The rapid deployment of military personnel across several time zones for sustained operations such as the recent air campaign in Kosovo, is a major challenge for sleep-wakefulness management. Different strategies are required to maintain operational efficiency at its highest level. They include, but are not limited to, adjustment of work schedules, sleep hygiene, napping and the controlled use of pharmacological agents. In order to enable the Alliance to continue to carry out this type of operation, scientific progress in this field must be communicated to military physicians in the field and the challenges presented should be understood by commanders both in the field and at headquarters; it's the main goal of this Lecture series. We have to inform all military medical personnel and all military operational personnel of the practice of sleep-wakefulness management, by clearly demonstrating the positive and negative aspects of the measures employed.

Derived from text

*Military Operations; Sleep; Wakefulness; Activity Cycles (Biology)*

**20030004243** Rome Univ., Dipt. di Psicologia, Rome, Italy

**Individual Differences in Vigilance and Performance During Continuous/Sustained Operations**

Casagrande, Maria, Rome Univ., Italy; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 1-1 - 1-13; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A03, Hardcopy

Military operations are often characterized by prolonged periods of wakefulness; irregular rest-activity patterns; long haul flights. These situations are unnatural. Severe sleep debt can accumulate, leading to dangerous levels of sleepiness and decreases of performance. Although sleep deprivation, time of day and time on task are considered among the most important causal factors

of daytime sleepiness, the levels of vigilance may still significantly vary according to individual differences. Verifying whether and to what extent some stable individual differences are associated to specific variations of vigilance and performance may be important in orienting the best criteria for the selection of personnel involved in prolonged activity for many hours or unusual hours, and/or monotonous activity. Concerning individual differences, a distinction can be made between the so-called temporary individual differences and permanent individual differences. The former are to be considered as a series of coping mechanisms, i.e. the set of capacities and abilities that modify workloads or directly affect the homeostatic and/or circadian factors that induce sleepiness. These are considered as the outcome of an active sphere of behaviour which makes individuals directly "involved" in handling their own activities. Permanent differences, instead, are to be considered as "constitutional" differences, i.e. as characteristics that exist for genetic and/or physiological reasons, including gender, age, some personality features (such as extroversion/introversion, field-dependence, etc.) and circadian typology. Some individual coping strategies can minimize the adverse effects of sleep loss and circadian rhythm desynchronization and promote optimal vigilance and performance in operational settings. Equally, some individual traits can facilitate a good adaptability to continuous/sustained operations. Both an age less than 40-50 years and morningness are particularly crucial determinants of a good adaptability to work at unusual hours and, maybe, to continuous/sustained operations. Equally, both flexibility of sleeping habits and ability to overcome drowsiness are related to both better long-term tolerance in shiftwork and the capacity to sustain vigilance and performance at unusual hours and over time.

Author

*Military Operations; Wakefulness; Human Performance; Workloads (Psychophysiology)*

**20030004245** QinetiQ Ltd., Centre for Human Sciences, Farnborough, UK

### **Jet-Lag Syndrome**

Stone, Barbara M., QinetiQ Ltd., UK; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 3-1 - 3-9; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A02, Hardcopy

Rapid travel across time zones leads to a lack of synchrony between the activity of the internal rhythm generating systems of an individual and the local social or environmental time cues of the new time zone. The internal circadian clock adapts slowly to this mismatch leading to the syndrome known as jet-lag. This syndrome is particularly characterized by sleep disturbances, reduced daytime alertness and performance, gastrointestinal symptoms and a general feeling of malaise. These symptoms are obviously undesirable for service personnel who are involved in intensive and sustained operations and who may have to deploy to a location involving travel across several time zones. Following north-south travel there are no problems with jet lag (Buck et al., 1989) The adaptation of the circadian clock may take around one hour per day without countermeasures to adapt to a new time zone. However, around one third of travellers do not experience jet lag. In particular sleep disturbance is experienced by around 78% of subjects after a transmeridian flight whereas after 3 nights only around 30% of subjects experienced disturbance. In another study 40% of subjects reported subjective weakness. There have been a number of studies on the effects of transmeridian flight on sleep. In general the severity of the sleep disturbance following transmeridian flight is related to the direction of travel and to the number of time zones crossed. Following eastward flight and when sleep is scheduled in advance of the home time zone there may be difficulties falling asleep and problems awakening in the morning. These difficulties may not be seen on the first night in the new time zone as if the flight involves an overnight flight without sleep. Such sleep problems may persist for several days and reductions in SWS and REM sleep may be present. After westward flights the sleep disturbance may only last for two or three days. Sleep quality is good in the first part of the night, with increased SWS on the first night associated with the long period without sleep. On subsequent nights an increase in REM sleep has been observed. Recently reports of temporal lobe atrophy, spatial cognitive deficits in cabin crew chronically exposed to repetitive transmeridian flight have appeared in the literature. However, military personnel are unlikely to be subjected to frequent time zone changes.

Author

*Circadian Rhythms; Jet Lag; Sleep Deprivation; Signs and Symptoms; Human Factors Engineering*

**20030004246** Army Aeromedical Research Lab., Fort Rucker, AL USA

### **Efficacy of Napping Strategies to Counter the Effects of Sleep Deprivation**

Caldwell, J. Lynn, Army Aeromedical Research Lab., USA; Sleep/Wakefulness Management in Continuous/Sustained Operations; November 2002, pp. 4-1 - 4-11; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A03, Hardcopy

There is an abundance of evidence indicating that a nap taken during long periods of otherwise continuous wakefulness is extremely beneficial for improving alertness and performance. However, scheduling naps is not a simple matter. Several factors are important to consider before implementing a napping regime into a continuous operations scenario.

Derived from text

*Sleep Deprivation; Sleep; Human Performance*

**20030004247** Army Aeromedical Research Lab., Fort Rucker, AL USA

**Fatigue in Aviation Sustained Operations, the Utility of Napping, and the Problem of Sleep Inertia**

Caldwell, John A., Army Aeromedical Research Lab., USA; Prazinko, Brian F., Army Aeromedical Research Lab., USA; Caldwell, J. Lynn, Army Aeromedical Research Lab., USA; *Sleep/Wakefulness Management in Continuous/Sustained Operations*; November 2002, pp. 5-1 - 5-7; In English; Also announced as 20030004241; No Copyright; Avail: CASI; C01, CD-ROM; A02, Microfiche; A02, Hardcopy

Improperly managed aircrew fatigue can seriously degrade the performance, alertness, and safety of personnel in the operational environment. Fortunately, this danger can be minimized by the use of carefully planned napping strategies. Naps are effective because they are known to reduce the homeostatic drive for sleep. In a variety of settings, napping has been shown to produce several relatively long-lasting benefits. Unfortunately, there is a down side to this countermeasure in that personnel can suffer from several minutes of grogginess immediately after a nap has ended. This phenomenon is called sleep inertia. In operational contexts, the negative impact of sleep inertia must be weighed against the longer-lasting benefits of any napping strategy. If napping is to be implemented, specific steps can be taken to reduce the probability that sleep inertia will be severe and/or persistent.

Author

*Sleep; Flight Operations; Fatigue (Biology); Spacecrews*

54

**MAN/SYSTEM TECHNOLOGY AND LIFE SUPPORT**

*Includes human factors engineering; bionics, man-machine, life support, space suits and protective clothing. For related information see also 16 Space Transportation and 52 Aerospace Medicine..*

**20030002655** NASA Johnson Space Center, Houston, TX USA

**Predicting Strength and Fatigue for Suited and Unsuited Conditions from Empirical Data**

Maida, James C., NASA Johnson Space Center, USA; Gonzalez, L. J., Johnson Engineering Corp., USA; Rajulu, S., National Space Biomedical Research Inst., USA; [2001]; 1p; In English; Bioastronautics Investigators' Workshop 2001, 2001, Galveston, TX, USA; Sponsored by Universities Space Research Association, USA

Contract(s)/Grant(s): NRA-96-HEDS-05; No Copyright; Avail: Issuing Activity; Abstract Only

The need for longer and more labor-intensive extra-vehicular activities (EVA) is required for construction and maintenance of the International Space Station (ISS). Issues pertaining to human performance while wearing a space suit (EMU) for prolonged periods have become more important. This project was conducted to investigate how a pressurized Extra-vehicular Mobility Unit (EMU) affects human upper body joint strength and fatigue and how to predict it from computer models based on the data collected.

Author

*Extravehicular Activity; Extravehicular Mobility Units; Joints (Anatomy); Human Performance; Fatigue (Biology); Performance Prediction*

**20030002666** NASA Johnson Space Center, Houston, TX USA

**Work and Fatigue Characteristics of Unsuited and Suited Humans During Isolated, Isokinetic Joint Motions**

Gonzalez, L. Javier, Johnson Engineering Corp., USA; Maida, James C., NASA Johnson Space Center, USA; Miles, Erica H., Lockheed Engineering and Sciences Co., USA; Rajulu, S. L., National Space Biomedical Research Inst., USA; Pandya, A. K., Lockheed Engineering and Sciences Co., USA; [2001]; 1p; In English

Contract(s)/Grant(s): NRA-96-HEDS-05; No Copyright; Avail: Issuing Activity; Abstract Only

The effects of a pressurized suit on human performance were investigated. The suit is known as an Extra-vehicular Mobility Unit (EMU) and is worn by astronauts while working outside of their space craft in low earth orbit. Isolated isokinetic joint torques of three female and three male subjects (all experienced users of the suit) were measured while working at 100% and 80% of their maximum voluntary torque (MVT). It was found that the average decrease in the total amount of work done when the subjects

were wearing the EMU was 48% and 41% while working at 100% and 80% MVT, respectively. There is a clear relationship between the MVT and the time and amount of work done until fatigue. In general the stronger joints took longer to fatigue and did more work than the weaker joints. However, it is not clear which joints are most affected by the EMU suit in terms of the amount of work done. The average amount of total work done increased by 5.2% and 20.4% for the unsuited and suited cases, respectively, when the subject went from working at 100% to 80% MVT. Also, the average time to fatigue increased by 9.2% and 25.6% for the unsuited and suited cases, respectively, when the subjects went from working at 100% to 80% MVT. The EMU also decreased the joint range of motion. It was also found that the experimentally measured torque decay could be predicted by a logarithmic equation. The absolute average error in the predictions was found to be 18.3% and 18.9% for the unsuited and suited subject, respectively, working at 100% MVT, and 22.5% and 18.8% for the unsuited and suited subject, respectively, working at 80% MVT. These results could be very useful in the design of future EMU suits, and planning of Extra-Vehicular Activity (EVA) for the upcoming International Space Station assembly operations.

Author

*Extravehicular Activity; Extravehicular Mobility Units; Astronauts; Torque; Joints (Anatomy); Human Performance; Fatigue (Biology)*

**20030002675** National Space Biomedical Research Inst., Houston, TX USA

**Advanced Life Support Food Subsystem Salad Crop Requirements**

Perchonok, Michele H., National Space Biomedical Research Inst., USA; Stevens, Irene, Lockheed Engineering and Sciences Co., USA; Swango, Beverly E., Johnson Engineering Corp., USA; Toerne, Mary E., Johnson Engineering Corp., USA; [2002]; 1p; In English; ICES Conference, 15-18 Jul. 2002, San Antonio, TX, USA; Sponsored by Society of Automotive Engineers, Inc., USA; No Copyright; Avail: Issuing Activity; Abstract Only

As the National Aeronautics and Space Administration (NASA) begins to look towards longer duration space flights, the importance of fresh foods and varied menu choices increases. Long duration space missions require development of both a Transit Food System and a Lunar or Planetary Food System. These two systems are intrinsically different since the first one will be utilized in the transit vehicle in microgravity conditions while the second will be used in conditions of partial gravity (hypogravity). The Transit Food System will consist of prepackaged food of extended shelf life. Microgravity imposes significant limitations on the ability of the crew to handle food and allows only for minimal processing. Salad crops will be available for the planetary mission. Supplementing the transit food system with salad crops is also being considered. These crops will include carrots, tomatoes, lettuce, radish, spinach, chard, cabbage, and onion. The crops will be incorporated in the menu along with the prepackaged food. The fresh tasting salad crops will provide variety, texture, and color in the menu. This variety should provide increased psychological benefit. Preliminary studies on spinach, tomatoes, and bok choy have been completed. Sensory and analytical tests, including color and moisture were conducted on the chamber grown crops and compared to store bought spinach, tomatoes, and bok choy. Preliminary studies of the appropriate serving sizes and number of servings per week have also been conducted.

Author

*Consumables (Spacecrew Supplies); Space Flight Feeding; Food Production (In Space); Nutritional Requirements*

**20030002685** National Space Biomedical Research Inst., Houston, TX USA

**Space Food Systems Laboratory**

Perchonok, Michele, National Space Biomedical Research Inst., USA; Jan. 31, 2001; 1p; In English; Mission Systems 2001: A Space Lab. Odessa, 31 Jan. 2001, Unknown; No Copyright; Avail: Issuing Activity; Abstract Only

The Space Food Systems Laboratory (SFSL) is a multipurpose laboratory responsible for space food and package research and development. It is located on-site at Johnson Space Center in Building 17. The facility supports the development of flight food, menus, packaging and food related hardware for Shuttle, International Space Station, and Advanced Life Support food systems. All foods used to support NASA ground tests and/or missions must meet the highest standards before they are 'accepted' for use on actual space flights. The foods are evaluated for nutritional content, sensory acceptability, safety, storage and shelf life, and suitability for use in micro-gravity. The food packaging is also tested to determine its functionality and suitability for use in space. Food Scientist, Registered Dieticians, Packaging Engineers, Food Systems Engineers, and Technicians staff the Space Food Systems Laboratory.

Author

*Laboratories; Space Flight Feeding; Space Rations*

**20030003729** Texas Univ., Dept. of Mechanical and Industrial Engineering, El Paso, TX USA

**[High Pressure Gas Tanks] Final Report**

Quintana, Rolando, Texas Univ., USA; Dec. 18, 2002; 5p; In English

Contract(s)/Grant(s): NAG10-225; RTOP 334-20-00

Report No.(s): UTEP-26-1203-90; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

Four high-pressure gas tanks, the basis of this study, were especially made by a private contractor and tested before being delivered to NASA Kennedy Space Center. In order to insure 100% reliability of each individual tank the staff at KSC decided to again submit the four tanks under more rigorous tests. These tests were conducted during a period from April 10 through May 8 at KSC. This application further validates the predictive safety model for accident prevention and system failure in the testing of four high-pressure gas tanks at Kennedy Space Center, called Continuous Hazard Tracking and Failure Prediction Methodology (CHTFPM). It is apparent from the variety of barriers available for a hazard control that some barriers will be more successful than others in providing protection. In order to complete the Barrier Analysis of the system, a Task Analysis and a Biomechanical Study were performed to establish the relationship between the degree of biomechanical non-conformities and the anomalies found within the system on particular joints of the body. This relationship was possible to obtain by conducting a Regression Analysis to the previously generated data. From the information derived the body segment with the lowest percentage of non-conformities was the neck flexion with 46.7%. Intense analysis of the system was conducted including Preliminary Hazard Analysis (PHA), Failure Mode and Effect Analysis (FMEA), and Barrier Analysis. These analyses resulted in the identification of occurrences of conditions, which may be becoming hazardous in the given system. These conditions, known as dendritics, may become hazards and could result in an accident, system malfunction, or unacceptable risk conditions. A total of 56 possible dendritics were identified. Work sampling was performed to observe the occurrence each dendritic. The out of control points generated from a Weighted c control chart along with a Pareto analysis indicate that the dendritics "Personnel not Wearing Proper Protective and Hose/tubing located in high-traffic area" which account for 59.18% of total dendritic frequency need to be addressed to reduce the chance of a hazard from occurring. However, the occurrences of some dendritics are more important than others. As a result immediate, from a Weighted c perspective, corrective action should be taken to ameliorate the cause of the Class A dendritic "Personnel located under suspended or moving loads" rather than just the most commonly occurring dendritics. In any case the vast majority of data obtained indicates that testing operations possess a relatively high degree of safety.

Derived from text

*Fuel Tanks; System Failures; Regression Analysis; Prediction Analysis Techniques; Compressed Gas; Accident Prevention*

**20030003738** National Space Biomedical Research Inst., Houston, TX USA

**The Challenges in the Development of a Long Duration Space Mission Food System**

Perchonok, Michele H., National Space Biomedical Research Inst., USA; Swango, Beverly, Spacehab, Inc., USA; Toerne, Mary E., Spacehab, Inc., USA; [2001]; 8p; In English; The Instrumentation, Systems and Automation Society Conference, 11-13 Sep. 2001, Houston, TX, USA; Sponsored by Instrumentation, Systems and Automation Society, USA; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The Advanced Food System at Johnson Space Center/NASA will be responsible for supplying food to the crew for long duration exploratory missions. These missions require development of both a Transit Food System and of a Planetary Food System. The Transit Food System will consist of pre-packaged food of extended shelf life. It will be supplemented with salad crops that will be consumed fresh. The challenge is to develop a food system with a shelf life of 3 - 5 years that will use minimal power and create minimal waste from the food packaging. The Planetary Food System will allow for food processing of crops grown on the planetary surface due to the presence of some gravitational force. Crops will be processed to final products to provide a nutritious and acceptable diet for the crew. The food system must be flexible due to crop variation, availability, and shelf life. Crew meals, based on these: crops, must be nutritious, high quality, safe, and contain variety. The Advanced Food System becomes a fulcrum creating the right connection from crops to crew meals while dealing with issues of integration within a closed self-regenerative system (e.g., safety, waste production, volumes, water usage, etc.).

Author

*Space Missions; Food Processing; Storage Stability; Service Life; Packaging*

**20030003759** Pennsylvania State Univ., PA USA

**Modular Research Rover and Gesture Control System for EVA**

Richter, Joel, Pennsylvania State Univ., USA; Sloan, Kevin, Pennsylvania State Univ., USA; Barnwell, Elizabeth, Pennsylvania State Univ., USA; Benski, Adrienne, Pennsylvania State Univ., USA; Blank, Amy, Pennsylvania State Univ., USA; Clark, Kevin, Pennsylvania State Univ., USA; Legget, Lisa, Pennsylvania State Univ., USA; McGuire, Steve, Pennsylvania State Univ., USA; Moshtagh, Nima, Pennsylvania State Univ., USA; Smidansky, Paul, Pennsylvania State Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 67-77; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

As technology and computing power increases at extraordinary rates, our ability to effectively explore our solar system increases to new levels. The immediate future will see the continual development of robotic exploration as our primary means of exploring other planets. Once the time does arise for mankind to again push his frontiers to new limits, our definition of space exploration will be completely redefined. However, human exploration of our solar system cannot happen without the assistance of our robotic counterparts which helped blaze the trail into space. This transition to human exploration will see astronauts beyond the immediate communication reaches of Earth being forced to work with equipment that was at one time controlled by large teams of scientists and engineers with immediate access to significant computing resources. In order to deal with these problems, the Penn State Mars Society is developing a new method of robotic control that allows an astronaut in the field on the surface of Mars to be able to directly control any robotic equipment that he could potentially be working with. by integrating virtual reality (VR) gloves into an astronaut's space suit gloves, his hands now become an accurately measurable and rather versatile input device. Gloves of this nature are rather small and unobtrusive, and as such, can very easily be incorporated into the gloves that an astronaut would be wearing. The gloves as an input system will remain passive until activated by a command from the user. At this point, they begin to actively monitor the hand's motion. They would relay this information to a computer on-board the rover, which would in turn convert this complex hand model into a command to execute. When the user is ready to free himself from the input state, another unique gesture can be used to deactivate the control system. This method of interfacing with a computer will require refinement and testing, and for that purpose a rover is being built.

Author

*Extravehicular Activity; Robotics; Solar System; Space Exploration; Roving Vehicles; Control Systems Design*

**20030003764** Washington Univ., Seattle, WA USA

**Self-Sustained Closed Ecological Systems**

Barbee, David, Washington Univ., USA; Augustein, Emily, Washington Univ., USA; Frazier, Zach, Washington Univ., USA; Guerquin, Mike, Washington Univ., USA; Marshal, Hillary, Washington Univ., USA; Saito, Yuichi, Washington Univ., USA; Thompson, Emily, Washington Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 136-144; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A02, Hardcopy; A02, Microfiche

The focus of this project is the development of closed ecological systems (CES) to sustain a population of aquatic invertebrates for more than 30 days. Permanent habitation of space will require the development of CES capable of meeting the biological needs of human inhabitants. Such a system must provide water, oxygen, and food while removing waste products and recycling the mass of the system. Ideally, the ecological system will recycle wastes into requirements and function with minimal mass exchange. Current NASA research has been directed toward the optimization (in terms of volume, energy, mass) of the components of closed systems (i.e. crop production in space). This project explores the creation of small (75ml) aquatic CES testing different chemical media, temperature, light cycles, and physical conditions. Experimental CES consisted of freshwater algae and the grazer *Daphnia magna*. Computerized image analysis techniques were developed and implemented for abundance estimation and modeling population dynamics. Rotation of the containers, to vary the direction of gravity, did not alter survival or reproduction. Increased inorganic nutrients (Nitrate and Phosphate) were tested to determine if inorganic limitations prevented additional generations. Most CES conditions resulted in the survival of *D. magna* population including the F1 (offspring of original animals) generation. Ongoing work focuses on conditions that will permit an F2 generation (Grandchildren of original animals) and beyond.

Author

*Closed Ecological Systems; Ecosystems; Invertebrates; Organisms; Image Analysis; Nutrients*

**20030003801** NASA Ames Research Center, Moffett Field, CA USA

**Reactive Carbon from Life Support Wastes for Incinerator Flue Gas Cleanup**

Fisher, J. W.; Pisharody, S.; Moran, M. J.; Wignarajah, K.; Shi, Y.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-795947; No Copyright; Avail: National Technical Information Service (NTIS)

This paper presents the results from a joint research initiative between NASA Ames Research Center and Lawrence Berkeley National lab. The objective of the research is to produce activated carbon from life support wastes and to use the activated carbon to adsorb and chemically reduce the NO(sub x) and SO(sub 2) contained in incinerator flue gas. Inedible biomass waste from food production is the primary waste considered for conversion to activated carbon. Results to date show adsorption of both NO(sub x) and SO(sub 2) in activated carbon made from biomass. Conversion of adsorbed NO(sub x) to nitrogen has also been observed.

NTIS

*Activated Carbon; Flue Gases; Incinerators; Life Support Systems*

**20030003998** Michigan Univ., Transportation Research Inst., Ann Arbor, MI USA

**Night Vision Enhancement Systems for Ground Vehicles: The Human Factors Literature Final Report, Mar. 01 - Mar. 02**

Tsimhoni, O.; Green, P.; Apr. 2002; 134p; In English

Report No.(s): PB2003-100204; UMTRI-2002-05; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

This report summarizes applies human factors studies of vision enhancement systems (both night vision goggles and LCD-based systems) and related topics for driving at night. Research recommendations are given based on gaps in the literature.

NTIS

*Night Vision; Human Factors Engineering*

**20030004112** NASA Johnson Space Center, Houston, TX USA

**Shelf Life Considerations and Techniques**

Perchonok, Michele H., NASA Johnson Space Center, USA; [2001]; 18p; In English; Institute of Food Technologists, 22 Jun. 2002, New Orleans, LA, USA; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This viewgraph presentation provides information on factors contributing to the shelf life of food products. The presentation addresses the microbial, chemical, and physical changes which spoil in food products over time, and measures which can retard these changes. Attention is given to oxidation and enzymatic changes in food products. The presentation describes tests which can be performed on food items to measure their shelf life, including quantitative analysis and accelerated life testing, and then describes two case studies, one on rice, and the other on the NASA food system.

Author

*Service Life; Food; Quality; Safety; Preserving; Packaging; Experiment Design*

**20030004254** NASA Johnson Space Center, Houston, TX USA

**An Illumination Modeling System for Human Factors Analyses**

Huynh, Thong, Lockheed Martin Corp., USA; Maida, James C., NASA Johnson Space Center, USA; [2002]; 6p; In English; CAES 99: Computer-Aided Ergonomics and Safety Meeting, 19-21 May 1999, Barcelona, Spain; Sponsored by Louisville Univ., USA

Contract(s)/Grant(s): NRA-95-OLMSA-01; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Seeing is critical to human performance. Lighting is critical for seeing. Therefore, lighting is critical to human performance. This is common sense, and here on earth, it is easily taken for granted. However, on orbit, because the sun will rise or set every 45 minutes on average, humans working in space must cope with extremely dynamic lighting conditions. Contrast conditions of harsh shadowing and glare is also severe. The prediction of lighting conditions for critical operations is essential. Crew training can factor lighting into the lesson plans when necessary. Mission planners can determine whether low-light video cameras are required or whether additional luminaires need to be flown. The optimization of the quantity and quality of light is needed because of the effects on crew safety, on electrical power and on equipment maintainability. To address all of these issues, an illumination modeling system has been developed by the Graphics Research and Analyses Facility (GRAF) and Lighting Environment Test Facility (LETF) in the Space Human Factors Laboratory at NASA Johnson Space Center. The system uses physically based ray tracing software (Radiance) developed at Lawrence Berkeley Laboratories, a human factors oriented geometric modeling system (PLAID) and an extensive database of humans and environments. Material reflectivity properties of major surfaces and critical surfaces are measured using a gonio-reflectometer. Luminaires (lights) are measured for beam spread distribution, color and intensity. Video camera performances are measured for color and light sensitivity. 3D geometric models of humans and the environment are combined with the material and light models to form a system capable of predicting lighting conditions and visibility conditions in space.

Author

*Human Factors Engineering; Illuminating; Test Facilities; Mathematical Models; Computer Graphics; Computer Systems Programs*

## 55 EXO BIOLOGY

*Includes astrobiology; planetary biology; and extraterrestrial life. For the biological effects of aerospace environments on humans see 52 Aerospace medicine; on animals and plants see 51 Life Sciences. For psychological and behavioral effects of aerospace environments see 53 Behavioral Science.*

**20030003761** California Univ., Earth and Planetary Science Dept., Berkeley, CA USA

### **Exobiology: The Survival Ability of Halophiles Under Martian Conditions**

Chu, Hui-Tung, California Univ., USA; Sheng, William, California Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 94-106; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

The recently developed Odyssey gamma-ray spectrometer (GRS) has detected high concentrations of hydrogen, which strongly indicates there is permafrost and water ice in the upper meter of soil in the South Pole region of Mars. This finding presents the possibility that halophilic (salt loving) Archea might be present in its ice. It is possible that there may be areas of saline ice on Mars, since saline is found in Arctic ice. Halophiles are known to survive well under adverse conditions and have possibly lain dormant since the Upper Permian (250 million years) in salt deposits. Consequently, two halophiles isolated from San Francisco Bay salt ponds were selected to determine if they could survive the severe Martian conditions. To date, they have survived at least 8 months under experimental conditions. Future experiments will include dormant halophilic isolates from Lake Searles red salt crystals and Upper Permian Berchtesgaden rock salt.

Author

*Halophiles; Mars Environment; Exobiology; Mars Surface*

## 60 COMPUTER OPERATIONS AND HARDWARE

*Includes hardware for computer graphics, firmware and data processing. For components see 33 Electronics and Electrical Engineering. For computer vision see 63 Cybernetics, Artificial Intelligence and Robotics.*

**20030002654** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

### **An Experimental Framework for Executing Applications in Dynamic Grid Environments Final Report**

Huedo, Eduardo, Consejo Superior de Investigaciones Cientificas, Spain; Montero, Ruben S., Institute for Computer Applications in Science and Engineering, USA; Llorente, Ignacio M., Institute for Computer Applications in Science and Engineering, USA; November 2002; 32p; In English; Sponsored in part by Virginia's Commonwealth Technology Research Fund  
Contract(s)/Grant(s): NAS1-97046; TIC-2002-00334; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211960; NAS 1.26:211960; ICASE-2002-43; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Grid opens up opportunities for resource-starved scientists and engineers to harness highly distributed computing resources. A number of Grid middleware projects are currently available to support the simultaneous exploitation of heterogeneous resources distributed in different administrative domains. However, efficient job submission and management continue being far from accessible to ordinary scientists and engineers due to the dynamic and complex nature of the Grid. This report describes a new Globus framework that allows an easier and more efficient execution of jobs in a 'submit and forget' fashion. Adaptation to dynamic Grid conditions is achieved by supporting automatic application migration following performance degradation, 'better' resource discovery, requirement change, owner decision or remote resource failure. The report also includes experimental results of the behavior of our framework on the TRGP testbed.

Author

*Wide Area Networks; Architecture (Computers); Computation*

**20030003813** Virginia Commonwealth Univ., Dept. of Electrical Engineering, Richmond, VA USA

### **An Embedded Reconfigurable Logic Module Final Report**

Tucker, Jerry H., Virginia Commonwealth Univ., USA; Klenke, Robert H., Virginia Commonwealth Univ., USA; [2002]; 43p; In English

Contract(s)/Grant(s): NAG1-01042

Report No.(s): NLPN-01-111; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

A Miniature Embedded Reconfigurable Computer and Logic (MERCAL) module has been developed and verified. MERCAL was designed to be a general-purpose, universal module that can provide significant hardware and software resources to meet the requirements of many of today's complex embedded applications. This is accomplished in the MERCAL module by combining a sub credit card size PC in a DIMM form factor with a XILINX Spartan I1 FPGA. The PC has the ability to download program files to the FPGA to configure it for different hardware functions and to transfer data to and from the FPGA via the PC's ISA bus during run time. The MERCAL module combines, in a compact package, the computational power of a 133 MHz PC with up to 150,000 gate equivalents of digital logic that can be reconfigured by software. The general architecture and functionality of the MERCAL hardware and system software are described.

Author

*Architecture (Computers); Embedded Computer Systems; Field-Programmable Gate Arrays; Reconfigurable Hardware; Logic Design; Software Engineering*

## 61

### COMPUTER PROGRAMMING AND SOFTWARE

*Includes software engineering, computer programs, routines, algorithms, and specific applications, e.g., CAD/CAM. For computer software applied to specific applications, see also the associated category.*

**20030002225** Naval Postgraduate School, Monterey, CA USA

#### **The Impact on Quality of Service When Using Security-Enabling Filters to Provide for the Security of Run-Time Virtual Environments**

Salles, Ernesto J.; Sep. 2002; 151p; In English; Original contains color images

Report No.(s): AD-A407195; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The Naval Postgraduate School is developing NPSNET-V, a Run-Time Extensible Virtual Environment (RTEVE) framework. RTEVEs differ from traditional VEs in that applications within the environment can both discover and use new object types and behaviors at runtime. As the use of this technology has become more valuable to organizations, the need for adequate security has arisen, particularly for sensitive military and commercial applications. The level of security measures employed by these applications must be weighed against their impact on Quality of Service (QOS). To address RTEVE security issues, we developed a taxonomy identifying twenty-five information assurance (IA) areas within RTEVEs. We then designed and implemented a Security Management System for NPSNET-V (NSMS) that provided security through the use of three communications filters that provide for encryption, sequencing verification, and integrity. This design addressed four of the twenty-five areas identified in the taxonomy: component authentication; and communications confidentiality, integrity, and authentication. Analysis of the encryption, sequencing, and integrity filters indicates that their use introduces a negligible delay of 0.111 milliseconds for a 156 byte data packet, at the cost in packet size increase of 41 bytes; this indicates the technical feasibility of RTEVE data packet security at minimal cost to QOS.

DTIC

*Computer Information Security; Telecommunication; Distributed Interactive Simulation*

**20030002228** NASA Langley Research Center, Hampton, VA USA

#### **A Nonlinear, Human-Centered Approach to Motion Cueing with a Neurocomputing Solver**

Telban, Robert J., State Univ. of New York, USA; Cardullo, Frank M., State Univ. of New York, USA; Houck, Jacob A., NASA Langley Research Center, USA; [2002]; 10p; In English; AIAA Modeling and Simulation Technologies Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4692; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper discusses the continuation of research into the development of new motion cueing algorithms first reported in 1999. In this earlier work, two viable approaches to motion cueing were identified: the coordinated adaptive washout algorithm or 'adaptive algorithm', and the 'optimal algorithm'. In this study, a novel approach to motion cueing is discussed that would combine features of both algorithms. The new algorithm is formulated as a linear optimal control problem, incorporating improved vestibular models and an integrated visual-vestibular motion perception model previously reported. A control law is generated from the motion platform states, resulting in a set of nonlinear cueing filters. The time-varying control law requires the matrix Riccati equation to be solved in real time. Therefore, in order to meet the real time requirement, a neurocomputing approach is used to solve this computationally challenging problem. Single degree-of-freedom responses for the nonlinear algorithm were generated and compared to the adaptive and optimal algorithms. Results for the heave mode show the nonlinear algorithm

producing a motion cue with a time-varying washout, sustaining small cues for a longer duration and washing out larger cues more quickly. The addition of the optokinetic influence from the integrated perception model was shown to improve the response to a surge input, producing a specific force response with no steady-state washout. Improved cues are also observed for responses to a sway input. Yaw mode responses reveal that the nonlinear algorithm improves the motion cues by reducing the magnitude of negative cues. The effectiveness of the nonlinear algorithm as compared to the adaptive and linear optimal algorithms will be evaluated on a motion platform, the NASA Langley Research Center Visual Motion Simulator (VMS), and ultimately the Cockpit Motion Facility (CMF) with a series of pilot controlled maneuvers. A proposed experimental procedure is discussed. The results of this evaluation will be used to assess motion cueing performance.

Author

*Algorithms; Cues; Mathematical Models; Computerized Simulation; Motion Perception; Visual Perception; Evolvable Hardware; Artificial Intelligence*

**20030002260** NASA Marshall Space Flight Center, Huntsville, AL USA

**Internet Voice Distribution System (IVoDS) Utilization in Remote Payload Operations**

Best, Susan, NASA Marshall Space Flight Center, USA; Bradford, Bob, NASA Marshall Space Flight Center, USA; Chamberlain, Jim, NASA Marshall Space Flight Center, USA; Nichols, Kelvin, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; Space Ops 2002, 9-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Due to limited crew availability to support science and the large number of experiments to be operated simultaneously, telepresence is key to a successful International Space Station (ISS) science program. Crew, operations personnel at NASA centers, and researchers at universities and companies around the world must work closely together to perform scientific experiments on-board ISS. NASA has initiated use of Voice over Internet Protocol (VoIP) to supplement the existing HVoDS mission voice communications system used by researchers. The Internet Voice Distribution System (IVoDS) connects researchers to mission support "loops" or conferences via Internet Protocol networks such as the high-speed Internet 2. Researchers use IVoDS software on personal computers to talk with operations personnel at NASA centers. IVoDS also has the capability, if authorized, to allow researchers to communicate with the ISS crew during experiment operations. NODS was developed by Marshall Space Flight Center with contractors A2 Technology, Inc. FVC, Lockheed- Martin, and VoIP Group. IVoDS is currently undergoing field-testing with full deployment for up to 50 simultaneous users expected in 2002. Research is currently being performed to take full advantage of the digital world - the Personal Computer and Internet Protocol networks - to qualitatively enhance communications among ISS operations personnel. In addition to the current voice capability, video and data-sharing capabilities are being investigated. Major obstacles being addressed include network bandwidth capacity and strict security requirements. Techniques being investigated to reduce and overcome these obstacles include emerging audio-video protocols and network technology including multicast and quality-of-service.

Author

*Internets; Voice Communication; Communication Networks; Field Tests; Video Data*

**20030002267** Georgia State Univ., Atlanta, GA USA

**Representing and Reasoning With Design Records for Evolutionary Systems Final Report, Feb.-Dec. 1998**

Aug. 2002; 44p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-C-0047; Proj-5581

Report No.(s): AD-A407173; AFRL-IF-RS-TR-2002-194; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In the context of evolving missions and radical changes in the strategic and operational environments in the DoD (Department of Defense), the ability to understand the rationale behind key decisions and evaluate the repercussions of changes in underlying assumptions and requirements will be very valuable to key decision makers. In this research we propose to develop models and mechanisms necessary to provide comprehensive Design Records (DR) that help understand, evaluate and reuse critical decisions in complex problem solving situations such as the specification and development of C4I (Command, Control, Communication, Computer, and Information) systems. Based on theoretical and empirical studies, model(s) to represent critical components of the rationale behind critical decisions have been developed. Mechanisms designed to support the needs of various stakeholders involved in the decision making process are discussed. A prototype decision support system that incorporates these models and mechanisms to support the capture and use of design records is discussed with examples drawn from the context of the design of information products. Additional examples drawn from various system development scenarios are also discussed in Appendix I.

DTIC

*Software Engineering; Problem Solving; Decision Making; Decision Support Systems*

**20030002323** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Using CMMI to Improve Earned Value Management**

Solomon, Paul; Oct. 2002; 34p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407766; CMU/SEI-2002-TN-016; No Copyright; Avail: Defense Technical Information Center (DTIC)

For organizations using Earned Value Management (EVM) or that plan to implement EVM during Capability Maturity Model Integration (CMMI) implementation, this technical note provides guidance for cost-effective process improvement and appraisal. Mapping and comparison tables between CMMI and the U. S. national standard on EVM are provided. These tables can be used to identify practices within CMMI that are not included in the EVM standard but, if added to an organization's processes, will strengthen adherence to EVM principles. The tables also can be used to develop instruments that will provide evidence to an appraisal team to enable it to quickly verify and validate specific practices based upon effective implementation of EVM. Furthermore, information such as glossary components, typical work products, and examples are included in this technical note to aid those using CMMI for process improvement. For organizations using technical performance measurement, a primary base measure for earned value, additional guidance and information is provided. Finally, additional references and an EVM glossary are provided.

DTIC

*Management Information Systems; Industrial Management*

**20030002325** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Model-Based Verification: An Engineering Practice**

Gluch, David P.; Comella-Dorda, Santiago; Hudak, John; Lewis, Grace; Walker, John; Oct. 2002; 53p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407768; CMU/SEI-2002-TR-021; ESC-TR-2002-021; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Model-Based Verification (MBV) involves building and analyzing formal models of a system as an approach to identifying and guiding the correction of defects in software engineering artifacts. This report summarizes MBV and outlines the responsibilities of engineers engaged in Model-Based Verification. Each of the practices is described together with an initial set of guideline documents. These descriptions include procedural information, technical foundations for the practice, and engineering techniques for an MBV practitioner.

DTIC

*Software Engineering; Quality Control*

**20030002327** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Simplex Architecture Performance and Cost**

Gagliardi, Mike; Marz, Theodore; Altman, Neal; Walker, John; Sep. 2000; 45p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407772; CMU/SEI-2000-TR-006; ESC-TR-2000-006; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Simplex Architecture facilitates the building of dependable and upgradable realtime systems. Before using the technology, potential users want to know more about the costs of adopting the Simplex paradigm compared to the benefits of using it. This paper examines Simplex performance and the costs associated with its use.

DTIC

*Software Engineering; Optimization*

**20030002329** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Product Line State of the Practice Report**

Cohen, Sholom; Sep. 2002; 74p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407780; CMU/SEI-2002-TN-017; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Software product lines represent a new and promising approach for fielding software systems. Companies that have launched software product line efforts report significant improvements in cost savings, quality, productivity, and time to market. Technically, they report a high degree of success in developing approaches that address the software engineering and technical management of their product lines. Organizationally, these companies report success as well as challenges that they must still overcome. This technical note reports on the state of software product line practice in industry. The report uses a narrative

approach, based on a composite of individual companies' experiences in implementing software product lines. The report blends a case study with the results of a product line questionnaire that was sent to organizations with meaningful product line experiences and with the results of a product line workshop held during the recent International Conference on Software Reuse.

DTIC

*Software Engineering; Computer Programming; Engineering Management*

**20030002333** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Using the Technology Readiness Levels Scale to Support Technology Management in the DOD's ATD/STO Environments**

Graettinger, Caroline P.; Garcia, Suzanne; Sivy, Jeannine; Schenk, Robert J.; Van Syckle, Peter J.; Sep. 2002; 41p; In English  
Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407785; CMU/SEI-2002-SR-027; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In early 2002, the Communications Electronics Command (CECOM) Manager of the Army Tactical Wireless Network Assurance (TWNA) Science and Technology Objective (STO) FY03-07, hereafter referred to as STO, requested assistance from the Software Engineering Institute (SEI) in improving STO methods for assessing the maturity of new information assurance technologies. The STO was seeking to use technology maturity, as measured by the Technology Readiness Levels (TRLs) scale, as a metric in its decision-making process for selecting new technologies for STO development and maturation, technologies that would eventually be transitioned to Army tactical programs. This report describes the results of the SEI study of the feasibility of (a) using TRLs in STO technology screening, (b) developing or acquiring a TRL tool, and (c) implementing a TRL tool.

DTIC

*Standards; Technology Assessment; Communication Equipment; Computer Programming; Support Systems*

**20030002346** Single Integrated Air Picture System Engineering Task Force, Arlington, VA USA

**Single Integrated Air Picture (SIAP) Block 1 Issues**

Aug. 2002; 48p; In English

Report No.(s): AD-A407697; SIAP-TR-2002-014; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The SIAP Block 1 Issues Technical Report describes and documents the SIAP Block 1 Issue selection process and results. This Technical Report also serves as a vehicle for the solicitation of recommendations, suggestions, and insights from relevant subject matter experts, appropriate Service representatives and members of the larger Joint IADS and Missile Defense communities to improve the technical depth, credibility, and repeatability of the SIAP SE Block system engineering process.

DTIC

*Systems Engineering; Air Defense; Computer Programs*

**20030002384** Lockheed Martin Corp., Camden, NJ USA

**Multi-Agent Common Operating Environment (MACOE) Final Report, Jun. 1998-Dec. 2001**

Whitebread, Ken; Hofmann, Martin; Pridmore, Lori; Jul. 2002; 27p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-C-0162; DARPA ORDER-J377; Proj-AGEN

Report No.(s): AD-A407683; AFRL-IF-RS-TR-2002-148; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The Multi-Agent Common Operating Environment is an effort funded under the CoABS program executed by prime contractor Lockheed Martin Advanced Technology Labs (LM ATL). ATL's mission under the CoABS MACOE program is to advance the application and transition of agent based systems into the Military through the definition, test and evaluation of technology requirements, prototypes, and applications of human-agent teams and multi-agent teams.

DTIC

*Systems Engineering; Technology Utilization; Data Processing; Command and Control*

**20030002386** Northwestern Univ., Evanston, IL USA

**A MATLAB Compilation Environment for Adaptive Computing Systems Final Report, Mar. 1998-Aug. 2001**

Banerjee, Prithviraj; Jun. 2002; 20p; In English; Original contains color images

Contract(s)/Grant(s): F30602-98-2-0144; DARPA ORDER-D002; Proj-D002

Report No.(s): AD-A407681; AFRL-IF-RS-TR-2002-147; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This report provides a brief summary of the research and development of a compiler for a mix of general purpose processors and adaptive computing processors from MATLAB. It incorporates a list of publications resulting from this research.

DTIC

*Compilers; Central Processing Units; Field-Programmable Gate Arrays; Adaptive Control*

**20030002394** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Successful Product Line Development and Sustainment: A DOD Case Study**

Cohen, Sholom; Dunn, Ed; Soule, Albert; Sep. 2002; 56p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407788; CMU/SEI-2002-TN-018; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The Engineering, Test, and Evaluation Department of the Naval Undersea Warfare Center - Division Newport (NUWC) has developed a software product line asset base, named RangeWare, to support test range operations. NUWC has also fielded a product line of range systems using the asset base. RangeWare provides an object services architecture to support integration of sensor and other range data for analysis and display by range equipment. After several pilot applications of RangeWare, NUWC is now taking RangeWare into a sustainment phase, expanding the coverage of the asset base in terms of object and distribution services as well as applying the assets to new systems. This case study describes RangeWare and NUWC's product line practices to sustain and support the evolution of RangeWare. These practices include "Operations," "Data Collection," "Metrics and Tracking," "Software System Integration," "Configuration Management," "Tool Support," "Structuring the Organization," "Building a Business Case," and others. The case study also examines NUWC's lessons learned and its plans for improved process definition for RangeWare product production.

DTIC

*Systems Engineering; Resources Management; Test Ranges; Commerce*

**20030002396** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**SEI Independent Research and Development Projects**

Cross, Steve; Forrester, Eileen; Hissam, Scott; Kazman, Rick; Levine, Linda; Oct. 2002; 103p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407792; CMU/SEI-2002-TR-023; ESC-TR-2002-023; No Copyright; Avail: CASI; A06, Hardcopy; A02, Microfiche

Each year, the Software Engineering Institute (SEI) undertakes several Independent Research and Development (IR&D) projects. These projects serve to (a) support feasibility studies investigating whether further work by the SEI would be of potential benefit and (b) support further exploratory work to determine if there is sufficient value in eventually funding the feasibility study work as an SEI initiative. Projects are chosen based on their potential to mature and/or transition software engineering practices, develop information that will help in deciding whether further work is worth funding, and set new directions for SEI work. This report describes the IR&D projects that were conducted during fiscal year 2002 (October 2001 through September 2002).

DTIC

*Computer Programming; Software Engineering*

**20030002397** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Life-Cycle Models for Survivable Systems**

Linger, Richard C.; Lipson, Howard F.; McHugh, John; Mead, Nancy R.; Sledge, Carol A.; Oct. 2002; 72p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407793; CMU/SEI-2002-TR-026; ESC-TR-2002-026; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

Today's large-scale, highly distributed, networked systems improve the efficiency and effectiveness of organizations by permitting whole new levels of organizational integration. However, such integration is accompanied by elevated risks of intrusion and compromise. Incorporating survivability capabilities into an organization's systems can mitigate these risks. Current software development life-cycle models are not focused on creating survivable systems, and exhibit shortcomings when the goal is to develop systems with a high degree of assurance of survivability. If addressed at all, survivability issues are often relegated to a separate thread of project activity, with the result that survivability is treated as an add-on property. For each life-cycle activity, survivability goals should be addressed, and methods to ensure survivability incorporated. This report explains survivability concepts, describes a software development life-cycle model for survivability, and illustrates techniques that can be applied during new development activities to support survivability goals. It also describes a software life-cycle model and associated activities to support survivability goals for systems based on commercial off-the-shelf products.

DTIC

*Computer Programs; Intrusion; Computer Programming; Risk*

**20030002398** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**Software Architecture Reconstruction: Practice Needs and Current Approaches**

O'Brien, Liam; Stoermer, Christoph; Verhoef, Chris; Aug. 2002; 39p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407795; CMU/SEI-2002-TR-024; ESC/MA-TR-2002-024; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Software architectures serve as the blueprints for systems, and they are central to the development of software product lines and the design of component-based systems. In existing systems, the architecture often must be reconstructed to reflect the as-built system accurately. This report presents the concept of practice scenarios for architecture reconstruction, which outline common problem/solution pairs that can be used in the strategic application of architecture reconstruction at Department of Defense (DoD) and commercial organizations. Based on an investigation of already developed and presented reconstruction approaches, the report describes deficiencies that have been uncovered in several practice scenarios and proposes improvements.

DTIC

*Software Engineering; Defense Program; Computer Programming*

**20030002399** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**A Basis for Composition Language CL**

Ivers, James; Sinha, Nishant; Wallnau, Kurt; Sep. 2002; 65p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407797; CMU/SEI-2002-TN-026; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

CL is a composition language for predictable assembly from certifiable components. An application assembly process is predictable if the runtime behavior of an assembly of components can be predicted from known properties of components and their patterns of interaction. CL is similar to other composition languages that combine a component and connector style of description with a core compositional semantics specified in a process algebra. CL differs from these in its explicit treatment of details that are usually abstracted or ignored. For example, CL makes explicit the allocation of execution threads to component behavior; this distinguishes concurrent from sequential behavior, and leads to potentially smaller state spaces as well as more accurate behavioral descriptions. This report describes the main concepts of CL and its rudimentary graphical syntax. This report also defines and illustrates the compositional semantics for CL using Hoare's CSP. The twin objectives of this report are to consolidate our current thinking about an ideal CL and to provide a starting point for the design of a practical and implementable CL. This report closes with a discussion of several open issues that must be resolved before this second objective can be satisfied.

DTIC

*Software Engineering; Algebra; Syntax*

**20030002480** Trusted Information Systems, Inc., Los Angeles, CA USA

**Extensible Operating System Security Final Report, Aug. 1997-Sep. 2000**

Hollingworth, Dennis; Redmond, Timothy; Rice, Robert; Sep. 2002; 35p; In English; Original contains color images

Contract(s)/Grant(s): F30602-97-C-0258; AF Proj. F207

Report No.(s): AD-A408087; AFRL-IF-RS-TR-2002-230; No Copyright; Avail: Defense Technical Information Center (DTIC)

The EXOS project investigated the practical application of security to extensible operating systems. The project leaders investigated how security policies should be represented and supported in extensible systems, concluding that classical policy models are intuitive, capture widely accepted policy requirements, and provide a concrete foundation for systems evaluation efforts. The investigators introduced support for several well known, important user-level security policy models. In addition, the investigators introduced kernel-oriented security by supporting the separation of kernel code into segments and enforcing a domain/type policy on threads as they execute or otherwise access system segments. Finally, they devised a domain/type policy extensibility strategy that is conservative, preserving prior policy after allowed extensions.

DTIC

*Computer Information Security; Operating Systems (Computers)*

**20030002515** Naval Postgraduate School, Monterey, CA USA

**Enhancements and Extensions of Formal Models for Risk Assessment in Software Projects**

Murrah, Michael R.; Sep. 2002; 371p; In English; Original contains color images

Report No.(s): AD-A408068; No Copyright; Avail: CASI; A16, Hardcopy; A03, Microfiche

The Modified Risk Model is a macro model developed to aid program managers in effectively planning the required effort to deliver software products. The model projects the probability of completing a software project, subject to the available resources

supplied by management. This approach to software project risk management is unique because the model's input parameters are derived. Subjective variables are not part of the model. Different program managers would derive the same projections on the same software project. Risk management is most effective in impacting the project's success if project risks are identified and mitigated early in the software lifecycle. The Modified Risk Model was developed specifically for this purpose. Additionally, the Modified Risk Model is versatile enough to be adapted to any software development activity.

DTIC

*Software Engineering; Project Management; Analyzing; Risk*

**20030002531** Forest Service, Northeastern Research Station, South Burlington, VT USA

**Helping Resource Expertise Meet People's Needs: The NED Set of Software**

Twery, Mark J., Forest Service, USA; Conservation of Biological Diversity: A Key to the Restoration of the Chesapeake Bay Ecosystem and Beyond; [2001], pp. 42-47; In English; Also announced as 20030002529; Copyright; Avail: Issuing Activity

Helping people understand the consequences of their activities on the land is an important part of improving the decisions they make with respect to natural resources management. Although there is extensive information on the effects of various management actions on ecological systems, often it is scattered in scientific literature, single-resource oriented, and difficult to understand. Decision-support software such as NED is one approach to making this vast store of knowledge available, accessible, and useful to people who must make decisions about managing natural resources. NED is a collection of software products intended to help resource managers develop goals, assess current and future conditions, and produce sustainable management plans for forest properties. NED includes specialized programs that help landowners identify and articulate management goals, help foresters evaluate a timber inventory and project future growth, or help anyone interested to understand the relationships between wildlife species and their habitats. NED also includes an integrated program that allows evaluation of multiple management goals and identifies the trade-offs among potentially incompatible goals or activities. The programs run in the Windows(TM) operating system, are public domain, and have to date hundreds of regular users.

Author

*Computer Programs; Ecosystems; Habitats; Resources Management*

**20030002627** MRJ Technology Solutions, Inc., Moffett Field, CA USA

**On the Efficacy of Source Code Optimizations for Cache-Based Systems**

VanderWijngaart, Rob F., MRJ Technology Solutions, Inc., USA; Saphir, William C., California Univ., Lawrence Berkeley National Lab., USA; [1998]; 24p; In English

Contract(s)/Grant(s): NAS2-14303; RTOP 519-40-12; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Obtaining high performance without machine-specific tuning is an important goal of scientific application programmers. Since most scientific processing is done on commodity microprocessors with hierarchical memory systems, this goal of "portable performance" can be achieved if a common set of optimization principles is effective for all such systems. It is widely believed, or at least hoped, that portable performance can be realized. The rule of thumb for optimization on hierarchical memory systems is to maximize temporal and spatial locality of memory references by reusing data and minimizing memory access stride. We investigate the effects of a number of optimizations on the performance of three related kernels taken from a computational fluid dynamics application. Timing the kernels on a range of processors, we observe an inconsistent and often counterintuitive impact of the optimizations on performance. In particular, code variations that have a positive impact on one architecture can have a negative impact on another, and variations expected to be unimportant can produce large effects. Moreover, we find that cache miss rates-as reported by a cache simulation tool, and confirmed by hardware counters-only partially explain the results. By contrast, the compiler-generated assembly code provides more insight by revealing the importance of processor-specific instructions and of compiler maturity, both of which strongly, and sometimes unexpectedly, influence performance. We conclude that it is difficult to obtain performance portability on modern cache-based computers, and comment on the implications of this result.

Author

*Computational Fluid Dynamics; Computer Programs; Memory (Computers); Microprocessors; Optimization; Data Storage; Compilers*

**20030002642** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

**An Application of an Iterative Approach to DOD Software Migration Planning *Final Report***

Bergey, John; O'Brien, Liam; Smith, Dennis; Sep. 2002; 25p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407970; CMU/SEI-2002-TN-027; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In recent years, system modernization has received much attention within the Department of Defense (DoD). Typically, that attention has focused on the technical and acquisition issues associated with the new system. Less attention has been paid to the equally important issue of planning the migration from the old system to the new system. This technical note reports on the early results of an approach that is currently being piloted to support software migration planning. This approach focuses on deriving actionable mini-plans for focus areas that are identified in an initial increment of an overall migration plan.

DTIC

*Computer Programs; Software Engineering; Iteration*

**20030002763** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

**Ontological Engineering and Mapping in Multiagent Systems Development**

DiLeo, Jonathan M.; Mar. 2002; 142p; In English; Original contains color images

Report No.(s): AD-A408048; AFIT/GCS/ENG/02M-03; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Multiagent systems have received much attention in recent years due to their advantages in complex, distributed environments. Previous work at the Air Force Institute of Technology has developed a methodology for analyzing, designing, and developing multiagent systems, called Multiagent Systems Engineering (MaSE). MaSE currently does not address the information domain of the system, which is an integral part of designing proper system execution. This research extends the MaSE methodology to include the use of ontologies for information domain specification. The extensions allow the designer to specify information flow by using objects from the ontology as parameters in agent conversations. The developer can then ensure system functionality by verifying that each agent has the information required to accomplish the system goals. To fully describe the system design, the developer must describe the relationships between the system ontology and any agent component ontologies. This research also developed a ranking model to assist the user with creating such mappings, to show the relationships between the objects in the ontologies.

DTIC

*Systems Engineering; Computer Programming; Semantics*

**20030002768** NASA Ames Research Center, Moffett Field, CA USA

**Designing Adaptive Low Dissipative High Order Schemes**

Yee, H. C., NASA Ames Research Center, USA; Sjoegreen, B., Royal Inst. of Tech., Sweden; [2002]; 4p; In English; Second International Conference on Computational Fluid Dynamics, 15-19 Jul. 2002, Sydney, Australia; Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Proper control of the numerical dissipation/filter to accurately resolve all relevant multiscales of complex flow problems while still maintaining nonlinear stability and efficiency for long-time numerical integrations poses a great challenge to the design of numerical methods. The required type and amount of numerical dissipation/filter are not only physical problem dependent, but also vary from one flow region to another. This is particularly true for unsteady high-speed shock/shear/boundary-layer/turbulence/acoustics interactions and/or combustion problems since the dynamics of the nonlinear effect of these flows are not well-understood. Even with extensive grid refinement, it is of paramount importance to have proper control on the type and amount of numerical dissipation/filter in regions where it is needed.

Author

*Numerical Analysis; Dissipation; Shock Layers; Shear Layers; High Speed*

**20030002784** NASA Ames Research Center, Moffett Field, CA USA

**Reducing False Positives in Runtime Analysis of Deadlocks**

Bensalem, Saddek, Verimag, France; Havelund, Klaus, NASA Ames Research Center, USA; [2002]; 20p; In English; TACAS 2003 Conference, Unknown

Contract(s)/Grant(s): NAS2-00065; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper presents an improvement of a standard algorithm for detecting dead-lock potentials in multi-threaded programs, in that it reduces the number of false positives. The standard algorithm works as follows. The multi-threaded program under observation is executed, while lock and unlock events are observed. A graph of locks is built, with edges between locks symbolizing locking orders. Any cycle in the graph signifies a potential for a deadlock. The typical standard example is the group of dining philosophers sharing forks. The algorithm is interesting because it can catch deadlock potentials even though no deadlocks occur in the examined trace, and at the same time it scales very well in contrast to more formal approaches to deadlock detection. The algorithm, however, can yield false positives (as well as false negatives). The extension of the algorithm described in this paper reduces the amount of false positives for three particular cases: when a gate lock protects a cycle, when a single thread

introduces a cycle, and when the code segments in different threads that cause the cycle can actually not execute in parallel. The paper formalizes a theory for dynamic deadlock detection and compares it to model checking and static analysis techniques. It furthermore describes an implementation for analyzing Java programs and its application to two case studies: a planetary rover and a space craft altitude control system.

Author

*Algorithms; Computer Programs; Dining Philosophers Problem; Detection*

**20030002816** NASA Ames Research Center, Moffett Field, CA USA

**An Overview of the Runtime Verification Tool Java PathExplorer**

Havelund, Klaus, NASA Ames Research Center, USA; Rosu, Grigore, Illinois Univ. at Urbana-Champaign, USA; [2002]; 26p; In English  
Contract(s)/Grant(s): NAS2-00065; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

We present an overview of the Java PathExplorer runtime verification tool, in short referred to as JPAX. JPAX can monitor the execution of a Java program and check that it conforms with a set of user provided properties formulated in temporal logic. JPAX can in addition analyze the program for concurrency errors such as deadlocks and data races. The concurrency analysis requires no user provided specification. The tool facilitates automated instrumentation of a program's bytecode, which when executed will emit an event stream, the execution trace, to an observer. The observer dispatches the incoming event stream to a set of observer processes, each performing a specialized analysis, such as the temporal logic verification, the deadlock analysis and the data race analysis. Temporal logic specifications can be formulated by the user in the Maude rewriting logic, where Maude is a high-speed rewriting system for equational logic, but here extended with executable temporal logic. The Maude rewriting engine is then activated as an event driven monitoring process. Alternatively, temporal specifications can be translated into efficient automata, which check the event stream. JPAX can be used during program testing to gain increased information about program executions, and can potentially furthermore be applied during operation to survey safety critical systems.

Author

*Computer Programs; Errors; Java (Programming Language)*

**20030003694** NASA Langley Research Center, Hampton, VA USA

**Field-Programmable Gate Array Computer in Structural Analysis: An Initial Exploration**

Singleterry, Robert C., Jr., NASA Langley Research Center, USA; Sobieszczanski-Sobieski, Jaroslaw, NASA Langley Research Center, USA; Brown, Samuel, Star Bridge Systems, Inc., USA; [2002]; 11p; In English; 43rd AIAA/AMSE/ASCE/AHS Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-1761; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

This paper reports on an initial assessment of using a Field-Programmable Gate Array (FPGA) computational device as a new tool for solving structural mechanics problems. A FPGA is an assemblage of binary gates arranged in logical blocks that are interconnected via software in a manner dependent on the algorithm being implemented and can be reprogrammed thousands of times per second. In effect, this creates a computer specialized for the problem that automatically exploits all the potential for parallel computing intrinsic in an algorithm. This inherent parallelism is the most important feature of the FPGA computational environment. It is therefore important that if a problem offers a choice of different solution algorithms, an algorithm of a higher degree of inherent parallelism should be selected. It is found that in structural analysis, an 'analog computer' style of programming, which solves problems by direct simulation of the terms in the governing differential equations, yields a more favorable solution algorithm than current solution methods. This style of programming is facilitated by a 'drag-and-drop' graphic programming language that is supplied with the particular type of FPGA computer reported in this paper. Simple examples in structural dynamics and statics illustrate the solution approach used. The FPGA system also allows linear scalability in computing capability. As the problem grows, the number of FPGA chips can be increased with no loss of computing efficiency due to data flow or algorithmic latency that occurs when a single problem is distributed among many conventional processors that operate in parallel. This initial assessment finds the FPGA hardware and software to be in their infancy in regard to the user conveniences; however, they have enormous potential for shrinking the elapsed time of structural analysis solutions if programmed with algorithms that exhibit inherent parallelism and linear scalability. This potential warrants further development of FPGA-tailored algorithms for structural analysis.

Author

*Field-Programmable Gate Arrays; Evolvable Hardware; Structural Analysis; Algorithms; Parallel Processing (Computers); Nonlinearity; Computer Networks*

**20030003699** NASA Ames Research Center, Moffett Field, CA USA

**The Computing and Data Grid Approach: Infrastructure for Distributed Science Applications**

Johnston, William E., NASA Ames Research Center, USA; Sep. 25, 2002; 19p; In English

Contract(s)/Grant(s): NAS2-14303; DE-AC03-76SF-00098; RTOP 704-40-00; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

With the advent of Grids - infrastructure for using and managing widely distributed computing and data resources in the science environment - there is now an opportunity to provide a standard, large-scale, computing, data, instrument, and collaboration environment for science that spans many different projects and provides the required infrastructure and services in a relatively uniform and supportable way. Grid technology has evolved over the past several years to provide the services and infrastructure needed for building 'virtual' systems and organizations. We argue that Grid technology provides an excellent basis for the creation of the integrated environments that can combine the resources needed to support the large-scale science projects located at multiple laboratories and universities. We present some science case studies that indicate that a paradigm shift in the process of science will come about as a result of Grids providing transparent and secure access to advanced and integrated information and technologies infrastructure: powerful computing systems, large-scale data archives, scientific instruments, and collaboration tools. These changes will be in the form of services that can be integrated with the user's work environment, and that enable uniform and highly capable access to these computers, data, and instruments, regardless of the location or exact nature of these resources. These services will integrate transient-use resources like computing systems, scientific instruments, and data caches (e.g., as they are needed to perform a simulation or analyze data from a single experiment); persistent-use resources. such as databases, data catalogues, and archives, and; collaborators, whose involvement will continue for the lifetime of a project or longer. While we largely address large-scale science in this paper, Grids, particularly when combined with Web Services, will address a broad spectrum of science scenarios. both large and small scale.

Author

*Computation; Wide Area Networks; Architecture (Computers)*

**20030003717** NASA Ames Research Center, Moffett Field, CA USA

**Performance and Scalability of the NAS Parallel Benchmarks in Java**

Frumkin, Michael A., NASA Ames Research Center, USA; Schultz, Matthew, NASA Ames Research Center, USA; Jin, Haoqiang, NASA Ames Research Center, USA; Yan, Jerry, NASA Ames Research Center, USA; Oct. 11, 2002; 7p; In English; International Workshop on Java for Parallel and Distributed Programming, 22-26 Apr. 2003, Nice, Nice, France, France; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Several features make Java an attractive choice for scientific applications. In order to gauge the applicability of Java to Computational Fluid Dynamics (CFD), we have implemented the NAS (NASA Advanced Supercomputing) Parallel Benchmarks in Java. The performance and scalability of the benchmarks point out the areas where improvement in Java compiler technology and in Java thread implementation would position Java closer to FORTRAN in the competition for scientific applications.

Author

*Java (Programming Language); Computational Fluid Dynamics; Performance; Parallel Processing (Computers)*

**20030003734** NASA Ames Research Center, Moffett Field, CA USA

**Program Model Checking as a New Trend**

Havelund, Klaus, Kestrel Technology, LLC, USA; Visser, Willem, Research Inst. for Advanced Computer Science, USA; [2002]; 14p; In English

Contract(s)/Grant(s): NAS2-00065; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper introduces a special section of STTT (International Journal on Software Tools for Technology Transfer) containing a selection of papers that were presented at the 7th International SPIN workshop, Stanford, August 30 - September 1, 2000. The workshop was named SPIN Model Checking and Software Verification, with an emphasis on model checking of programs. The paper outlines the motivation for stressing software verification, rather than only design and model verification, by presenting the work done in the Automated Software Engineering group at NASA Ames Research Center within the last 5 years. This includes work in software model checking, testing like technologies and static analysis.

Author

*Program Verification (Computers); Computer Programs*

**20030003767** Argonne National Lab., IL USA

**Flexible Object-Oriented Software Framework for Developing Complex Multimedia Simulations**

Sydelko, P. J.; Dolph, J. E.; Christiansen, J. H.; 2002; In English; This document is color dependent and/or in landscape layout.

It is currently only available on CD-ROM

Report No.(s): DE2002-801609; No Copyright; Avail: National Technical Information Service (NTIS)

Decision makers involved in brownfields redevelopment and long-term stewardship must consider environmental conditions, future-use potential, site ownership, area infrastructure, funding resources, cost recovery, regulations, risk and liability management, community relations, and expected return on investment in a comprehensive and integrated fashion to achieve desired results. Successful brownfields redevelopment requires the ability to assess the impacts of redevelopment options on multiple interrelated aspects of the ecosystem, both natural and societal. Computer-based tools, such as simulation models, databases, and geographical information systems (GISs) can be used to address brownfields planning and project execution. The transparent integration of these tools into a comprehensive and dynamic decision support system would greatly enhance the brownfields assessment process. Such a system needs to be able to adapt to shifting and expanding analytical requirements and contexts. The Dynamic Information Architecture System (DIAS) is a flexible, extensible, object-oriented framework for developing and maintaining complex multidisciplinary simulations of a wide variety of application domains.

NTIS

*Software Engineering; Object-Oriented Programming; Computer Techniques; Decision Support Systems; Information Systems*

**20030003768** President's Information Technology Advisory Committee, Washington, DC USA

**Developing Open Source Software to Advanced High End Computing: Report to the President**

Oct. 2000; 32p; In English

Report No.(s): PB2003-101776; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The President's Information Technology Advisory Committee (PITAC) is very pleased to submit the second report in the series of follow-ups to our February 1999 report to the President, Information Technology Research: Investing in Our Future. Open Source Software for High End Computing highlights our recommendations for a research strategy that uses open source software development as the new model for answering America's high end computing software needs.

NTIS

*Supercomputers; Software Engineering*

**20030004234** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**XML Based Scientific Data Management Facility Final Report**

Mehrotra, P., NASA Ames Research Center, USA; Zubair, M., Institute for Computer Applications in Science and Engineering, USA; November 2002; 14p; In English; WebNet 2001, 2001, Orlando, FL, USA

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211968; NAS 1.26:211968; ICASE-2002-45; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The World Wide Web consortium has developed an Extensible Markup Language (XML) to support the building of better information management infrastructures. The scientific computing community realizing the benefits of XML has designed markup languages for scientific data. In this paper, we propose a XML based scientific data management facility, XDMF. The project is motivated by the fact that even though a lot of scientific data is being generated, it is not being shared because of lack of standards and infrastructure support for discovering and transforming the data. The proposed data management facility can be used to discover the scientific data itself, the transformation functions, and also for applying the required transformations. We have built a prototype system of the proposed data management facility that can work on different platforms. We have implemented the system using Java, and Apache XSLT engine Xalan. To support remote data and transformation functions, we had to extend the XSLT specification and the Xalan package.

Author

*Data Management; Information Management; World Wide Web*

**20030004256** NASA Ames Research Center, Moffett Field, CA USA

**Combining Static Analysis and Model Checking for Software Analysis**

Brat, Guillaume, NASA Ames Research Center, USA; Visser, Willem, NASA Ames Research Center, USA; [2003]; 8p; In English; Automated Software Engineering 2001, San Diego, CA, USA; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

We present an iterative technique in which model checking and static analysis are combined to verify large software systems. The role of the static analysis is to compute partial order information which the model checker uses to reduce the state space. During exploration, the model checker also computes aliasing information that it gives to the static analyzer which can then refine its analysis. The result of this refined analysis is then fed back to the model checker which updates its partial order reduction. At

each step of this iterative process, the static analysis computes optimistic information which results in an unsafe reduction of the state space. However we show that the process converges to a fixed point at which time the partial order information is safe and the whole state space is explored.

Author

*Computer Programs; Software Engineering; Static Models*

## 62

### COMPUTER SYSTEMS

*Includes computer networks and distributed processing systems. For information systems see 82 Documentation and Information Science. For computer systems applied to specific applications, see the associated category.*

**20030002249** Air Force Inst. of Tech., School of Engineering and Management, Wright-Patterson AFB, OH USA

#### **Using an Inductive Learning Algorithm to Improve Antibody Generation in a Single Packet Computer Defense Immune System**

Aycock, Russell J.; Mar. 2002; 72p; In English

Report No.(s): AD-A407723; AFIT/GIR/ENG/02M-01; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The USA Air Force relies heavily on computer networks for many day-to-day activities. Many of these networks are affected by various types of attacks that can be launched from anywhere on the globe. The rising prominence of organizations such as the AFCERT and the MAJCOM NOSCs is evidence of an increasing realization among the Air Force leadership that protecting our computer networks is vitally important. A critical requirement for protecting our networks is the ability to detect attacks and intrusion attempts. This research is an effort to refine a portion of an AFIT-developed intrusion detection system known as the Computer Defense Immune System (CDIS). CDIS is based on the human immune system and uses antibodies to attempt to detect network intrusion attempts. The antibodies have various attributes of which a subset is randomly activated at generation time. This research attempts to determine which of the antibody attributes are most useful in helping to build successful antibodies.

DTIC

*Algorithms; Computer Networks; Computer Information Security; Intrusion*

**20030002332** Carnegie-Mellon Univ., Software Engineering Inst., Pittsburgh, PA USA

#### **Trustworthy Refinement Through Intrusion-Aware Design**

Ellison, Robert J.; Moore, Andrew P.; Oct. 2002; 62p; In English

Contract(s)/Grant(s): F19628-00-C-0003

Report No.(s): AD-A407784; CMU/SEI-2002-TR-036; ESC-TR-2002-036; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

High confidence in a system's survivability requires an accurate understanding of the system's threat environment and the impact of that environment on system operations. Unfortunately, existing development methods for secure and survivable information systems often have a patchwork approach in which the focus is on deciding which popular security components to integrate rather than making a rational assessment of how to address the attacks that are likely to compromise the overall mission. This report proposes an intrusion-aware design model called trustworthy refinement through intrusion-aware design (TRIAD). TRIAD enables information system engineers to use known and hypothesized attack patterns to iteratively improve and continually maintain system survivability, even as the system and threat environment evolve over time.

DTIC

*Intrusion; Iteration; Security*

**20030002481** Integrated Sensors, Inc., Utica, NY USA

#### **High Performance Real-Time Fusion Architecture *Final Report, Jul. 2000-Sep. 2001***

Fountain, Garry; Sep. 2002; 68p; In English; Original contains color images

Contract(s)/Grant(s): F30602-00-C-0111; AF Proj. 407T

Report No.(s): AD-A408086; AFRL-IF-RS-TR-2002-234; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The objective of this effort was to define, prototype and demonstrate an affordable next-generation JDL Level 2 fusion and exploitation architecture called the High Performance Real-Time Fusion Architecture (HPRTF). It was the goal of HPRTF to produce the following: Identification of processing bottlenecks that limit current Level 2 fusion systems from performing in real-time. Development of a hardware requirements trade space for real-time execution and identification of affordable solutions, Definition of an affordable, scalable, next generation fusion architecture, which will support real-time execution of Level 2 fusion

systems. Development and demonstration of critical portions of a next generation Level 2 fusion architecture prototype system that demonstrates the capability of real-time execution.

DTIC

*Real Time Operation; Multisensor Fusion; Architecture (Computers)*

**20030002759** Battelle Memorial Inst., Columbus, OH USA

**SR 395 Spokane FY99 Earmark Evaluation. Final Phase II Report**

Sep. 20, 2001; 68p; In English

Report No.(s): PB2003-100294; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The availability of traveler information regarding accidents, construction activities, road-weather conditions, and flooding events is limited in this study region. The concept underlying this evaluation is that with better road condition information, commercial and individual travelers will be able to make better decisions regarding their trip timing, route selection, and preparedness leading to a more efficient and safer transportation system.

NTIS

*Transportation; Information Systems*

**20030002771** NASA Ames Research Center, Moffett Field, CA USA

**Message Passing and Shared Address Space Parallelism on an SMP Cluster**

Shan, Hongzhang, California Univ., Lawrence Berkeley National Lab., USA; Singh, Jaswinder P., Princeton Univ., USA; Olikier, Leonid, California Univ., Lawrence Berkeley National Lab., USA; Biswas, Rupak, NASA Ames Research Center, USA; Oct. 01, 2002; 22p; In English

Contract(s)/Grant(s): DE-AC03-76SF-000098; NSF ESS-98-06751; RTOP 704-40-24; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Currently, message passing (MP) and shared address space (SAS) are the two leading parallel programming paradigms. MP has been standardized with MPI, and is the more common and mature approach; however, code development can be extremely difficult, especially for irregularly structured computations. SAS offers substantial ease of programming, but may suffer from performance limitations due to poor spatial locality and high protocol overhead. In this paper, we compare the performance of and the programming effort required for six applications under both programming models on a 32-processor PC-SMP cluster, a platform that is becoming increasingly attractive for high-end scientific computing. Our application suite consists of codes that typically do not exhibit scalable performance under shared-memory programming due to their high communication-to-computation ratios and/or complex communication patterns. Results indicate that SAS can achieve about half the parallel efficiency of MPI for most of our applications, while being competitive for the others. A hybrid MPI+SAS strategy shows only a small performance advantage over pure MPI in some cases. Finally, improved implementations of two MPI collective operations on PC-SMP clusters are presented.

Author

*Parallel Programming; Computation; Messages*

**20030002789** NASA Ames Research Center, Moffett Field, CA USA

**Performance Analysis of Multilevel Parallel Applications on Shared Memory Architectures**

Jost, Gabriele, NASA Ames Research Center, USA; Jin, Haoqiang, NASA Ames Research Center, USA; Labarta, Jesus, Technical Univ., Spain; Gimenez, Judit, Technical Univ., Spain; Caubet, Jordi, Technical Univ., Spain; Apr. 27, 2002; 16p; In English; International Parallel and Distributed Processing Symposium (IPDPS), Apr. 2003, Nice, France

Contract(s)/Grant(s): NAS2-14303; NASA Order A-61812-D; DTTS59-99-D-00437; TIC2001-0995-C02-01; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

In this paper we describe how to apply powerful performance analysis techniques to understand the behavior of multilevel parallel applications. We use the Paraver/OMPItrace performance analysis system for our study. This system consists of two major components: The OMPItrace dynamic instrumentation mechanism, which allows the tracing of processes and threads and the Paraver graphical user interface for inspection and analyses of the generated traces. We describe how to use the system to conduct a detailed comparative study of a benchmark code implemented in five different programming paradigms applicable for shared memory

Author

*Architecture (Computers); Memory (Computers); Reliability Analysis*

**20030002820** NASA Ames Research Center, Moffett Field, CA USA

**Supercomputing 2002: NAS Demo Abstracts**

Oct. 29, 2002; 5p; In English; NAS Demo Abstracts for Supercomputing 2002, 16-22 Nov. 2002, Baltimore, MD, USA  
Contract(s)/Grant(s): RTOP 725-10-31; RTOP 725-10-11; RTOP 704-40-42; RTOP 704-40-52; Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The hyperwall is a new concept in visual supercomputing, conceived and developed by the NAS Exploratory Computing Group. The hyperwall will allow simultaneous and coordinated visualization and interaction of an array of processes, such as the computations of a parameter study or the parallel evolutions of a genetic algorithm population. Making over 65 million pixels available to the user, the hyperwall will enable and elicit qualitatively new ways of leveraging computers to accomplish science. It is currently still unclear whether we will be able to transport the hyperwall to SC02. The crucial display frame still has not been completed by the metal fabrication shop, although they promised an August delivery. Also, we are still working the fragile node issue, which may require transplantation of the compute nodes from the present 2U cases into 3U cases. This modification will increase the present 3-rack configuration to 5 racks.

Derived from text

*Supercomputers; Display Devices; Pixels*

**20030004005** National Inst. of Standards and Technology, Gaithersburg, MD USA

**Computer Security: Federal S/MIME V3 Client Profile**

Chernick, C. M.; Nov. 2002; 34p; In English

Report No.(s): PB2002-107931; NIST/SP-800-49; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

S/MIME (Secure/Multipurpose Internet Mail Extensions) is a set of specifications for securing electronic mail. S/MIME is based upon the widely used MIME standard (MIME) and describes a protocol for adding cryptographic security services through MIME encapsulation of digitally signed and encrypted objects. The basic security services offered by S/MIME are authentication, non-repudiation of origin, message integrity, and message privacy. Optional security services include signed receipts, security labels, secure mailing lists, and an extended method of identifying the signers certificate(s).

NTIS

*Electronic Mail; Computer Information Security*

**63**

**CYBERNETICS, ARTIFICIAL INTELLIGENCE AND ROBOTICS**

*Includes feedback and control theory, information theory, machine learning, and expert systems. For related information see also 54 Man/System Technology and Life Support.*

**20030002264** NASA Langley Research Center, Hampton, VA USA

**LPV Controller Interpolation for Improved Gain-Scheduling Control Performance**

Wu, Fen, North Carolina State Univ., USA; Kim, SungWan, NASA Langley Research Center, USA; [2002]; 10p; In English; AIAA Guidance, Navigation and Control Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4759; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

In this paper, a new gain-scheduling control design approach is proposed by combining LPV (linear parameter-varying) control theory with interpolation techniques. The improvement of gain-scheduled controllers can be achieved from local synthesis of Lyapunov functions and continuous construction of a global Lyapunov function by interpolation. It has been shown that this combined LPV control design scheme is capable of improving closed-loop performance derived from local performance improvement. The gain of the LPV controller will also change continuously across parameter space. The advantages of the newly proposed LPV control is demonstrated through a detailed AMB controller design example.

Author

*Control Theory; Controllers; Feedback Control; Control Systems Design; Linear Parameter-Varying Control; Interpolation; Scheduling*

## NUMERICAL ANALYSIS

*Includes iteration, differential and difference equations, and numerical approximation.*

**20030002215** Ohio Univ., Dept. of Aerospace Engineering and Engineering Mechanics, USA

### **On-Board Generation of Three-Dimensional Constrained Entry Trajectories**

Shen, Zuojun, Iowa State Univ. of Science and Technology, USA; Lu, Ping, Ohio Univ., USA; Jan. 09, 2002; 10p; In English; 2002 AIAA GN&C Conference, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): NAS8-01105; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

A methodology for very fast design of 3DOF entry trajectories subject to all common inequality and equality constraints is developed. The approach make novel use of the well known quasi-equilibrium glide phenomenon in lifting entry as a center piece for conveniently enforcing the inequality constraints which are otherwise difficulty to handle. The algorithm is able to generate a complete feasible 3DOF entry trajectory, given the entry conditions, values of constraint parameters, and final conditions in about 2 seconds on a PC. Numerical simulations with the X-33 vehicle model for various entry missions to land at Kennedy Space Center will be presented.

Author

*Trajectories; Algorithms; Three Dimensional Models; Atmospheric Entry*

**20030002229** NASA Langley Research Center, Hampton, VA USA

### **Adjoint-Based, Three-Dimensional Error Prediction and Grid Adaptation**

Park, Michael A., NASA Langley Research Center, USA; [2002]; 12p; In English; 32nd Fluid Dynamics Conference, 24-27 Jun. 2002, Saint Louis, MO, USA

Report No.(s): AIAA Paper 2002-3286; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Engineering computational fluid dynamics (CFD) analysis and design applications focus on output functions (e.g., lift, drag). Errors in these output functions are generally unknown and conservatively accurate solutions may be computed. Computable error estimates can offer the possibility to minimize computational work for a prescribed error tolerance. Such an estimate can be computed by solving the flow equations and the linear adjoint problem for the functional of interest. The computational mesh can be modified to minimize the uncertainty of a computed error estimate. This robust mesh-adaptation procedure automatically terminates when the simulation is within a user specified error tolerance. This procedure for estimating and adapting to error in a functional is demonstrated for three-dimensional Euler problems. An adaptive mesh procedure that links to a Computer Aided Design (CAD) surface representation is demonstrated for wing, wing-body, and extruded high lift airfoil configurations. The error estimation and adaptation procedure yielded corrected functions that are as accurate as functions calculated on uniformly refined grids with ten times as many grid points.

Author

*Computational Fluid Dynamics; Computer Aided Design; Computational Grids*

**20030002261** NASA Ames Research Center, Moffett Field, CA USA

### **Implementing Production Grids**

Johnston, William E., NASA Ames Research Center, USA; [2002]; 53p; In English

Contract(s)/Grant(s): DE-AC03-76SF-00098; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

We have presented the essence of experience gained in building two production Grids, and provided some of the global context for this work. As the reader might imagine, there were a lot of false starts, refinements to the approaches and to the software, and several substantial integration projects (SRB and Condor integrated with Globus) to get where we are today. However, the point of this paper is to try and make it substantially easier for others to get to the point where Information Power Grids (IPG) and the DOE Science Grids are today. This is what is needed in order to move us toward the vision of a common cyber infrastructure for science. The author would also like to remind the readers that this paper primarily represents the actual experiences that resulted from specific architectural and software choices during the design and implementation of these two Grids. The choices made were dictated by the criteria laid out in section 1. There is a lot more Grid software available today that there was four years ago, and various of these packages are being integrated into IPG and the DOE Grids. However, the foundation choices of Globus, SRB, and Condor would not be significantly different today than they were four years ago. Nonetheless, if the GGF is successful in its work - and we have every reason to believe that it will be - then in a few years we will see that the 28 functions provided by these packages will be defined in terms of protocols and MIS, and there will be several robust

implementations available for each of the basic components, especially the Grid Common Services. The impact of the emerging Web Grid Services work is not yet clear. It will likely have a substantial impact on building higher level services, however it is the opinion of the author that this will in no way obviate the need for the Grid Common Services. These are the foundation of Grids, and the focus of almost all of the operational and persistent infrastructure aspects of Grids.

Derived from text

*Computational Grids; Information Systems; Data Management; Grid Generation (Mathematics); Distributed Processing*

**20030002281** NASA Marshall Space Flight Center, Huntsville, AL USA

**An Analysis for an Internet Grid to Support Space Based Operations**

Bradford, Robert, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; SpaceOPS 2002, 9-12 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Currently, and in the past, dedicated communication circuits and "network services" with very stringent performance requirements have been used to support manned and unmanned mission critical ground operations at GSFC, JSC, MSFC, KSC and other NASA facilities. Because of the evolution of network technology, it is time to investigate other approaches to providing mission services for space ground and flight operations. In various scientific disciplines, effort is under way to develop network/computing grids. These grids consisting of networks and computing equipment are enabling lower cost science. Specifically, earthquake research is headed in this direction. With a standard for network and computing interfaces using a grid, a researcher would not be required to develop and engineer NASA/DoD specific interfaces with the attendant increased cost. Use of the Internet Protocol (IP), CCSDS packet spec, and reed-solomon for satellite error correction etc. can be adopted/standardized to provide these interfaces. Generally most interfaces are developed at least to some degree end to end. This study would investigate the feasibility of using existing standards and protocols necessary to implement a SpaceOps Grid. New interface definitions or adoption/modification of existing ones for the various space operational services is required for voice both space based and ground, video, telemetry, commanding and planning may play a role to some undefined level. Security will be a separate focus in the study since security is such a large issue in using public networks. This SpaceOps Grid would be transparent to users. It would be analogous to the Ethernet protocol's ease of use in that a researcher would plug in their experiment or instrument at one end and would be connected to the appropriate host or server without further intervention. Free flyers would be in this category as well. They would be launched and would transmit without any further intervention with the researcher or ground ops personnel. The payback in developing these new approaches in support of manned and unmanned operations is lower cost and will enable direct participation by more people in organizations and educational institutions in space based science. by lowering the high cost of space based operations and networking, more resource will be available to the science community for science. With a specific grid in place, experiment development and operations would be much less costly by using standardized network interfaces. Because of the extensive connectivity on a global basis, significant numbers of people would participate in science who otherwise would not be able to participate.

Author

*Internets; Earthquakes; Error Analysis; Computational Grids*

**20030002671** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Optimization of Systems with Uncertainty: Initial Developments for Performance, Robustness and Reliability Based Designs Final Report**

Crespo, Luis G., Institute for Computer Applications in Science and Engineering, USA; November 2002; 28p; In English

Contract(s)/Grant(s): NAS1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211952; NAS 1.26:211952; ICASE-2002-40; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This paper presents a study on the optimization of systems with structured uncertainties, whose inputs and outputs can be exhaustively described in the probabilistic sense. by propagating the uncertainty from the input to the output in the space of the probability density functions and the moments, optimization problems that pursue performance, robustness and reliability based designs are studied. By specifying the desired outputs in terms of desired probability density functions and then in terms of meaningful probabilistic indices, we settle a computationally viable framework for solving practical optimization problems. Applications to static optimization and stability control are used to illustrate the relevance of incorporating uncertainty in the early stages of the design. Several examples that admit a full probabilistic description of the output in terms of the design variables and the uncertain inputs are used to elucidate the main features of the generic problem and its solution. Extensions to problems that do not admit closed form solutions are also evaluated. Concrete evidence of the importance of using a consistent probabilistic formulation of the optimization problem and a meaningful probabilistic description of its solution is provided in the examples.

In the stability control problem the analysis shows that standard deterministic approaches lead to designs with high probability of running into instability. The implementation of such designs can indeed have catastrophic consequences.

Author

*Optimization; Probability Theory; Uncertain Systems*

**20030002674** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Local Discontinuous Galerkin Methods for Partial Differential Equations with Higher Order Derivatives** *Final Report*

Yan, Jue, Brown Univ., USA; Shu, Chi-Wang, Institute for Computer Applications in Science and Engineering, USA; November 2002; 24p; In English

Contract(s)/Grant(s): NAS1-97046; DAAD19-00-1-0405; F49620-99-1-0077; NSF DMS-98-04985; NSF ECS-99-06606; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211959; NAS 1.26:211959; ICASE-2002-42; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

In this paper we review the existing and develop new continuous Galerkin methods for solving time dependent partial differential equations with higher order derivatives in one and multiple space dimensions. We review local discontinuous Galerkin methods for convection diffusion equations involving second derivatives and for KdV type equations involving third derivatives. We then develop new local discontinuous Galerkin methods for the time dependent bi-harmonic type equations involving fourth derivatives, and partial differential equations involving fifth derivatives. For these new methods we present correct interface numerical fluxes and prove  $L(\exp 2)$  stability for general nonlinear problems. Preliminary numerical examples are shown to illustrate these methods. Finally, we present new results on a post-processing technique, originally designed for methods with good negative-order error estimates, on the local discontinuous Galerkin methods applied to equations with higher derivatives. Numerical experiments show that this technique works as well for the new higher derivative cases, in effectively doubling the rate of convergence with negligible additional computational cost, for linear as well as some nonlinear problems, with a local uniform mesh.

Author

*Galerkin Method; Partial Differential Equations; Time Dependence; Convection-Diffusion Equation; Korteweg-Devries Equation*

**20030002751** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Finite Element Analysis of Wrinkled Membrane Structures for Sunshield Applications**

Johnston, John D., NASA Goddard Space Flight Center, USA; [2002]; 12p; In English; 43rd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, 22-25 Apr. 2002, Denver, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1456; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The deployable sunshield is an example of a gossamer structure envisioned for use on future space telescopes. The basic structure consists of multiple layers of pretensioned, thin-film membranes supported by deployable booms. The prediction and verification of sunshield dynamics has been identified as an area in need of technology development due to the difficulties inherent in predicting nonlinear structural behavior of the membranes and because of the challenges involved. In ground testing of the full-scale structure. This paper describes a finite element analysis of a subscale sunshield that has been subjected to ground testing in support of the Next Generation Space Telescope (NGST) program. The analysis utilizes a nonlinear material model that accounts for wrinkling of the membranes. Results are presented from a nonlinear static preloading analysis and subsequent dynamics analyses to illustrate baseline sunshield structural characteristics. Studies are then described which provide further insight into the effect of membrane pre-load on sunshield dynamics and the performance of different membrane modeling techniques. Lastly, a comparison of analytical predictions and ground test results is presented.

Author

*Finite Element Method; Membrane Structures; Structural Analysis; Prediction Analysis Techniques; Scale Models; Sun*

**20030004236** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**A Dissimilarity Measure for Clustering High- and Infinite Dimensional Data that Satisfies the Triangle Inequality *Final Report***

Socolovsky, Eduardo A., Hampton Univ., USA; December 2002; 16p; In English

Contract(s)/Grant(s): NAS1-97046

Report No.(s): NASA/CR-2002-212136; NAS 1.26:212136; ICASE-IR-43; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The cosine or correlation measures of similarity used to cluster high dimensional data are interpreted as projections, and the orthogonal components are used to define a complementary dissimilarity measure to form a similarity-dissimilarity measure pair. Using a geometrical approach, a number of properties of this pair is established. This approach is also extended to general inner-product spaces of any dimension. These properties include the triangle inequality for the defined dissimilarity measure, error estimates for the triangle inequality and bounds on both measures that can be obtained with a few floating-point operations from previously computed values of the measures. The bounds and error estimates for the similarity and dissimilarity measures can be used to reduce the computational complexity of clustering algorithms and enhance their scalability, and the triangle inequality allows the design of clustering algorithms for high dimensional distributed data.

Author

*Analogy; Inequalities; Error Analysis; Triangles*

**20030004284** Institute for Computer Applications in Science and Engineering, Hampton, VA USA

**Higher Order Time Integration Schemes for the Unsteady Navier-Stokes Equations on Unstructured Meshes *Final Report***

Jothiprasad, Giridhar, Institute for Computer Applications in Science and Engineering, USA; Mavriplis, Dimitri J., Institute for Computer Applications in Science and Engineering, USA; Caughey, David A., Cornell Univ., USA; November 2002; 30p; In English

Contract(s)/Grant(s): NAG1-97046; RTOP 505-90-52-01

Report No.(s): NASA/CR-2002-211967; NAS 1.26:211967; ICASE-2002-44; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The efficiency gains obtained using higher-order implicit Runge-Kutta schemes as compared with the second-order accurate backward difference schemes for the unsteady Navier-Stokes equations are investigated. Three different algorithms for solving the nonlinear system of equations arising at each timestep are presented. The first algorithm (NMG) is a pseudo-time-stepping scheme which employs a non-linear full approximation storage (FAS) agglomeration multigrid method to accelerate convergence. The other two algorithms are based on Inexact Newton's methods. The linear system arising at each Newton step is solved using iterative/Krylov techniques and left preconditioning is used to accelerate convergence of the linear solvers. One of the methods (LMG) uses Richardson's iterative scheme for solving the linear system at each Newton step while the other (PGMRES) uses the Generalized Minimal Residual method. Results demonstrating the relative superiority of these Newton's methods based schemes are presented. Efficiency gains as high as 10 are obtained by combining the higher-order time integration schemes with the more efficient nonlinear solvers.

Author

*Algorithms; Navier-Stokes Equation; Unstructured Grids (Mathematics); Measure and Integration; Runge-Kutta Method*

## 65

### STATISTICS AND PROBABILITY

*Includes data sampling and smoothing; Monte Carlo method; time series and analysis; and stochastic processes.*

**20030002355** Sandia National Labs., Albuquerque, NM USA

**Combination of Evidence in Dempster-Shafer Theory**

Sentz, K.; Ferson, S.; Apr. 2002; 100p; In English

Report No.(s): DE2002-800792; SAND2000-0835; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Dempster-Shafer theory offers an alternative to traditional probabilistic theory for the mathematical representation of uncertainty. The significant innovation of this framework is that it allows for the allocation of a probability mass to sets or intervals. Dempster-Shafer theory does not require an assumption regarding the probability of the individual constituents of the set or interval. This is a potentially valuable tool for the evaluation of risk and reliability in engineering applications when it is not possible to obtain a precise measurement from experiments, or when knowledge is obtained from expert elicitation. An important aspect of this theory is the combination of evidence obtained from multiple sources and the modeling of conflict between them.

This report surveys a number of possible combination rules for Dempster-Shafer structures and provides examples of the implementation of these rules for discrete and interval-valued data.

NTIS

*Probability Theory; Combinatorial Analysis*

66

## SYSTEMS ANALYSIS AND OPERATIONS RESEARCH

*Includes mathematical modeling of systems; network analysis; mathematical programming; decision theory; and game theory.*

**20030002661** Naval Postgraduate School, Dept. of Operations Research, Monterey, CA USA

### **Capital Investment Planning Aid (CIPA): An Optimization-Based Decision-Support Tool to Plan Procurement and Retirement of Naval Platforms**

Salmeron, Javier; Dell, Robert F.; Brown, Gerald G.; Rowe, Anton; Sep. 2002; 133p; In English; Original contains color images  
Contract(s)/Grant(s): MIPR-N6227102MPRJK50

Report No.(s): AD-A408011; NPS-OR-02-006; No Copyright; Avail: CASI; A07, Hardcopy; A02, Microfiche

Capital Investment Planning Aid (CIPA) is an optimization-based decision support system custom-built for the U.S. Navy to formulate complete force structure plans that include ship, submarine, and aircraft procurement and retirement schedules over a 30-year planning horizon. This is an important problem, representing a \$1 trillion (2002 dollars) commitment by the Navy. Each candidate plan must respect annual budgets in several funding categories, while following Navy planning guidance such as keeping shipyards efficiently employed, limiting the average and/or maximum age of platforms, and meeting Integrated Warfare Architecture (IWAR) requirements. Without CIPA, such alternatives must be manually assembled—a slow, laborious, demanding task fraught with opportunities for clerical error. CIPA offers a graphical interface to organize planning data, accepts ad hoc manual guidance, optimally completes the missing details of any alternate scenario in a second or two, displays its recommendations and their consequences, and provides scenario cataloging and comparison tools. CIPA reduces to minutes the planning cycle from expert question to exploratory scenarios to PowerPoint slides displaying results. This document describes the planning environment into which CIPA has been introduced, how CIPA works, and shows how CIPA is used.

DTIC

*Navy; Heuristic Methods; Decision Support Systems; Procurement; Ships; Life Cycle Costs*

67

## THEORETICAL MATHEMATICS

*Includes algebra, functional analysis, geometry, topology set theory, group theory and number theory.*

**20030002460** Geophysical Observatory, Helsinki, Finland

### **Discretizations of Generalized Random Variables with Applications to Inverse Problems**

Lasanen, Sari, Geophysical Observatory, Finland; 2002; ISSN 1239-6303; 68p; In English

Report No.(s): Rept-130; ISBN 951-41-0919-8; Copyright; Avail: Issuing Activity

The aim of an inverse problem is to recover an unknown object from indirect data. Most inverse problems, as are various problems in applied mathematics, are divided into exact problems in infinite-dimensional function spaces and their finite-dimensional approximations. Generally, the first problem consists of proving the existence, uniqueness and explicit form of a solution. The latter problem involves numerical implementations directed towards processing measurement data. The purpose of this thesis is to define conditions sufficient for convergence of numerical solutions to the exact solution in the Gaussian linear statistical inverse theory.

Derived from text

*Random Variables; Discretization (Mathematics); Problem Solving; Numerical Analysis*

70  
**PHYSICS (GENERAL)**

*Includes general research topics related to mechanics, kinetics, magnetism, and electrodynamics. For specific areas of physics see categories 71 through 77. For related instrumentation see 35 Instrumentation and Photography; for geophysics, astrophysics or solar physics see 46 Geophysics, 90 Astrophysics, or 92 Solar Physics.*

**20030002367** Alberta Univ., Dept. of Physics, Edmonton, Alberta Canada

**O micron( $\alpha^2$ )ln( $m_{\mu}/m_e$ ) Corrections to Electron Energy Spectrum in Muon Decay**

Arbuzov, A.; Melnikov, K.; May 15, 2002; 12p; In English

Report No.(s): DE2002-799930; SLAC-PUB-9220; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

O micron( $\alpha^2$ )ln( $m_{\mu}/m_e$ ) corrections to electron energy spectrum in muon decay are computed using perturbative fragmentation function approach. The magnitude of these corrections is comparable to anticipated precision of the TWIST experiment at TRIUMF where Michel parameters will be extracted from the measurement of the electron energy spectrum in muon decay.

NTIS

*Electron Energy; Muons; Particle Decay*

**20030002652** California Univ., Electrical Engineering Dept., Los Angeles, CA USA

**Fractal FSS: Various Self-Similar Geometries Used for Dual-Band and Dual-Polarized FSS**

Gianvittorio, John P.; Rahmat-Samii, Yahya; Romeu, Jordi; Jan. 2001; 4p; In English

Report No.(s): AD-A408001; ARO-35875.163; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

In our attempt to design a frequency selective surface (FSS) that is resonant at two distinct bands, dual-polarized, and has a simple planar design, several self-similar elements based on fractal geometry have been investigated. In this paper these various geometries will be presented along with their characteristics.

DTIC

*Fractals; Frequencies*

**20030002676** Michigan Univ., Dept. of Nuclear Engineering and Radiological Sciences, Ann Arbor, MI USA

**Crossed-Field, High Energy Microwave Source Experiments and Theory Final Report, 1 May 1999-30 Apr. 2002**

Gilgenbach, Ronald M.; Jul. 2002; 32p; In English; Original contains color images

Contract(s)/Grant(s): F49620-99-1-0255; AF Proj. 2301

Report No.(s): AD-A408034; AFRL-SR-AR-TR-02-0328; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Relativistic magnetron experiments have successfully been accomplished utilizing the MELBA accelerator at parameters of -300 to -400 kV, 1-10 kA and pulselengths of -0.5 microseconds. A major accomplishment has been the installation of a ceramic insulator stack, which has improved the base vacuum by a factor of 10 from 10<sup>-0</sup> Torr scale to the 10<sup>-1</sup> Torr scale. The Titan-Pulse Sciences magnetron is a 6-vane device operating at about 1 GHz. Microwave power has been extracted from two-opposing-cavities of this magnetron. Assuming equal output power in both arms, peak, extracted microwave power between 120 MW and 400 MW has been achieved. Microwave pulse shortening is observed with typical pulselengths in the range between 10 ns and 100 ns. Time-frequency analysis has been utilized for mode identification, indicating both the pi-mode and the 213 -pi mode.

DTIC

*Microwaves; Electron Accelerators; Magnetrons*

**20030003631** Iowa Univ., Dept. of Physics and Astronomy, Iowa City, IA USA

**Optically-Excited Waves in 3D Dusty Plasmas**

Goree, John, Iowa Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 163-191; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Flight experiments are planned for an interdisciplinary study of waves (i.e., phonons) in 3D Coulomb lattices. The experimental system will be a suspension of charged polymer microspheres in a gas-discharge plasma. This so-called "dusty plasma" is a macroscopic system where the microspheres arrange themselves, due to their mutual repulsion, in a lattice. Like a colloidal suspension, this lattice can be in a crystalline or liquid state. The particles are imaged directly using video microscopy. These experiments are an extension of 2D experiments performed in the laboratory, under gravity conditions. Sedimentation due to gravity causes the microspheres to settle rapidly into a 2D layer that is levitated by the strong electric field near an electrode

in a plasma. by eliminating gravity, it is possible to fill a 3D volume with the suspension. Experiments will focus on the shear acoustic wave in the lattice. This kind of wave has particle motion that is transverse to the direction of wave propagation. Our experiments will exploit the low damping of a dusty plasma as compared to colloidal suspensions, We will excite the waves using a manipulation laser, which applies a radiation pressure on the particles. Particle motion will be measured in-situ using direct imaging with video microscopy. After the experiment, we will analyze the video data by computing the particle velocities and then analyzing the wave motion of the particles. The experiment is to be performed on-orbit in ISS, with accommodation probably in the FIR. Preliminary tests of the experimental procedures will be done in parabolic aircraft flights.

Author

*Dusty Plasmas; Wave Propagation; Microparticles; Imaging Techniques; Excitation; Three Dimensional Models*

**20030003732** Argonne National Lab., IL USA

**Possible Triaxial Superdeformation in (174)Hf**

Hartley, D. J.; Djongolov, M.; Riedinger, L. L.; Kondev, F. G.; Janssens, R. V. F.; 2002; 12p; In English

Report No.(s): DE2002-801590; ANL/PHY/CP-108697; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Three, possibly four, regularly spaced rotational bands with large dynamical moments of inertia, which are consistent with known superdeformed bands in the Lu/Hf region, have been identified in 174 Hf. The states were populated in the 130 Te (48 Ca, 4n) reaction at a beam energy of 194 MeV. The gammasphere array detected the emitted gamma radiation.

NTIS

*Deformation; Hafnium; Moments of Inertia; Emittance; Gamma Rays*

**20030003832** Argonne National Lab., IL USA

**Coherent Synchrotron Radiation and Microbunching in Bunch Compressors**

Borland, M.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801605; No Copyright; Avail: National Technical Information Service (NTIS)

Coherent synchrotron radiation (CSR) is of great interest to those designing accelerators as drivers for free-electron lasers (FELs) and energy recovery linacs (ERLs). A growing body of experimental evidence indicates the potentially serious impact of CSR on beam quality as we attempt to create high-brightness, high-current electron bunches using magnetic compression techniques. It is not an overstatement to say that the success of FEL and ERL projects could well depend on how well CSR is understood in the design phase. Simulation codes typically show qualitative or rough quantitative agreement with experiments, indicating that our understanding of the physics is improving but incomplete. For example, an unexpected microbunching instability was recently discovered with the code elegant and is now the subject of intense theoretical work. This paper presents an overview of CSR issues, including recent simulation results on the CSR instability. Experimental results and issues are also discussed.

NTIS

*Compressors; Electron Bunching*

71  
**ACOUSTICS**

*Includes sound generation, transmission, and attenuation. For noise pollution see 45 Environment Pollution. For aircraft noise see also 02 Aerodynamics and 07 Aircraft Propulsion Propulsion and Power.*

**20030002263** NASA Langley Research Center, Hampton, VA USA

**Slat Cove Noise Modeling: A Posteriori Analysis of Unsteady RANS Simulations**

Choudhari, Meelan, NASA Langley Research Center, USA; Khorrami, Mehdi R., NASA Langley Research Center, USA; Lockard, David P., NASA Langley Research Center, USA; Atkins, Harold L., NASA Langley Research Center, USA; Lilley, Geoffrey M., Pennsylvania State Univ., USA; [2002]; 8p; In English; 8th AIAA/CEAS Aeroacoustics Conference and Exhibit, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2468; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A companion paper by Khorrami et al demonstrates the feasibility of simulating the (nominally) self-sustained, large-scale unsteadiness within the leading-edge slat-cove region of multi-element airfoils using unsteady Reynolds-Averaged Navier-Stokes (URANS) equations, provided that the turbulence production term in the underlying two-equation turbulence model is switched off within the cove region. In conjunction with a FfowesWilliams-Hawkings solver, the URANS computations were shown to capture the dominant portion of the acoustic spectrum attributed to slat noise, as well as reproducing the increased intensity of slat cove motions (and, correspondingly, far-field noise as well) at the lower angles of attack. This paper examines that simulation database, augmented by additional simulations, with the objective of transitioning this apparent success to aeroacoustic predictions in an engineering context. As a first step towards this goal, the simulated flow and acoustic fields are compared with experiment and simplified analytical model. Rather intense near-field fluctuations in the simulated flow are found to be associated with unsteady separation along the slat bottom surface, relatively close to the slat cusp. Accuracy of the laminar-cove simulations in this near-wall region is raised to be an open issue. The adjoint Green's function approach is also explored in an attempt to identify the most efficient noise source locations.

Author

*Navier-Stokes Equation; Direct Numerical Simulation; Computational Fluid Dynamics; Aeroacoustics; Noise Prediction (Aircraft); Noise Reduction; Applications Programs (Computers); Unsteady Flow*

**20030002265** NASA Langley Research Center, Hampton, VA USA

**Aeroacoustic Measurements of a Wing/Slat Model**

Mendoza, Jeff M., Honeywell Engines, Systems and Services, USA; Brooks, Thomas F., NASA Langley Research Center, USA; Humphreys, William M., NASA Langley Research Center, USA; [2002]; 18p; In English; 8th AIAA/CEAS Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-2604; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Aeroacoustic evaluations of high-lift devices have been carried out in the Quiet Flow Facility of the NASA Langley Research Center. The present paper deals with detailed flow and acoustic measurements that have been made to understand, and to possibly predict and reduce, the noise from a wing leading edge slat configuration. The acoustic database is obtained by a moveable Small Aperture Directional Array (SADA) of microphones designed to electronically steer to different portions of models under study. The slat is shown to be a uniform distributed noise source. The data was processed such that spectra and directivity were determined with respect to a one-foot span of slat. The spectra are normalized in various fashions to demonstrate slat noise character. In order to equate portions of the spectra to different slat noise components, trailing edge noise predictions using measured slat boundary layer parameters as inputs are compared to the measured slat noise spectra.

Author

*Aeroacoustics; Leading Edge Slats; Flow Measurement; Acoustic Measurement*

**20030002351** NASA Langley Research Center, Hampton, VA USA

**Challenges in Rotorcraft Acoustic Flight Prediction and Validation**

Boyd, D. Douglas, Jr., NASA Langley Research Center, USA; [2003]; 16p; In English; 41st AIAA Aerospace Sciences Meeting, 6-9 Jan. 2003, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2003-0709; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Challenges associated with rotorcraft acoustic flight prediction and validation are examined. First, an outline of a state-of-the-art rotorcraft aeroacoustic prediction methodology is presented. Components including rotorcraft aeromechanics, high resolution reconstruction, and rotorcraft acoustic prediction are discussed. Next, to illustrate challenges and issues involved, a case study is presented in which an analysis of flight data from a specific XV-15 tiltrotor acoustic flight test is discussed in detail. Issues related to validation of methodologies using flight test data are discussed. Primary flight parameters such as velocity, altitude, and attitude are discussed and compared for repeated flight conditions. Other measured steady state flight conditions are examined for consistency and steadiness. A representative example prediction is presented and suggestions are made for future research.

Author

*Rotary Wing Aircraft; Noise Prediction (Aircraft); Aeroacoustics; Applications Programs (Computers); Flight Characteristics; Flight Tests; Flight Conditions*

**20030002461** Southampton Univ., Inst. of Sound and Vibration Research, UK

**Effect of Acoustic Absorption by Hydrophone and Cable on A Reverberation Technique for Measuring Sound Absorption Coefficient of Particulate Suspensions**

Leighton, T. G., Southampton Univ., UK; Brown, N. R., Southampton Univ., UK; Richards, S. D., Southampton Univ., UK; October 2002; 13p; In English

Contract(s)/Grant(s): DERA-SSDW3/0001

Report No.(s): ISVR-TR-299; Copyright; Avail: Issuing Activity

A technique has been developed to measure the sound absorption coefficient of particulate suspensions using a reverberation time technique. This technique measures the change in the reverberation time of the test volume of water when small particles are added. It is described in detail in other publications, which are referenced. When measuring a reverberant sound field, it is good practice to make measurements at a number of discreet locations, and spatially average the results. This of course relies upon the assumption that the making of the measurement does not significantly affect the parameter which is being measured. However in the experiment described here, this is not the case. When the hydrophone position is changed (in order to measure the sound field at several locations), the resulting changes in the length of cable that is submerged cause changes in the absorption similar to those which result from the addition of particles. In this report, this effect is illustrated. Critically, this is not simply a phenomenon which is interesting its own right; rather, its influence is so great that it prevents the taking of measurements throughout the water volume. Instead a scheme is presented whereby the uncertainty, which comes from being able to take measurements in one location only, is estimated by taking measurements over a horizontal plane (a process which keeps constant the length of cable which is submerged). The error in the calculation of the particulate attenuation is principally due to the error in the measurement of the reverberation time given the constraint of taking the measurements at a single location rather than making a spatial average. It is noted that, since the absorption is obtained from the difference in reverberation time of particulate-free water and a given particulate suspension, then the more dilute suspensions (where the difference is slight) are more affected by the error in determining the reverberation time.

Author

*Absorptivity; Acoustic Attenuation; Hydrophones; Particulates; Reverberation; Sound Fields*

**20030002672** Lembaga Penerbangan dan Antariksa Nasional, Peneliti Pusat Pemanfaatan Sains Atmosfer dan Iklim, Jakarta, Indonesia

**Noise Research on Generator Systems and the Area Surrounding the Suralaya Steam Electric Center in Serang, Banten  
*Penelitian Kebisingan di Sistem Generator dan Daerah Sekitar PLTU Suralaya Serang Banten***

Latief, Chunaeni, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Budiyo, Afif, Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Ekaningtyas, Ir., Lembaga Penerbangan dan Antariksa Nasional, Indonesia; Majalah Lapan; 2002; ISSN 0126-0480; Volume 4, No. 1, pp. 19-30; In Malay-Indonesian; Copyright; Avail: Issuing Activity

Suralaya Steam Electric Center (PLTU) produced 3,400 MW electric as one of electrical industries has high internal noise to worker, mainly from electric generator and steam generator areas. by measuring noise level, quantity and quality analysis methods, the highest noise was 114 dBA/113 dBC from unit 1 and 7 on ground and fourth floors for normal load and full load. From frequency spectrum analysis the lowest noise was 180-190 Hz in unit 3 dan 4 on ground and fourth floors for normal load and full load. High frequency was 5.000 Hz from unit 6 on fourth floor on normal load. Noise from PLTU Suralaya has not impact noise to surrounding area. Noise source in surrounding area was caused by transportation activities.

Author

*Electric Generators; Noise Intensity; Steam; Noise (Sound)*

**20030003692** NASA Glenn Research Center, Cleveland, OH USA

**Fan Noise Source Diagnostic Test Computation of Rotor Wake Turbulence Noise**

Nallasamy, M., QSS Group, Inc., USA; Envia, E., NASA Glenn Research Center, USA; Thorp, S. A., NASA Glenn Research Center, USA; Shabbir, A., Toledo Univ., USA; August 2002; 18p; In English; Eighth Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 781-30-11

Report No.(s): NASA/TM-2002-211798; NAS 1.15:211798; E-13493; AIAA Paper 2002-2489; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

An important source mechanism of fan broadband noise is the interaction of rotor wake turbulence with the fan outlet guide vanes. A broadband noise model that utilizes computed rotor flow turbulence from a RANS code is used to predict fan broadband noise spectra. The noise model is employed to examine the broadband noise characteristics of the 22-inch Source Diagnostic Test fan rig for which broadband noise data were obtained in wind tunnel tests at the NASA Glenn Research Center. A 9-case matrix

of three outlet guide vane configurations at three representative fan tip speeds are considered. For all cases inlet and exhaust acoustic power spectra are computed and compared with the measured spectra where possible. In general, the acoustic power levels and shape of the predicted spectra are in good agreement with the measured data. The predicted spectra show the experimentally observed trends with fan tip speed, vane count, and vane sweep. The results also demonstrate the validity of using CFD-based turbulence information for fan broadband noise calculations.

Author

*Fan Blades; Turbulence; Wakes; Rotors; Rotor Aerodynamics; Noise Measurement; Guide Vanes; Aerodynamic Noise; Wind Tunnel Tests*

**20030003723** NASA Glenn Research Center, Cleveland, OH USA

**Towards Arbitrary Accuracy Inviscid Surface Boundary Conditions**

Dyson, Rodger W., NASA Glenn Research Center, USA; Hixon, Ray, NASA Lewis Research Center, USA; July 2002; 15p; In English; Eight Aeroacoustics Conference, 17-19 Jun. 2002, Breckenridge, CO, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 780-30-11

Report No.(s): NASA/TM-2002-211583; NAS 1.15:211583; E-13368; ICOMP-2002-04; AIAA Paper 2002-2438; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Inviscid nonlinear surface boundary conditions are currently limited to third order accuracy in time for non-moving surfaces and actually reduce to first order in time when the surfaces move. For steady-state calculations it may be possible to achieve higher accuracy in space, but high accuracy in time is required for efficient simulation of multiscale unsteady phenomena. A surprisingly simple technique is shown here that can be used to correct the normal pressure derivatives of the flow at a surface on a Cartesian grid so that arbitrarily high order time accuracy is achieved in idealized cases. This work demonstrates that nonlinear high order time accuracy at a solid surface is possible and desirable, but it also shows that the current practice of only correcting the pressure is inadequate.

Author

*Boundary Conditions; Inviscid Flow; Nonlinearity; Unsteady State; Surface Properties*

**20030003730** Wyle Labs., Inc., Arlington, VA USA

**A Tool for Low Noise Procedures Design and Community Noise Impact Assessment: The Rotorcraft Noise Model (RNM)**

Conner, David A., Army Aviation and Missile Command, USA; Page, Juliet A., Wyle Labs., Inc., USA; [2002]; 11p; In English; AHS International Technical Specialists' Meeting on Advanced Rotorcraft Technology and Life Saving Activities, 11-13 Nov. 2002, Utsunomiya, Japan; Sponsored by American Helicopter Society, Inc., USA; Original contains color illustrations; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

To improve aircraft noise impact modeling capabilities and to provide a tool to aid in the development of low noise terminal area operations for rotorcraft and tiltrotors, the Rotorcraft Noise Model (RNM) was developed by the NASA Langley Research Center and Wyle Laboratories. RNM is a simulation program that predicts how sound will propagate through the atmosphere and accumulate at receiver locations located on flat ground or varying terrain, for single and multiple vehicle flight operations. At the core of RNM are the vehicle noise sources, input as sound hemispheres. As the vehicle "flies" along its prescribed flight trajectory, the source sound propagation is simulated and accumulated at the receiver locations (single points of interest or multiple grid points) in a systematic time-based manner. These sound signals at the receiver locations may then be analyzed to obtain single event footprints, integrated noise contours, time histories, or numerous other features. RNM may also be used to generate spectral time history data over a ground mesh for the creation of single event sound animation videos. Acoustic properties of the noise source(s) are defined in terms of sound hemispheres that may be obtained from theoretical predictions, wind tunnel experimental results, flight test measurements, or a combination of the three. The sound hemispheres may contain broadband data (source levels as a function of one-third octave band) and pure-tone data (in the form of specific frequency sound pressure levels and phase). A PC executable version of RNM is publicly available and has been adopted by a number of organizations for Environmental Impact Assessment studies of rotorcraft noise. This paper provides a review of the required input data, the theoretical framework of RNM's propagation model and the output results. Code validation results are provided from a NATO helicopter noise flight test as well as a tiltrotor flight test program that used the RNM as a tool to aid in the development of low noise approach profiles.

Author

*Low Noise; Acoustic Properties; Tilt Rotor Aircraft; Aircraft Noise; Impact; Sound Propagation*

**20030003799** NASA Langley Research Center, Hampton, VA USA

**Reduction of Wake-Stator Interaction Noise Using Passive Porosity**

Tinetti, Ana F., Virginia Polytechnic Inst. and State Univ., USA; Kelly, Jeffrey J., Virginia Polytechnic Inst. and State Univ., USA; Thomas, Russell H., NASA Langley Research Center, USA; Bauer, Steven X. S., NASA Langley Research Center, USA; [2002]; 10p; In English; 40th AIAA Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-1036; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The present study was conducted to assess the potential of Passive Porosity Technology as a mechanism to reduce interaction noise in turbomachinery by reducing the fluctuating forces acting on the vane surfaces. To do so, a typical fan stator airfoil was subjected to the effects of a transversely moving wake; time histories of the primitive aerodynamic variables, obtained from Computational Fluid Dynamics (CFD) solutions, were then input into an acoustic prediction code. This procedure was performed on the solid airfoil to obtain a baseline, and on a series of porous configurations in order to isolate those that yield maximum noise reductions without compromising the aerodynamic performance of the stator. It was found that communication between regions of high pressure differential - made possible by the use of passive porosity - is necessary to significantly alter the noise radiation pattern of the stator airfoil. In general, noise reductions were obtained for those configurations incorporating passive porosity in the region between  $x/c$  is approximately 0.15 on the suction side of the airfoil and  $x/c$  is approximately 0.20 on the pressure side. Reductions in overall radiated noise of approximately 1.0 dB were obtained. The noise benefit increased to about 2.5 dB when the effects of loading noise alone were considered.

Author

*Computational Fluid Dynamics; Noise Reduction; Porosity; Turbomachinery*

**20030004013** Southampton Univ., Fluid Dynamics and Acoustics Group, UK

**The Estimation of Geoacoustic Properties from Broadband Acoustic Data, Focusing on Instantaneous Frequency Techniques**

Robb, G. B. N., Southampton Univ., UK; White, P. R., Southampton Univ., UK; Dix, J. K., Southampton Univ., UK; Bull, J. M., Southampton Univ., UK; Leighton, T. G., Southampton Univ., UK; Best, A. I., Southampton Univ., UK; October 2002; 54p; In English; Original contains color illustrations

Contract(s)/Grant(s): NERC-NER/S/A/2000/03621

Report No.(s): ISVR-TR-298; Copyright; Avail: Issuing Activity

The compressional wave velocity and attenuation of marine sediments are fundamental to marine science. In order to obtain reliable estimates of these parameters it is necessary to examine in situ acoustic data, which is generally broadband. A variety of techniques for estimating the compressional wave velocity and attenuation from broadband acoustic data are reviewed. The application of Instantaneous Frequency (IF) techniques to data collected from a normal-incidence chirp profiler is examined. For the datasets examined the best estimates of IF are obtained by dividing the chirp profile into a series of sections, estimating the IF of each trace in the section using the first moments of the Wigner Ville distribution, and stacking the resulting IF to obtain a composite IF for the section. As the datasets examined cover both gassy and saturated sediments, this is likely to be the optimum technique for chirp datasets collected from all sediment environments.

Author

*Broadband; Frequencies; Wave Attenuation; Acoustic Properties; Geophysics; Mathematical Models; Marine Environments*

**20030004286** Federal Aviation Administration, Cambridge, MA USA

**Computing the Absorption of Sound by the Atmosphere and its Applicability to Aircraft Noise Certification**

Rickley, E. J.; Aug. 1998; 64p; In English

Report No.(s): PB2003-101661; DTS-34-FA853-LR2; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The USA Department of Transportation, John A. Volpe National Transportation Systems Center (Volpe Center), Acoustics Facility, in support of the Federal Aviation Administration's Office of Environment and Energy (AEE), has recently completed a study of a new method for computing atmospheric absorption. This letter report presents the results of the study. Section 1 presents an introduction to the topic of atmospheric absorption as it relates to aircraft noise certification, along with the objective of the study. Section 2 discusses the evaluation procedure. Section 3 discusses the results of the evaluation. Section 4 and 5 present conclusions and recommendations, respectively.

NTIS

*Aircraft Noise; Atmospheric Attenuation; Certification*

## ATOMIC AND MOLECULAR PHYSICS

*Includes atomic and molecular structure, electron properties, and atomic and molecular spectra. For elementary particle physics see 73 Nuclear Physics.*

**20030002232** Massachusetts Univ., Dept. of Physics, Lowell, MA USA

### **B(sup o) (sub s) Oscillation Results**

Willocoq, S.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799999; SLAC-PUB-9358; No Copyright; Avail: National Technical Information Service (NTIS)

No abstract available.

NTIS

*Oscillations; Mesons; Particle Theory; Neutral Particles*

**20030002235** Stanford Linear Accelerator Center, Stanford, CA USA

### **Combined Phenomena of Beam-Beam and Beam-Electron Cloud Effects in Circular e+e- Colliders**

Ohmi, K.; Chao, A. W.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800086; SLAC-PUB-9471; No Copyright; Avail: National Technical Information Service (NTIS)

An electron cloud causes various effects in high intensity positron storage rings. Positron beam and electron cloud can be considered a typical two stream system with a plasma frequency. Beam-beam effect is also an important issue for high luminosity circular colliders. Colliding two beams are considered as a two-stream system with another plasma frequency. We study combined phenomena of the beam-electron cloud and beam-beam effects from a viewpoint of two complex 'two stream effects' with two plasma frequencies.

NTIS

*Particle Collisions; Electron Clouds; Storage Rings (Particle Accelerators); Positrons*

**20030002236** Stanford Linear Accelerator Center, Stanford, CA USA

### **Beam-Beam Experience At DA(phi)NE**

Alesini, D.; Bertolucci, S.; Biscari, C.; Boscolo, M.; Zobov, M.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800067; SLAC-PUB-9449; No Copyright; Avail: National Technical Information Service (NTIS)

This paper summarizes the results of experimental observations and measurements of beam-beam interactions in DA phi NE, the Frascati Phi-factory. The achieved results are reported with analysis of present limitations in both single and multibunch operation modes and compared with numerical simulations.

NTIS

*Beam Interactions; Numerical Analysis*

**20030002238** Stanford Linear Accelerator Center, Stanford, CA USA

### **Harmonic Cavities and Longitudinal Beam Stability in Electron Storage Rings**

Byrd, J. M.; DeSantis, S.; Stover, G.; Teytelman, D.; Fox, J.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800054; SLAC-PUB-9435; No Copyright; Avail: National Technical Information Service (NTIS)

Harmonic cavities have been used in storage rings to increase beam lifetime and Landau damping by lengthening the bunch. The need for lifetime increase is particularly great in the present generation of low to medium energy synchrotron light sources where the small transverse beam sizes lead to relatively short lifetimes from large angle intrabeam (Touschek) scattering. We review the beam dynamics of harmonic radiofrequency (RF) systems and discuss effects on longitudinal beam stability.

NTIS

*Storage Rings (Particle Accelerators); Cavities; Longitudinal Stability*

**20030002242** Fermi National Accelerator Lab., Batavia, IL USA

### **B Physics at the Tevatron**

Cranchaw, J.; Sep. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801535; FERMILAB/CONG-02/220-E; No Copyright; Avail: National Technical Information Service (NTIS)

A vibrant B physics program is being pursued at the Tevatron for Run II using the upgraded accelerator complex and the upgraded CDF and D0 detectors with the goal of collecting luminosity. This will provide measurements of various CP parameters which both complement and extend the programs at the B factories. There are also a variety of spectroscopy measurements currently available only at the Tevatron. The detectors are now largely commissioned and data acquisition is underway.

NTIS

*Particle Accelerators; Bosons; Spectroscopy; Hadrons*

**20030002243** Vrije Univ., Amsterdam, Netherlands

**Pion Form Factor**

Blok, H. P.; Huber, G. M.; Mack, D. J.; Aug. 20, 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801040; No Copyright; Avail: National Technical Information Service (NTIS)

The pion, and specifically its charge form factor, is of key interest in the study of the quark-gluon structure of hadrons. This is exemplified by the many calculations that treat the pion as one of their prime examples.

NTIS

*Form Factors; Pions; Quantum Chromodynamics; Charge Distribution*

**20030002275** Stanford Linear Accelerator Center, Stanford, CA USA

**Vacuum Performance and Beam Life Time in the PEP II Storage Rings**

Wienands, U.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800065; SLAC-PUB-9447; No Copyright; Avail: National Technical Information Service (NTIS)

The vacuum systems of the storage rings of the PEP-II B-Factory have had by now over two years of production running at high beam current and seen synchrotron radiation from almost 4 kAh (High Energy Ring (HER)) and 10 kAh (Low Energy Ring (LER)) of integrated beam current. The systems have performed well, reaching the design pressures and being able to cope with beam currents of almost 1 A (HER) and in excess of 2 A (LER). The photo-desorption coefficient was found in the HER to have reached values as low as 10 to the minus 7th power. The shielded bellows have performed very well, with only one pair of bellows assemblies damaged due to higher-order mode generation from a known, nearby source. Issues encountered during normal operation have been a significant amount of dust trapping in the HER and the effect of a cloud of photo-electrons around the positron beam affecting the LER beam size. A couple of chambers in the HER failed; these failures arose from a combination of design and fabrications issues. The beam life time in the LER has been lower than expected based on the vacuum pressure and has been determined to be Touschek limited.

NTIS

*Vacuum Systems; Storage Rings (Particle Accelerators)*

**20030002357** Stanford Linear Accelerator Center, Stanford, CA USA

**Measuring the Higgs boson's parity using tau --> rho nu**

Bower, G. R.; Pierzchala, T.; Was, Z.; Worek, M.; Mar. 2002; 16p; In English

Report No.(s): DE2002-800715; SLAC-PUB-9154; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

No abstract available.

NTIS

*Higgs Bosons; Parity*

**20030002358** Stanford Linear Accelerator Center, Stanford, CA USA

**Intrabeam Scattering and Wake Field Effects in Low Emittance Electron Rings**

Venturini, M.; Aug. 2002; 12p; In English

Report No.(s): DE2002-799996; SLAC-PUB-9355; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We present a model to study in a self-consistent way the interplay between intrabeam scattering and wake-field forces in low-emittance high-intensity electron storage rings. The regime of interest is that of the damping rings for the next generation of linear colliders.

NTIS

*Linear Accelerators; Electron Beams; Storage Rings (Particle Accelerators); Particle Collisions*

20030002359 Oklahoma State Univ., Stillwater, OK USA

**Radiative Processes ( $\tau \rightarrow \mu \gamma$ ,  $\mu \rightarrow \epsilon \gamma$  and  $(g-2)_{\mu}$ ) as Probes of ESSM/SO(10)**

Babu, K. S.; Pati, J. C.; Jul. 23, 2002; 32p; In English

Report No.(s): DE2002-799941; OSU-HEP-02-11; SLAC-PUB-9274; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

A variant of MSSM - the so-called Extended Supersymmetric Standard Model (ESSM) - has been motivated sometime ago on several grounds. Briefly speaking, in addition to the three chiral families, ESSM introduces two vectorlike families of quarks and leptons (together with their superpartners) that transform as  $16+16$  of SO(10), and possess an SO(10)-invariant mass of order one TeV. It assumes that the three chiral families acquire their masses primarily (barring small corrections of order one MeV) through their mixings with the two vectorlike families.

NTIS

*Standard Model (Particle Physics); Radiative Transfer*

20030002362 Stanford Linear Accelerator Center, Stanford, CA USA

**Half-Composite Standard Model at a TeV and  $\sin^2(\theta_w)$**

Dimopoulos, S.; Kaplan, D. E.; Aug. 2002; 12p; In English

Report No.(s): DE2002-799978; SLAC-PUB-9333; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We apply a recently proposed mechanism - in which an SU(3) symmetry predicts the weak mixing angle - to construct realistic theories with composite quarks and leptons at a TeV. Although the models are strongly coupled, they are reliably analyzed using complementarity and 't Hooft's anomaly matching. In the simplest models the right-handed fermions are composite, while the left-handed are elementary. Strong SU(2)<sub>R</sub> forces give rise to 12-particle instanton-mediated processes. They violate baryon and lepton numbers by three units and result in spectacular multilepton and multijet events at the LHC (Large Hadron Collider). Models in which the leptons are in an SU(3)-triplet can be directly tested in muonium-antimuonium conversion experiments.

NTIS

*Standard Model (Particle Physics); Theoretical Physics*

20030002368 Stanford Linear Accelerator Center, Stanford, CA USA

**Yet Another Extension of the Standard Model: Oases in the Desert**

Bjorken, J. D.; Pakvasa, S.; Tuan, S. F.; May 2002; 44p; In English

Report No.(s): DE2002-799927; SLAC-PUB-9212; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have searched for conceptually simple extensions of the standard model, and describe here a candidate model which we find attractive. Our starting point is the assumption that off-diagonal CKM mixing matrix elements are directly related by lowest order perturbation theory to the quark mass matrices. This appears to be most easily and naturally implemented by assuming that all off-diagonal elements reside in the down-quark mass matrix. This assumption is in turn naturally realized by introducing three generations of heavy, electroweak-singlet down quarks which couple to the Higgs sector diagonally in flavor, while mass-mixing off-diagonally with the light down-quarks. Anomaly cancellation then naturally leads to inclusion of electroweak vector-doublet leptons.

NTIS

*Matrices; Standard Model (Particle Physics)*

20030002373 Stanford Linear Accelerator Center, Stanford, CA USA

**Study of Intrabeam Scattering in Low-Energy Electron Rings**

Venturini, M.; Aug. 2002; 8p; In English

Report No.(s): DE2002-799997; SLAC-PUB-9356; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The paper contains a study of intrabeam scattering (IBS) in a low energy electron storage ring to be used as part of a Compton back-scattering X-ray source. We discuss time evolution of emittances and dependence of IBS growth rates on lattice parameters.

NTIS

*Electron Beams; Scattering*

20030002508 California Univ., Dept. of Chemistry, Santa Barbara, CA USA

**'Pure-Beams' of Highly Vibrationally Excited Molecules Final Report, 1 Mar. 2001-28 Feb. 2002**

Wodtke, Alec M.; Sep. 18, 2002; 4p; In English

Contract(s)/Grant(s): F49620-01-1-0201; Proj-3484

Report No.(s): AD-A407964; AFRL-SR-AR-TR-02-0384; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

The grant was used to purchase, construct, and install necessary instrumentation to implement Hexapole focusing of laser prepared vibrationally excited molecules. It consists of three differentially pumped chamber, for: (1) state preparation, (2) hexapole filtering and (3) detection. In addition two YAG-pumped dye laser systems were purchased from Spectra-Physics and Sirah, which allow stimulated emission pumping to prepare highly vibrationally excited states of molecules. We have also dedicated another existing YAG-pumped dye laser system to the project for REMPI and LIF detection of the focused molecules DTIC

*Excitation; Molecular Beams*

**20030002635** NASA Marshall Space Flight Center, Huntsville, AL USA

**Photonic Bandgaps in Photonic Molecules**

Smith, David D., NASA Marshall Space Flight Center, USA; Chang, Hongrok, Alabama Univ., USA; Gates, Amanda L., Alabama Univ., USA; Fuller, Kirk A., National Space Science and Technology Center, USA; Gregory, Don A., Alabama Univ., USA; Witherow, William K., NASA Marshall Space Flight Center, USA; Paley, Mark S., Universities Space Research Association, USA; Frazier, Donald O., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; Optics in the Southeast Conference, 24-26 Oct. 2002, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only

This talk will focus on photonic bandgaps that arise due to nearly free photon and tight-binding effects in coupled microparticle and ring-resonator systems. The Mie formulation for homogeneous spheres is generalized to handle core/shell systems and multiple concentric layers in a manner that exploits an analogy with stratified planar systems, thereby allowing concentric multi-layered structures to be treated as photonic bandgap (PBG) materials. Representative results from a Mie code employing this analogy demonstrate that photonic bands arising from nearly free photon effects are easily observed in the backscattering, asymmetry parameter, and albedo for periodic quarter-wave concentric layers, though are not readily apparent in extinction spectra. Rather, the periodicity simply alters the scattering profile, enhancing the ratio of backscattering to forward scattering inside the bandgap, in direct analogy with planar quarter-wave multilayers. PBGs arising from tight-binding may also be observed when the layers (or rings) are designed such that the coupling between them is weak. We demonstrate that for a structure consisting of N coupled micro-resonators, the morphology dependent resonances split into N higher-Q modes, in direct analogy with other types of oscillators, and that this splitting ultimately results in PBGs which can lead to enhanced nonlinear optical effects.

Author

*Energy Gaps (Solid State); Backscattering; Photons; Molecular Interactions; Coupling; Spheres*

**20030003693** NASA Glenn Research Center, Cleveland, OH USA

**A Desorbed Gas Molecular Ionization Mechanism for Arcing Onset in Solar Arrays Immersed in a Low-Density Plasma**

Galofaro, J., NASA Glenn Research Center, USA; Vayner, B., Ohio Aerospace Inst., USA; Ferguson, D., NASA Glenn Research Center, USA; Degroot, W., Silicon Light, Inc., USA; May 2002; 16p; In English; 33rd Plasmadynamics and Lasers Conference, 20-23 May 2002, Maui, HI, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-A4-05

Report No.(s): NASA/TM-2002-211552; NAS 1.15:211552; E-13327; AIAA Paper 2002-2262; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Previous experimental studies have hypothesized that the onset of Solar Array Arc (SAA) initiation in low-density space plasmas is caused by a desorbed gas molecular ionization mechanism. Indeed past investigations performed at the NASA Glenn Plasma Interaction Facility tend to not only support the desorbed gas molecular ionization mechanism, but have gone as far as identifying the crucial molecular species that must be present for molecular ion dominated process to occur. When electrical breakdown occurs at a triple junction site on a solar array panel, a quasi-neutral plasma cloud is ejected. Assuming the main component of the expelled plasma cloud by weight is due to water vapor, the fastest process available is due to HO molecules and OH(+) ions, or more succinctly, dissociative molecular-ion dominated recombination processes:  $\text{H}_2\text{O}(+) + e(-)$  yields  $\text{H}^* + \text{OH}^*$ . Recently published spectroscopic observations of solar array arc spectra in ground tests have revealed the well-known molecular OH band (302 to 309nm), as well as the molecular SiH band (387nm peak), and the molecular CH band (432nm peak). Note that the OH band is observed in emission arcs where water vapor is present. Strong atomic lines were also observed for H(sub beta) at 486nm and H(sub alpha) at 656.3nm in prior ground testing. Independent supporting evidence of desorbed gas molecular ionization mechanisms also come from measurements of arc current pulse widths at different capacitances. We will revisit an earlier first order approximation demonstrating the dependence of arc current pulse widths on the square root of the capacitance. The simple arc current pulse width model will be then be used to estimate the temperature of the arc plasma (currently believed to be somewhere in the range of 3 to 5 eV). The current paper then seeks to extend the outlined work by including numerous vacuum chamber measurements obtained with a quadrupole mass spectrometer. A small solar array was mounted inside the

vacuum chamber. A plasma source, also mounted inside the vacuum chamber, is used to simulate a low-density plasma environment. The solar array is then biased to a high negative potential and allowed to arc while a mass spectrometer is used to record the partial pressure of H<sub>2</sub>O and to track other significant changes in mass (1 to 150) AMU.

Author

*Molecular Gases; Molecular Ions; Solar Arrays; Space Plasmas; Gas Ionization*

**20030003742** Jefferson (Thomas) Lab. Computer Center, Newport News, VA USA

**Nucleon Compton Scattering with Two Space-Like Photons**

Afanasev, A.; Akushevich, I.; Merenkov, N. P.; 2002; 14p; In English

Report No.(s): DE2002-801025; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We calculated two-photon exchange effects for elastic electron-proton scattering at high momentum transfers. The corresponding nucleon Compton amplitude is defined by two space-like virtual photons that appear to have significant virtualities. We make predictions for a single-spin beam asymmetry and a single-spin target asymmetry or recoil proton polarization caused by an unpolarized electron beam.

NTIS

*Compton Effect; Photons; Computation; Elastic Scattering*

**20030003743** Kentucky Univ., Dept. of Physics and Astronomy, Lexington, KY USA

**Empirical Baye's Method and Tests in Very Light Quark Range from the Overlap Lattice QCD**

Doug, S. J.; Draper, T.; Horvath, I.; Lee, F. X.; Mathur, N.; Aug. 30, 2002; 8p; In English

Report No.(s): DE2002-801034; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Based on Bayesian theorem an empirical Baye's method is discussed. A programming chart for mass spectrum fitting is suggested. A weakly constrained way for getting priors to solve the chiral log data fitting singularity is tested.

NTIS

*Bayes Theorem; Quarks; Numerical Analysis*

**20030003798** Argonne National Lab., IL USA

**Two-Photon Decay of 1s2s (1)S(0) States in Heavy He-Like Atomic Systems**

Mokler, P. H.; Dunford, R. W.; Kanter, E. P.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799802; No Copyright; Avail: National Technical Information Service (NTIS)

He-like systems the decay of the 1s2s 1S0 excited state to the 1s2 1S0 ground state is not allowed. This excited state can only decay to the ground state via the emission of two photons. The spectral shape of the emitted continuum is determined by the complete structure of the atomic system as all bound and continuum P states contribute to the 2E1 decay. For very heavy atomic systems the 3P states ALSO have to be included and the normalized spectral shape changes with atomic number according to the relative strengthS of both, the electron-electron interaction and of the relativistic effects. A brief survey on the variation of the spectral shape of the two-photon continuum with atomic number is given and compared to experiments ranging from He-like Ni to He-like Au with special emphasis on the heavy relativistic system. The data compare well with fully relativistic calculations.

NTIS

*Radioactive Decay; Helium Isotopes; Atomic Physics; Atomic Structure; Atomic Energy Levels*

**20030003805** Fermi National Accelerator Lab., Batavia, IL USA

**Double Intensity Injection for Antiproton Production**

Ng, K. Y.; Sep. 2002; 72p; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801548; FERMILAB-TM-2183; No Copyright; Avail: CASI; A01, Microfiche; A04, Hardcopy

The linear density of protons injected into the Fermilab Main Injector is doubled for antiproton production using barrier waves. Adiabatic capture into 53-MHz buckets can be performed in about 10 ms with barrier waves on both sides to prevent excessive phase drift outside one booster-batch length. Simulation shows that although the injected protons are captured into 90 rf buckets, the amount of loss in the extra 6 buckets on either sides totals to only 0.51%.

NTIS

*Antiprotons; Injection; Injectors; Radio Frequencies*

**20030003806** Fermi National Accelerator Lab., Batavia, IL USA

**Progress in Lattice QCD**

Kronfeld, A. S.; Sep. 19, 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801546; FERMILAB-CONF-02/228-T; No Copyright; Avail: National Technical Information Service (NTIS)

After reviewing some of the mathematical foundations and numerical difficulties facing lattice QCD, I review the status of several calculations relevant to experimental high-energy physics. The topics considered are moments of structure functions, which may prove relevant to search for new phenomena at the LHC, and several aspects of flavor physics, which are relevant to understanding CP and flavor violation.

NTIS

*Progress; Cp Violation; Quantum Chromodynamics*

**20030003829** Stanford Linear Accelerator Center, Stanford, CA USA

**High-Energy QCD Asymptotics of Photon-Photon Collisions**

Brodsky, S. J.; Fadin, V. S.; Kim, V. T.; Lipatov, L. N.; Pivovarov, G. B.; Jul. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799968; CERN-TH/2002-143; PNPI-2002-2484,SLAC-PUB-9318; No Copyright; Avail: National Technical Information Service (NTIS)

The high-energy behaviour of the total cross section for highly virtual photons, as predicted by the BFKL equation at next-to-leading order (NLO) in QCD, is discussed. The NLO BFKL predictions, improved by the BLM optimal scale setting, are in good agreement with recent OPAL and L3 data at CERN LEP2. NLO BFKL predictions for future linear colliders are presented.

NTIS

*Quantum Chromodynamics; Collisions; Photons*

### 73

## NUCLEAR PHYSICS

*Includes nuclear particles; and reactor theory. For space radiation see 93 Space Radiation. For atomic and molecular physics see 72 Atomic and Molecular Physics. For elementary particle physics see 77 Physics of Elementary Particles and Fields. For nuclear astrophysics see 90 Astrophysics.*

**20030003710** Lawrence Livermore National Lab., Livermore, CA USA

**Recent Developments in the Design of the NLC Positron Source**

Kotseroglou, T.; Bharadwaj, V.; Clendenin, J. E.; Ecklund, S.; Frisch, J.; Nov. 05, 1999; 10p; In English

Report No.(s): DE2002-792752; UCRL-JC-136449; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Recent developments in the design of the Next Linear Collider (NLC) positron source based on updated beam parameters are described. The unpolarized NLC positron source (1,2) consists of a dedicated 6.2 GeV S-band electron accelerator, a high-Z positron production target, a capture system and an L-band positron linac. The 1998 failure of the SLC target, which is currently under investigation, may lead to a variation of the target design. Progress towards a polarized positron source is also presented. A moderately polarized positron beam colliding with a highly polarized electron beam results in an effective polarization large enough to explore new physics at NLC. One of the schemes towards a polarized positron source incorporates a polarized electron source, a 50 MeV electron accelerator, a thin target for positron production and a new capture system optimized for high-energy, small angular-divergence positrons. The yield for such a process, checked using the EGS4 code, is of the order of  $10^{10}$ . The EGS4 code has been enhanced to include the effect of polarization in bremsstrahlung and pair-production process.

NTIS

*Linear Accelerators; Positrons; Polarization; Electron Accelerators*

**20030003749** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Radiation Effects Testing at the 88-Inch Cyclotron at LBNL**

McMahan, M. A.; Koga, R.; 2002; 10p; In English

Report No.(s): DE2002-801932; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The effects of ionizing particles on sensitive microelectronics is an important component of the design of systems as diverse as satellites and space probes, detectors for high energy physics experiments and even internet server farms. Understanding the

effects of radiation on human cells is an equally important endeavor directed towards future manned missions in space and towards cancer therapy. At the 88-Inch Cyclotron at the Berkeley Laboratory, facilities are available for radiation effects testing (RET) with heavy ions and with protons. The techniques for doing these measurements and the advantages of using a cyclotron will be discussed, and the Cyclotron facilities will be compared with other facilities worldwide. RET of the same part at several facilities of varying beam energy can provide tests of the simple models used in this field and elucidate the relative importance of atomic and nuclear effects. The results and implications of such measurements will be discussed.

NTIS

*Cyclotrons; Radiation Effects; Atomic Theory; Research Facilities; Therapy*

**20030003788** NASA Marshall Space Flight Center, Huntsville, AL USA

**Overview of the High Performance Antiproton Trap (HiPAT) Experiment**

Martin, James, NASA Marshall Space Flight Center, USA; Chakrabarti, Suman, NASA Marshall Space Flight Center, USA; Pearson, Boise, NASA Marshall Space Flight Center, USA; Sims, W. Herbert, NASA Marshall Space Flight Center, USA; Lewis, Raymond, Lewis (R.) Co., USA; Fant, Wallace, Cortez 3 Service Corp., USA; [2002]; 23p; In English; 17th International Conference on the Application of Accelerators in Research and Industry, 14 Nov. 2002, Denton, TX, USA; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A general overview of the High Performance Antiproton Trap (HiPAT) Experiment is presented. The topics include: 1) Why Antimatter? 2) HiPAT Applicability; 3) Approach-Goals; 4) HiPAT General Layout; 5) Sizing For Containment; 6) Laboratory Operations; 7) Vacuum System Cleaning; 8) Ion Production Via Electron Gun; 9) Particle Capture Via Ion Sources; 10) Ion Beam Steering/Focusing; 11) Ideal Ion Stacking Sequence; 12) Setup For Dynamic Capture; 13) Dynamic Capture of H(+) Ions; 14) Dynamic Capture; 15) Radio Frequency Particle Detection; 16) Radio Frequency Antenna Modeling; and 17) R.F. Stabilization-Low Frequencies. A short presentation of propulsion applications of Antimatter is also given. This paper is in viewgraph form.

CASI

*Antiprotons; General Overviews; Matter-Antimatter Propulsion; Spacecraft Performance*

**20030003793** Stanford Linear Accelerator Center, Stanford, CA USA

**Report of Snowmass 2001 Working Group E2: Electron-positron Colliders from the phi to the zeta**

Zhao, Z.; Eigen, G.; Burdman, G.; Marciano, W.; Hitlin, D.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799981; SLAC-PUB-9337; APS/123-QED; No Copyright; Avail: National Technical Information Service (NTIS)

We report on the status and plans of experiments now running or proposed for electron-positron colliders at energies between the Phi and the Zeta.

NTIS

*Conferences; Electron-Positron Pairs*

**20030003794** Stanford Linear Accelerator Center, Stanford, CA USA

**Beyond the Standard Model Working Group: Summary Report**

Apr. 03, 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM Report No.(s): DE2002-799923; UCD-2002-05; SLAC-PUB-9183; No Copyright; Avail: National Technical Information Service (NTIS)

In this working group we have investigated a number of aspects of searches for new physics beyond the Standard Model (SM) at the running or planned TeV-scale colliders. For the most part, we have considered hadron colliders, as they will define particle physics at the energy frontier for the next ten years at least. The variety of models for Beyond the Standard Model (BSM) physics has grown immensely. It is clear that only future experiments can provide the needed direction to clarify the correct theory. Thus, our focus has been on exploring the extent to which hadron colliders can discover and study BSM physics in various models. We have placed special emphasis on scenarios in which the new signal might be difficult to find or of a very unexpected nature.

NTIS

*Hadrons; Particle Energy; Standard Model (Particle Physics)*

**20030004006** Stanford Linear Accelerator Center, Stanford, CA USA

**End-to-End Simulation: The Front End**

Haber, I.; Bieniosek, F. M.; Celata, S. M.; Friedman, A.; Bernal, S.; 2002; In English; This document is color dependent and/or

in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-802043; No Copyright; Avail: National Technical Information Service (NTIS)

For the intense beams in heavy ion fusion accelerators, details of the beam distribution as it emerges from the source region can determine the beam behavior well downstream. This occurs because collective space-charge modes excited as the beam is born remain undamped for many focusing periods. Traditional studies of the source region in particle beam systems have emphasized the behavior of averaged beam characteristics, such as total current, rms beam size, or emittance, rather than the details of the full beam distribution function that are necessary to predict the excitation of these modes. Simulations of the beam in the source region and comparisons to experimental measurements at LBNL and the University of Maryland are presented to illustrate some of the complexity in beam characteristics that has been uncovered as increased attention has been devoted to developing a detailed understanding of the source region. Also discussed are methods of using the simulations to infer characteristics of the beam distribution that can be difficult to measure directly.

NTIS

*Ion Beams; Heavy Ions; Ion Accelerators*

**20030004009** Princeton Univ., Plasma Physics Lab., NJ USA

**Overview of Theory and Modeling in the Heavy Ion Fusion Virtual National Laboratory**

Davidson, R. C.; Kaganovich, I. D.; Lee, W. W.; Qin, H.; Startsev, E. A.; May 08, 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-802037; No Copyright; Avail: National Technical Information Service (NTIS)

This paper presents analytical and simulation studies of intense heavy ion beam propagation, including the injection, acceleration, transport and compression phases, and beam transport and focusing in background plasma in the target chamber. Analytical theory and simulations that support the High Current Experiment (HCX), the Neutralized Transport Experiment (NTX), and the advanced injector development program, are being used to provide a basic understanding of the nonlinear beam dynamics and collective processes, and to develop design concepts for the next-step Integrated Beam Experiment (IBX), an Integrated Research Experiment (IRE), and a heavy ion fusion driver. 3-D nonlinear perturbative simulations have been applied to collective instabilities driven by beam temperature anisotropy, and to two-stream interactions between the beam ions and any unwanted background electrons; 3-D particle-in-cell simulations of the 2 MV Electrostatic Quadrupole (ESQ) injector have clarified the influence of pulse rise time; analytical studies and simulations of the drift compression process have been carried out; syntheses of a 4-D particle distribution function from phase-space projections have been developed; and studies of the generation and trapping of stray electrons in the beam self fields have been performed.

NTIS

*Heavy Ions; Nuclear Fusion; Ion Beams*

**20030004010** Fermi National Accelerator Lab., Batavia, IL USA

**Jet Measurements at D(Theta) using a Kappa Tau Algorithm**

Elvira, V. D.; Oct. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801911; FERMILAB-CONF-02/234-E; No Copyright; Avail: National Technical Information Service (NTIS)

D0 has implemented and calibrated a k(perpendicular) jet algorithm for the first time in a p(bar p) collider. We present two results based on 1992-1996 data which were recently published: the subjet multiplicity in quark and gluon jets and the central inclusive jet cross section. The measured ratio between subjet multiplicities in gluon and quark jets is consistent with theoretical predictions and previous experimental values. NLO pQCD predictions of the k(perpendicular) inclusive jet cross section agree with the D0 measurement, although marginally in the low p(sub T) range. We also present a preliminary measurement of thrust cross sections, which indicates the need to include higher than (alpha)(sub s)(sup 3) terms and resummation in the theoretical calculations.

NTIS

*Algorithms; Particle Accelerators; Jets*

*Includes light phenomena and the theory of optical devices. For lasers see 36 Lasers and Masers.*

**20030002254** NASA Marshall Space Flight Center, Huntsville, AL USA

**Primary Mirror Figure Maintenance of the Hobby-Eberly Telescope using the Segment Alignment Maintenance System**

Rakoczy, John, NASA Marshall Space Flight Center, USA; Hall, Drew, NASA Marshall Space Flight Center, USA; Howard, Ricky, NASA Marshall Space Flight Center, USA; Ly, William, NASA Marshall Space Flight Center, USA; Weir, John, NASA Marshall Space Flight Center, USA; Montgomery, Edward, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; SPIE Astronomical Telescopes and Instrumentation, Power Telescopes and Instrumentation into the New Millennium Conference, 21-28 Aug. 2002, Waikoloa, HI, USA; Sponsored by International Society for Optical Engineering, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Segment Alignment Maintenance System (SAMs) was installed on McDonald Observatory's Hobby-Eberly Telescope (HET) in August 2001. The SAMs became fully operational in October 2001. The SAMs uses a system of 480 inductive edge sensors to correct misalignments of the HET's 91 primary mirror segments when the segments are perturbed from their aligned reference positions. A special observer estimated and corrects for the global radius of curvature (GroC) mode, a mode unobservable by the edge sensors. The SAMs edge sensor system and (GroC) estimator are able to maintain HET's primary figure for much longer durations than previously had been observed. Telescope image quality has improved, and the amount of overhead time required from primary mirror alignment has been reduced. This paper gives a functional description of the SAMs control system and presents performance verification data. This paper also describes how the SAMs has improved the operational efficiency of the HET.

Author

*Telescopes; Mirrors; Maintenance; Alignment*

**20030002462** NASA Marshall Space Flight Center, Huntsville, AL USA

**Global Radius of Curvature Estimation and Control for the Hobby-Eberly Telescope**

Rakoczy, John, NASA Marshall Space Flight Center, USA; Hall, Drew, NASA Marshall Space Flight Center, USA; Howard, Ricky, NASA Marshall Space Flight Center, USA; Ly, William, NASA Marshall Space Flight Center, USA; Weir, John, NASA Marshall Space Flight Center, USA; Montgomery, Edward, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; SPIE Astronomical Telescopes and Instrumentation, Power Telescopes and Instrumentation into the New Millennium Conference, 21-28 Aug. 2002, Waikoloa, HI, USA; Sponsored by International Society for Optical Engineering, USA; No Copyright; Avail: Issuing Activity; Abstract Only

A system, which estimates the global radius of curvature (GroC) and corrects for changes in GroC on a segmented primary mirror has been developed for and verified on McDonald Observatory's Hobby Eberly Telescope (HET). The GroC estimation and control system utilizes HET's primary mirror control (PMC) system and the Segment Alignment Maintenance System (SAMS), an inductive edge sensor system. A special set of boundary conditions is applied to the derivation of the optimal edge match control. The special boundary conditions allow the further derivation of an observer, which enables estimation and control of the GroC mode to within HET's specification. The magnitude of the GroC mode can then be controlled despite the inability of the SAMS edge sensor system, by itself, to observe or control the GroC mode. The observer can be extended to any segmented mirror telescope. It will be shown that the observer improves with accuracy as the number of segments increases. This paper presents the mathematical theory of the observer. Simulation results will demonstrate the inherent accuracy and robustness of the system. Performance verification data from the HET will be presented.

Author

*Segmented Mirrors; Telescopes; Curvature; Control; Performance Tests*

**20030002496** NASA Marshall Space Flight Center, Huntsville, AL USA

**Utilizing the US Lab Nadir Research Window for Remote Sensing Operations with The Window Observational Research Facility (WORF)**

Turner, Richard, NASA Marshall Space Flight Center, USA; Barley, Bryan, NASA Marshall Space Flight Center, USA; Jan. 08, 2002; 1p; In English; 53rd International Astronautical Congress (IAF) 2002 World Space Congress, 10-19 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

The Window Observational Research Facility (WORF) is an ISPR-based rack facility designed to take advantage of the high optical quality US Lab Nadir research window. The WORF is based on the ISS Expedite the Processing of Experiments to Space Station (EXPRESS) rack mechanical structure and electronic systems. The WORF has a unique payload volume located at the

center of the rack that provides access to the window. The interior dimensions of the payload volume are 34-in. (86.36 cm) wide by 33-in. (83.82 cm) high by 23-in. (58.42 cm) deep. This facility supports the deployment of payloads such as 9 in. aerial photography cameras and 12 in. diameter optical equipment. The WOLF coupled with the optical quality of the USA Lab window support the deployment of various payload disciplines. The WOLF provides payloads with power, data command and control, air cooling, water cooling, and video processing. The WOLF's payload mounting surfaces and interfaces include the interior payload mounting shelf and the interior and exterior aircraft-like seat tracks. The payload mounting shelf is limited to a maximum mass of 136 kg (299 pounds). The WOLF can accommodate large payloads such as the commonly used Leica-Heerbrug RC-30 aerial photography camera (whose dimensions are 53.3 cm (21-in.) wide by 50.8 cm (20-in.) deep by 76.2 cm (30-in.) long). The performance characteristics of the WOLF allow it to support an array of payload disciplines. The WOLF provides a maximum of 3 Kw at 28 Vdc and has a maximum data rate of 10 Mbps. The WOLF's unique payload volume is designed to be light-tight, down to  $2.8 \times 10^{(exp -11)}$  Watts/cm<sup>2</sup>/steradian, and have low-reflective surfaces. This specially designed WOLF interior supports payload investigations that observe low-light-level phenomenon such as aurora. Although the WOLF rack does not employ any active rack isolation (i.e., vibration dampening) technology, the rack provides a very stable environment for payload operations (on the order of X microradians). The facility's software is capable of being updated during its period of deployment. The WOLF project also includes a Suitcase Simulator to allow for a payload developer to verify data interfaces at his development site, a trainer rack for astronauts to learn how to operate the WOLF prior to flight, and the use of the EXPRESS Functional Checkout Units to allow for payload checkout at the KSC prior to launch.

Author

*Remote Sensing; Research Facilities; Simulators; Optical Equipment; Technology Utilization*

**20030002514** North Carolina Agricultural and Technical State Univ., Dept. of Electrical Engineering, Greensboro, NC USA  
**Compliant Substrate for Mid Infrared Wavelength Region Final Report, 1 Mar. 1998-31 May 2001**

Iyer, Shanthi; Jun. 24, 2002; 52p; In English

Contract(s)/Grant(s): F49620-98-1-0328

Report No.(s): AD-A408066; AFRL-SR-AR-TR-02-0338; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The work in this project was focused on the growth of GaSb epilayer on a compliant layer by Molecular Beam Epitaxial (MBE) technique. A novel approach using the low temperature melting interlayer and a thin strained layer on top was investigated for compliancy. The structures examined consisted of GaAs host substrate, InSb as the low melting point interlayer, thin (Ga,Al) Sb layer, followed by thick GaSb overlayer. Growth results and characterization of these structures using various in-situ and ex-situ techniques are presented here. Amongst the different interlayers examined, InSb/GaSb(grown at low temperature of 400 deg C+) interlayer was found to be the most successful interlayer. The significant stress arising from the mismatch was accommodated by the interlayer, leading to reduced dislocation density (is less than  $10^{(exp 7)}/\text{sq cm}$ ) in the GaSb overlayer. Electronic properties of heteroepitaxial undoped and n-doping using SnTe source in InSb epilayers have been explained using the multichannel conduction process. High carrier (77K) mobility of 94,098 sq cm/V-sec on lightly doped samples has been achieved. Photoreflectance study of n-GaSb at E sub zero + delta sub zero transition energy has also been the subject of detailed investigation. The dependence of E sub zero + Delta sub zero transition energy on the doping levels has been analyzed by including the effects of band filling, band gap renormalization, and tail states.

DTIC

*Substrates; Optical Materials; Infrared Radiation; Laminates; Lattices; Dislocations (Materials); Interlayers*

**20030002688** NASA Marshall Space Flight Center, Huntsville, AL USA

**New Cryogenic Optical Test Capability at Marshall Space Flight Center's Space Optics Manufacturing Technology Center**

Kegley, Jeff, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; SPIE Astronomy Conference, 22-28 Aug. 2002, Waikoloa, HI, USA; Sponsored by International Society for Optical Engineering, USA; No Copyright; Avail: Issuing Activity; Abstract Only

A new cryogenic optical testing capability exists at Marshall Space Flight Center's Space Optics Manufacturing Technology Center (SOMTC). SOMTC has been performing optical wavefront testing at cryogenic temperatures since 1999 in the X-ray Cryogenic Test Facility's (XRCF's) large vacuum chamber. Recently the cryogenic optical testing capability has been extended to a smaller vacuum chamber. This smaller horizontal cylindrical vacuum chamber has been outfitted with a helium-cooled liner that can be connected to the facility's helium refrigeration system bringing the existing kilowatt of refrigeration capacity to bear on a 1 meter diameter x 2 meter long test envelope. Cryogenic environments to less than 20 Kelvin are now possible in only a few hours. SOMTC's existing instruments (the Instantaneous Phase-shifting Interferometer (IPI) from ADE Phase-Shift Technologies and the PhaseCam from 4D Vision Technologies) view the optic under test through a 150 mm clear aperture BK-7

window. Since activation and chamber characterization tests in September 2001, the new chamber has been used to perform a cryogenic (less than 30 Kelvin) optical test of a 22.5 cm diameter x 127 cm radius of curvature SiO<sub>2</sub> mirror, a cryogenic survival (less than 30 Kelvin) test of an adhesive, and a cryogenic cycle (less than 20 Kelvin) test of a ULE mirror. A vibration survey has also been performed on the test chamber. Chamber specifications and performance data, vibration environment data, and limited test results will be presented.

Author

*Research Facilities; Cryogenics; Vacuum Chambers; Cryogenic Temperature*

**20030003677** Argonne National Lab., IL USA

**Linear Actuator System with 1-Angstrom Closed-Loop Control Resolution and 50-millimeter Travel Range**

Shu, D.; Ham, Y.; Toellner, T. S.; Alp, E. E.; 2002; 18p; In English

Report No.(s): DE2002-799810; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We have designed and tested a novel linear actuator system with 1-angstrom closed-loop control resolution and 50-mm travel range. There are two major ultra precision motion control techniques that have been applied to this actuator: A novel laser Doppler encoder system with multiple-reflection optics. A specially designed high-stiffness weak-link mechanism with stacked thin metal sheets having sub-angstrom driving sensitivity with excellent stability. In this paper, we present the system design and test results of this linear actuator. Applications of this new actuator system are also discussed.

NTIS

*Actuators; Linear Systems; Systems Engineering; Feedback Control; Coders*

**20030003678** Argonne National Lab., Advanced Photon Source Div., IL USA

**Fabrication of X-ray Spiral Masks by Laser Ablation**

Peele, A. G.; Nugent, K. A.; McMahon, P. J.; Paterson, D.; Tran, C. Q.; 2002; 10p; In English

Report No.(s): DE2002-799812; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The authors describe microfabrication of a spiral mask modulation structure by excimer laser ablation. A multi-step fabrication using 15 separate chrome-on-quartz mask pattern is used to create a 16 step spiral staircase structure approximating the desired spiral ramp. The results of simulations and experimental results are presented.

NTIS

*Fabrication; Laser Ablation; Excimer Lasers; X Ray Optics; Simulation*

**20030003746** Argonne National Lab., IL USA

**Near-Field Stacking of Zone Plates in the X-Ray Range**

Maser, J.; Lai, B.; Yun, W.; Shastri, S. D.; Cai, Z.; 2002; 12p; In English

Report No.(s): DE2002-801586; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We use Fresnel zone plates as focusing optics in hard X-ray microprobes at energies typically between 6 and 30 keV. While a spatial resolution close to 0.1 microm can currently be achieved, highest spatial resolution is obtained only at reduced diffraction efficiency due to manufacturing limitations with respect to the aspect ratios of zone plates. To increase the effective thickness of zone plates, we are stacking several identical zone plates on-axis in close proximity. If the zone plates are aligned laterally to within better than an outermost zone width and longitudinally within the optical near-field, they form a single optical element of larger effective thickness and improved efficiency and reduced background from undiffracted radiation. This allows us both to use zone plates of moderate outermost zone width at energies of 30 keV and above, as well as to increase the efficiency of zone plates with small outermost zone widths particularly for the energy range of 6 - 15 keV.

NTIS

*X Rays; Remote Sensors; Spatial Resolution; Regions; Metal Plates*

**20030003752** Argonne National Lab., IL USA

**3-D Surface Profile Measurements of Large X-Ray Synchrotron Radiation Mirrors Using Stitching Interferometry**

Assoufid, L.; Bray, M.; Qian, J.; Shu, D.; 2002; 14p; In English

Report No.(s): DE2002-801583; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Stitching interferometry, using small-aperture, high-resolution, phase-measuring interferometry, has been proposed for quite some time now as a metrology technique to obtain 3-dimensional profiles of surfaces of oversized optical components and substrates. The aim of this work is to apply this method to the specific case of long grazing-incidence x-ray mirrors, such as those used in beamlines at synchrotron radiation facilities around the world. Both fabrication and characterization of these mirrors would greatly benefit from this technique because it offers the potential for providing measurements with accuracy and resolution

better than those obtained using existing noncontact laser profilers, such as the long trace profiler (LTP). Measurement data can be used as feedback for computer-controlled fabrication processes to correct for possible topography errors. The data can also be used for simulating and predicting mirror performance under realistic conditions. A semi-automated stitching system was built and tested at the X-ray Optics Metrology Laboratory of the Advanced Photon Source at Argonne National Laboratory. The initial objective was to achieve a measurement sensitivity on the order of 1 microrad rms. Preliminary tests on a 1m-long x-ray mirror showed system repeatability of less than 0.6 microrad rms. This value is comparable to that of a conventional LTP. The measurement accuracy was mostly affected by environmental perturbations and system calibration effects. With a fully automated and improved system (to be built in the near future), we expect to achieve measurement sensitivity on the order of 0.01 microrad rms or better. In this paper, after a brief review of basic principles and general technical difficulties and challenges of the stitching technique, a detailed description of the measurement setup is given and preliminary results obtained with it are analyzed and discussed.

NTIS

*Synchrotron Radiation; Three Dimensional Models; Profilometers; Mirrors; Interferometers*

**20030003797** Argonne National Lab., IL USA

**Profile Coating for KB Mirror Applications at the Advanced Photon Source**

Liu, C.; Assoufid, L.; Macrander, A.; Ice, G.; Tischler, J.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799811; No Copyright; Avail: National Technical Information Service (NTIS)

For microfocusing x-ray mirrors, an ellipse shape is desirable for aberration-free optics. However, it is difficult to polish elliptical mirrors to x-ray quality smoothness. A differential coating method to convert a cylindrical mirror to an elliptical one has been previously reported. The differential coating was obtained by varying the sputter source power while the mirror was passed through. Here we report a new method of profile coating to achieve the same goal more effectively. In the profile coating, the sputter source power is kept constant, while the substrate is passed over a contoured mask at a constant speed. The mask is placed very close to the substrate level (within 1.0 mm) on a shield-can over the sputter gun. Four-inch-diameter Si wafers were coated through a 100-mm-long by 152-mm-wide aperture on the top of the shield-can. The thickness distribution was then obtained using a spectroscopic ellipsometer with computer-controlled X-Y translation stages. A model has been developed to fit the measured thickness distribution of stationary growth. The relative thickness weightings are then digitized at every point 1 mm apart for the entire open area of the aperture. When the substrate is moving across the shield-can during a deposition, the film thickness is directly proportional to the length of the opening on the can along the moving direction. By equating the summation of relative weighting to the required relative thickness at the same position, the length of the opening at that position can be determined. By repeating the same process for the whole length of the required profile, a contour can be obtained for a desired thickness profile. The contoured mask is then placed on the opening of the shield-can. The number of passes and the moving speed of the substrate are determined according to the required thickness and the growth-rate calibration. The mirror coating profile is determined from the ideal surface figure of a focus ellipse and that obtained from a long trace profiler on the mirror. Preliminary test results using Au as a coating material will be presented.

NTIS

*Optical Materials; Photons; Mirrors; X Rays*

**20030003802** Argonne National Lab., IL USA

**Fabrication, Testing, and Performance of a Variable-Focus X-ray Compound Lens**

Khounsary, A.; Shastri, S. D.; Mashayekhi, A.; Macrander, A.; Smither, R.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801585; No Copyright; Avail: National Technical Information Service (NTIS)

Design, fabrication, testing, and performance of an x-ray lens assembly are described. The assembly consists of a number of precisely stacked and aligned parts, each of which is a section of an extruded aluminum piece having 16 parabolic cavities. The wall thickness between adjacent cavities is 0.2 mm. By stacking a number of long, extruded parts and cutting the assembly diagonally, a variable-focus lens system is devised. Moving the lens horizontally allows the incident beam to pass through fewer or more cavities focusing the emerging beam at any desired distance from the lens.

NTIS

*X Rays; Lenses; Focusing; Lens Design*

75  
**PLASMA PHYSICS**

*Includes magnetohydrodynamics and plasma fusion. For ionospheric plasmas see 46 Geophysics. For space plasmas see 90 Astrophysics.*

**20030002502** NASA Marshall Space Flight Center, Huntsville, AL USA

**Some Considerations on the Pulsed Electromagnetic Acceleration of Plasma**

Thio, Y. C. F., NASA Marshall Space Flight Center, USA; Markusic, T. E., NASA Marshall Space Flight Center, USA; Cassibry, J. T., NASA Marshall Space Flight Center, USA; Sommers, J. C., NASA Marshall Space Flight Center, USA; Turchi, P. J., Air Force Research Lab., USA; [2002]; 1p; In English; American Physical Society Division of Plasma Physics Annual Meeting, 11-15 Nov. 2002, Orlando, FL, USA; Sponsored by American Physical Society, USA; No Copyright; Avail: Issuing Activity; Abstract Only

In applying pulsed electromagnetic acceleration of plasma to space propulsion (known as pulsed plasma thrusters in the community), the mode of acceleration used has been mostly in the collisionless or near-collisionless regime. The preparation of the initial plasma is given scant attention. Collisional regime of accelerating the plasma, however, have been encountered in a variety of plasma accelerating devices. Both of these modes of acceleration are reviewed in a companion paper. In this paper, we discuss the considerations governing the controlled introduction and preparation of the initial plasma, so that the collisional mode of accelerating the plasma may be suitably enhanced.

Author

*Electromagnetic Acceleration; Plasmas (Physics); Pulsed Plasma Thrusters*

**20030002506** Institute of Electrical and Electronics Engineers, Piscataway, NJ USA

**29TH IEEE International Conference on Plasma Science Final Report**

Fedosejevs, Robert; Sep. 01, 2002; 10p; In English; Conf. on Plasma Science (29th). Held in Banff, Alberta, Canada, 26-30 May 2002

Contract(s)/Grant(s): F49620-01-1-0501

Report No.(s): AD-A407960; O2CH37340; AFRL-SR-AR-TR-02-0347; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

The 29th IEEE Conference on Plasma Science was held in Banff, Alberta, Canada from May 26-30, 2002. A total of 440 abstracts were submitted for Plenary, invited, oral and poster presentations which are included in the Conference Record Book. The presentations covered all major areas of Plasma Science including partially ionized plasmas, space plasmas, microwave devices, Z-pinches, magnetic fusion, laser-produced plasmas, flat panel displays, Plasma processing, medical and biological applications, plasma thrusters, plasma diagnostics and lighting plasmas.

DTIC

*Conferences; Plasma Physics*

**20030002657** Illinois Univ. at Urbana-Champaign, Savoy Aviation Research Lab., Urbana, IL USA

**Herriott Cell Interferometer for Density Measurements in Small-Scale Length Plasmas**

Antonsen, Erik; Burton, Rodney; Engelman, Scott; Spanjers, Greg; Jun. 2000; 21p; In English; Prepared in cooperation with Energy Research Consultants Inc Laguna Hills, CA

Contract(s)/Grant(s): F04611-99-C-0025

Report No.(s): AD-A408018; AFRL-PR-ED-TP-2000-139; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The introduction of a Herriott cell into a standard quadrature heterodyne interferometer is evaluated and demonstrated to increase the resolution of the system. Measurements of electron and neutral density during and after the current pulse are sought for modeling purposes for spacecraft contamination from Pulsed Plasma Thrusters. Testing is performed on the UIUC PPT-4, a coaxial electrothermal Pulsed Plasma Thruster pulsing at 20 J. Analytical and experimental analysis is conducted to determine the integrity of the phase front and the effect of multiple passes on the density measurements taken. The phase front quality is found to be acceptable for interferometric purposes and density measurements are taken for 2, 6, 14, and 18 passes in the Herriott cell. The advantage of the cell is obvious at late times when the external room vibrations induce an apparent phase shift in the same direction as neutral particles. Due to the same dependence on wavelength, 2 laser frequencies cannot be used to separate neutral and vibration contributions. The Herriott cell allows a density resolution increase linear with the number of passes that does not increase the vibrational component. Uncertainties from both vibrational sources and shot-to-shot variations of the thruster itself are investigated and characterized for this system. Due to variations in room vibrations on a day to day basis, the cell was unable to characterize the neutral density of the thruster. However, for single tests, neutral density measurements were acquired. The

Herriott cell with 18 passes introduced a 9-fold increase in resolution over the standard 2-pass interferometric setup. At 200 microseconds for single tests at 14 and 18 passes ( $\sim 20$  shots averaged) neutral density at the exit plane was shown to be no more than  $1 \times 10^{16}$ /cu cm. Peak electron density (4 microseconds) was shown to be  $5.0 \times 10^{15} \pm 1.1 \times 10^{15}$ /cu cm.

DTIC

*Thrusters; Plasma Engines; Interferometers; Plasmas (Physics)*

**20030002697** Courter Products, Boyne City, MI USA

**Radiation Transfer Modeling in Electrothermal Chemical (ETC) Ignition Interim Report, Jun. 2001-Mar. 2002**

Kappen, Klaus; Sep. 2002; 28p; In English; In German

Contract(s)/Grant(s): DAAH04-96-C-0086

Report No.(s): AD-A407989; ARL-CR-506; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The use of plasma ignition for high-performance guns has been pursued at several levels. As part of the program at the U.S. Army Research Laboratory (ARL), we are attempting to define the role of the broadband electromagnetic radiation that is a key energy component of the plasma discharge. In particular, this effort is developing a radiation transfer model that will be incorporated into the computational fluid dynamics (CFD) model of plasma ignition. This effort will allow more physically realistic characterization of the energy transfer in the plasma and its interaction with the propellant in the models. This report summarizes the physical background of the radiation transport, and the validation of the different submodules by use of published data will be presented. Current efforts include the coupling of the radiation model to the ARL NSRG2 code for the plasma-propellant interaction simulation. Furthermore, a series of laboratory experiments will be performed to validate the CFD code with the incorporated radiation transport submodel.

DTIC

*Computational Fluid Dynamics; Electromagnetic Radiation; Ignition; Guns (Ordnance); Plasmas (Physics)*

**20030002753** NASA Marshall Space Flight Center, Huntsville, AL USA

**Pulsed Electromagnetic Acceleration of Plasmas**

Thio, Y. C. Francis, NASA Marshall Space Flight Center, USA; Cassibry, Jason T., Alabama Univ., USA; Markusic, Tom E., NASA Marshall Space Flight Center, USA; [2002]; 9p; In English; 38th AIAA/ASME/SAE/ASEE Joint Propulsion Conference and Exhibit, 7-10 Jul. 2002, Indianapolis, IN, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-3803; Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

A major shift in paradigm in driving pulsed plasma thruster is necessary if the original goal of accelerating a plasma sheet efficiently to high velocities as a plasma "slug" is to be realized. Firstly, the plasma interior needs to be highly collisional so that it can be dammed by the plasma edge layer not (upstream) adjacent to the driving 'vacuum' magnetic field. Secondly, the plasma edge layer needs to be strongly magnetized so that its Hall parameter is of the order of unity in this region to ensure excellent coupling of the Lorentz force to the plasma. Thirdly, to prevent and/or suppress the occurrence of secondary arcs or restrike behind the plasma, the region behind the plasma needs to be collisionless and extremely magnetized with sufficiently large Hall parameter. This places a vacuum requirement on the bore conditions prior to the shot. These requirements are quantified in the paper and lead to the introduction of three new design parameters corresponding to these three plasma requirements. The first parameter, labeled in the paper as  $\gamma$  (sub 1), pertains to the permissible ratio of the diffusive excursion of the plasma during the course of the acceleration to the plasma longitudinal dimension. The second parameter is the required Hall parameter of the edge plasma region, and the third parameter the required Hall parameter of the region behind the plasma. Experimental research is required to quantify the values of these design parameters. Based upon fundamental theory of the transport processes in plasma, some theoretical guidance on the choice of these parameters are provided to help designing the necessary experiments to acquire these data.

Author

*Electromagnetic Acceleration; Plasmas (Physics); Pulsed Plasma Thrusters; Mathematical Models*

**20030003750** Lawrence Livermore National Lab., Livermore, CA USA

**FY96-98 Summary Report Mercury: Next Generation Laser for High Energy Density Physics SI-014**

Bayramian, A.; Beach, R.; Bibeau, C.; Chanteloup, J. C.; Ebberts, C.; May 23, 2000; 112p; In English

Report No.(s): DE2002-802082; UCRL-ID-139294; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The scope of the Mercury Laser project encompasses the research, development, and engineering required to build a new generation of diode-pumped solid-state lasers for Inertial Confinement Fusion (ICF). The Mercury Laser will be the first integrated demonstration of laser diodes, crystals, and gas cooling within a scalable laser architecture.

NTIS

*Inertial Confinement Fusion; Mercury (Metal); Solid State Lasers; Semiconductor Lasers*

**20030003809** Argonne National Lab., IL USA

**Chamber Wall Response to Target Implosion in Inertial Fusion Reactors: New and Critical Assessments**

Hassanein, A.; Morozov, V.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799786; No Copyright; Avail: National Technical Information Service (NTIS)

The chamber walls in inertial fusion energy (IFE) reactors are exposed to harsh conditions following each target implosion. Key issues of the cyclic IFE operation include intense photon and ion deposition, wall thermal and hydrodynamic evolution, wall erosion and fatigue lifetime, and chamber clearing and evacuation to ensure desirable conditions prior to target implosion. Several methods for wall protection have been proposed in the past, each having its own advantages and disadvantages. These methods include use of solid bare walls, gas-filled cavities, and liquid walls/jets. Detailed models have been developed for reflected laser light, emitted photons, and target debris deposition and interaction with chamber components and have been implemented in the comprehensive HEIGHTS software package. The hydrodynamic response of gasfilled cavities and photon radiation transport of the deposited energy has been calculated by means of new and advanced numerical techniques. Fragmentation models of liquid jets as a result of the deposited energy have also been developed, and the impact on chamber clearing dynamics has been evaluated. The focus of this study is to critically assess the reliability and the dynamic response of chamber walls in various proposed protection methods for IFE systems. of particular concern is the effect on wall erosion lifetime of various erosion mechanisms, such as vaporization, chemical and physical sputtering, melt/liquid splashing and explosive erosion, and fragmentation of liquid walls.

NTIS

*Inertial Fusion (Reactor); Targets; Implosions; Dynamic Response*

**20030004007** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Mini RF-Driven Ion Sources for Focused Ion Beam Systems**

Jiang, X.; Ji, Q.; Chang, A.; Leung, K. N.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-802041; No Copyright; Avail: National Technical Information Service (NTIS)

Mini RF-driven ion sources with 1.2 cm and 1.5 cm inner chamber diameter have been developed at Lawrence Berkeley National Laboratory. Several gas species have been tested including argon, krypton and hydrogen. These mini ion sources operate in inductively coupled mode and are capable of generating high current density ion beams at tens of watts. Since the plasma potential is relatively low in the plasma chamber, these mini ion sources can function reliably without any perceptible sputtering damage. The mini RF-driven ion sources will be combined with electrostatic focusing columns, and are capable of producing nano focused ion beams for micro machining and semiconductor fabrications.

NTIS

*Ion Sources; Ion Beams*

## 76

### SOLID-STATE PHYSICS

*Includes condensed matter physics, crystallography, and superconductivity. For related information see also 33 Electronics and Electrical Engineering and 36 Lasers and Masers.*

**20030002498** NASA Marshall Space Flight Center, Huntsville, AL USA

**Tetragonal Lysozyme Nucleation and Crystal Growth: The Role of the Solution Phase**

Pusey, Marc L., NASA Marshall Space Flight Center, USA; Forsythe, Elizabeth, NASA Marshall Space Flight Center, USA; Sumida, John, NASA Marshall Space Flight Center, USA; Maxwell, Daniel, NASA Marshall Space Flight Center, USA; Gorti, Sridhar, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; Sixth Microgravity Fluids Physics and Transport Phenomena Conference, 14-16 Aug. 2002, Cleveland, OH, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Experimental evidence indicates a dominant role of solution phase interactions in nucleating and growing tetragonal lysozyme crystals. These interactions are extensive, even at saturation, and may be a primary cause of misoriented regions in crystals grown on Earth. Microgravity, by limiting interfacial concentrations to diffusion-controlled levels, may benefit crystal quality by also reducing the extent of associated species present at the interface.

Author

*Crystal Growth; Lysozyme; Nucleation; Tetragons; Solutions; Phase Separation (Materials)*

**20030002500** NASA Marshall Space Flight Center, Huntsville, AL USA

**Fundamental Studies of Crystal Growth of Microporous Materials**

Dutta, P., NASA Marshall Space Flight Center, USA; George, M., NASA Marshall Space Flight Center, USA; Ramachandran, N., NASA Marshall Space Flight Center, USA; Schoeman, B., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; Microgravity Materials Science Conference Proceedings, 25-26 Jun. 2002, Huntsville, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only

Microporous materials are framework structures with well-defined porosity, often of molecular dimensions. Zeolites contain aluminum and silicon atoms in their framework and are the most extensively studied amongst all microporous materials. Framework structures with P, Ga, Fe, Co, Zn, B, Ti and a host of other elements have also been made. Typical synthesis of microporous materials involve mixing the framework elements (or compounds, thereof) in a basic solution, followed by aging in some cases and then heating at elevated temperatures. This process is termed hydrothermal synthesis, and involves complex chemical and physical changes. Because of a limited understanding of this process, most synthesis advancements happen by a trial and error approach. There is considerable interest in understanding the synthesis process at a molecular level with the expectation that eventually new framework structures will be built by design. The basic issues in the microporous materials crystallization process include: (1) Nature of the molecular units responsible for the crystal nuclei formation; (2) Nature of the nuclei and nucleation process; (3) Growth process of the nuclei into crystal; (4) Morphological control and size of the resulting crystal; (5) Surface structure of the resulting crystals; (6) Transformation of frameworks into other frameworks or condensed structures. The NASA-funded research described in this report focuses to varying degrees on all of the above issues and has been described in several publications. Following is the presentation of the highlights of our current research program. The report is divided into five sections: (1) Fundamental aspects of the crystal growth process; (2) Morphological and Surface properties of crystals; (3) Crystal dissolution and transformations; (4) Modeling of Crystal Growth; (5) Relevant Microgravity Experiments.

Author

*Crystal Growth; Microporosity; Mechanical Properties; Porous Materials; Surface Properties; Crystal Morphology; Molecular Interactions*

**20030002501** NASA Marshall Space Flight Center, Huntsville, AL USA

**Characterization of the Protein Crystal Growth Apparatus for Microgravity Aboard the Space Station**

Kundrot, Craig E., NASA Marshall Space Flight Center, USA; Roeber, D., NASA Marshall Space Flight Center, USA; Achari, A., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; XIX Congress of the International Union of Crystallography, 5-15 Aug. 2002, Geneva, Switzerland; No Copyright; Avail: Issuing Activity; Abstract Only

We have conducted experiments to determine the equilibration rates of some major precipitants used in protein crystallography aboard the International Space Station (ISS). The solutions were placed in the Protein Crystallization Apparatus for Microgravity (PCAM) which mimic Cryschem sitting drop trays. The trays were placed in cylinders. These cylinders were placed inside a Single locker Thermal Enclosure System (STES), and were activated for different durations during the flight. Bumpers pressed against elastomers seal drops in a deactivated state during pre-flight and prior to transfer to the ISS. Activation occurs while in flight on the ISS by releasing the bumpers allowing the drops to be exposed to the reservoir. PCAM was flown to the ISS on STS 100, Flight 6A, on April 19, 2001. Six series of equilibration experiments were tested for each precipitant with a small amount of Green Fluorescent Protein (GFP). Cylinder 10 was never activated, 7 was activated for 40 days, 8 was activated for 20 days, 9 was activated for 10 days, 11 was activated for 4 days and 12 was activated for 2 days. Upon the return to Earth by STS 104 on July 24, 2001 the samples were transferred to Marshall Space Flight Center. The samples were then brought to the lab and the volumes of each sample were measured.

Author

*International Space Station; Microgravity; Protein Crystal Growth; Measuring Instruments*

**20030002637** Universitaet der Bundeswehr Muenchen, Fakultae fuer Elektrotechnik, Neubiberg, Germany  
**Stoichiometry Experiments of Layer Systems for Nanoelectronics** *Stoichimetrieuntersuchungen von Schichtsystemen fuer die Nanoelektronik*

Bieringer, Peter; Mar. 2000; 152p; In German

Report No.(s): AD-A408055; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The study deals with problems in the stoichiometric analysis of thin layers in silicon semiconductors, with the secondary mass-spectrometric system (SIMS) and the Rutherford backscatter spectrometric system (RES) selected as analytical methods. The appropriateness of these methods to the tests concluded is demonstrated ultimately in the study: SIMS is proven to be unfit, whereas the RBS system, as the author expected from the beginning, exemplifies the barometer by which the stoichiometric analysis of mixed layers can be scrutinized. SIMS is then shown to be ideal for determining the concentration of doping substances, due to the system's relative measuring capacity. Ever-thinning layers, however, tend to be problematic for both approaches.

DTIC

*Semiconducting Films; Stoichiometry; Nanotechnology*

**20030002686** NASA Marshall Space Flight Center, Huntsville, AL USA

**X-Ray and Electrostatic Levitation Undercooling Studies in Ti-Zr-Ni Quasicrystals Forming Alloys**

Rogers, J. R., NASA Marshall Space Flight Center, USA; Hyers, R. W., NASA Marshall Space Flight Center, USA; Rathz, T. J., NASA Marshall Space Flight Center, USA; Kelton, K. F., NASA Marshall Space Flight Center, USA; Gangopadhyay, A. K., NASA Marshall Space Flight Center, USA; Woo, G. L., NASA Marshall Space Flight Center, USA; Hannet, L., NASA Marshall Space Flight Center, USA; Krishnan, S., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

The first undercooling nucleation measurements of electrostatic-levitated droplets of TiZrNi alloys that form the icosahedral quasicrystal phase (i-phase) are presented. The reduced undercooling for crystallization decreases with an increasing polytetrahedral order of the primary solidifying phase, supporting the existence of a developing icosahedral short-range order in the undercooled liquid. X-ray diffraction measurements made at the Advance Photon Source on levitated liquid droplets of these alloys at their liquidus temperatures, however, show no evidence for increased icosahedral order. This suggests that significant ordering only occurs below the melting temperature.

Author

*Electrostatics; Levitation; Supercooling; Alloys; Protein Crystal Growth*

**20030003655** Pennsylvania Univ., Dept. of Bioengineering and Chemical Engineering, Philadelphia, PA USA

**Assembly of Colloidal Materials Using Bioadhesive Interactions**

Hammer, Daniel A., Pennsylvania Univ., USA; Hiddessen, Amy L., Pennsylvania Univ., USA; Tohver, Valeria, Pennsylvania Univ., USA; Crocker, John C., Pennsylvania Univ., USA; Weitz, David A., Harvard Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 637-657; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

We have pursued the use of biological crosslinking molecules of several types to make colloidal materials at relatively low volume fraction of colloidal particles. The objective is to make binary alloys of colloidal particles, made of two different colloidal particles coated with complementary biological lock-and-key binding molecules, which assemble due to the biological specificity. The long-term goal is to use low affinity lock-and-key biological interactions, so that they can anneal to form crystalline states. We have used a variety of different surface chemistries in order to make colloidal materials. Our first system involved using selectin-carbohydrate (sialyl-Lewis<sup>x</sup>) interactions; this chemistry is derived from immune system. This chemical interaction is of relatively low affinity, with timescales for dissociation of several seconds. Furthermore, the adhesion mediated by these molecules can be reversed by the chelation of calcium atoms; thus assembled structures can be disassembled reversibly. Our second system employed avidin-biotin chemistry. This well-studied system is of high affinity, and is generally irreversible on a laboratory time-scale. Thus, we would expect selectin-carbohydrate interactions at high molecular density and avidin-biotin interactions to give kinetically-trapped structures; however, at low densities, we would expect significant differences in the structure and dynamics of the two materials, owing to their very different release rates. We have also begun to use a third chemistry - DNA hybridization. By attaching single stranded DNA oligonucleotide chains to beads, we can drive the assembly of colloidal materials by hybridization of complementary DNA chains. It is well known that DNA adenosine-thymine (A-T) and guanine-cytosine (G-C) bases hybridize pairwise with a Gibbs free energy change of 1.7 kcal/mol per base; thus, the energy of the assembly can be modulated by altering the number of complementary bases in the DNA chains. Using these different crosslinking molecules, we have assembled colloidal materials from different-sized colloidal particles, A and B. In the first sets of experiment, we used high densities of adhesion molecules, and 0.96 micron (A) and 5.5 micron (B) diameter particles. The high density of adhesion

molecules means that the structures are kinetically trapped in nonequilibrium configurations. The structure of the suspension can be varied by changing the number ratio of the two types of colloidal particles, NA and NB, where A is the smaller particle. With carbohydrate-selectin or avidin-biotin interactions, large NA/NB leads to the formation of colloidal micelles, with the large center B particle surrounded by many smaller A particles. As the ratio NA/NB decreases, the structures become more extended, approaching the formation of macro-Rouse polymers - extended linear chains where A beads are connected with intervening small B linkers.

Author

*Molecular Interactions; Association Reactions; Synthesis (Chemistry); Adhesion; Crosslinking; Crystallization; Crystal Growth*

**20030003728** Argonne National Lab., IL USA

**Control-Theoretic Formulation of the Bunch Train Cavity Interaction**

Schwartz, C.; Haddad, A. H.; Nassiri, A.; Mar. 01, 2001; 18p; In English

Report No.(s): DE2002-799784; ANL/ASD/CP-104272; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

The bunch train cavity interaction is an accelerator physics problem, for which a system-theoretic model is lacking. Modal analysis has been used to characterize the system dynamics, exploiting the system's symmetry. Corresponding, control design has been done using classical frequency-domain-based control. Several shortcomings of these methods are highlighted, all of which are remedied by a new time-domain, system-theoretic model presented herein. The new formulation is a periodic, discrete-time system, amenable to state-space control-design methods.

NTIS

*Cavities; Bunching; Mathematical Models; Accelerators; Control Theory*

**20030003747** Argonne National Lab., IL USA

**Practical Superconductor Development for Electrical Power Applications *Quarterly Report***

Sep. 2001; 28p; In English

Report No.(s): DE2002-801660; ANL/ET/RP-106185; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

This is a multiyear experimental research program that focuses on improving relevant material properties of high-Tc superconductors (HTS) and developing fabrication methods that can be transferred to industry for production of commercial conductors. A key element of this Argonne National Laboratory (ANL) program is the development of teaming relationships with industrial partners in the areas of conductor development and prototype electric power system product demonstration.

NTIS

*High Temperature Superconductors; Superconductors (Materials); Fabrication; Electric Batteries*

**20030003748** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Can Laterally Overgrown GaN Layers be free of Structural Defects?**

Cherns, D.; Liliental-Weber, Z.; 2002; 10p; In English

Report No.(s): DE2002-801931; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

Transmission electron microscopy has been used to examine dislocations present in an epitaxial laterally overgrown (ELOG) sample of GaN grown on (0001)sapphire. Studies of both plan-view and cross-sectional samples revealed arrays of dislocations present in the (11-20) boundary between the seed and the wing (overgrown) material and at the meeting front between adjacent wings, as well as dislocations in the form of half-loops extending into the wing regions.

NTIS

*Gallium Nitrides; Structural Analysis; Dislocations (Materials); Boundaries*

**20030003753** Ames Lab., IA USA

**Low Temperature Cryocooler Regenerator Materials**

Gschneidner, K. A.; Pecharsky, A. O.; Pecharsky, V. K.; Jun. 2002; 14p; In English

Report No.(s): DE2002-802144; Rept-13; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

There are four important factors which influence the magnitude of the magnetic heat capacity near the magnetic ordering transition temperature. These include the theoretical magnetic entropy, the deGennes factor, crystalline electric field, and the RKKY (Ruderman-Kittel-Kasuya-Yosida) interaction. The lattice contribution to the heat capacity also needs to be considered since it is the sum of the lattice and magnetic contributions which give rise to the heat capacity maxima. The lattice heat capacity depends on the chemical composition, crystal structure and temperature. As a result, one can obtain large changes in the heat

capacity maxima by alloying. Several ternary intermetallic systems have been examined in light of these criteria. A number of deviations from the expected behaviors have been found and are discussed.

NTIS

*Low Temperature; Regenerators; Cryogenic Cooling; Crystal Structure; Temperature Effects*

**20030003807** Argonne National Lab., IL USA

**Fabrication of Biaxially Textured Templates for Coated Conductors by Inclined Substrate Deposition**

Dorris, S. E.; Ma, B.; Li, M.; Fisher, B. L.; Koritala, R. E.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799798; No Copyright; Avail: National Technical Information Service (NTIS)

YBCO-coated conductors will enable the development of smaller, lighter, more efficient electric power devices that can be operated at temperatures approaching that of liquid nitrogen. The critical current density ( $J_c$ ) of YBCO films on flexible metallic substrates has been significantly improved by epitaxially growing the YBCO on biaxially textured template films. Inclined substrate deposition (ISD) offers the potential for rapidly producing high-quality biaxially textured buffer layers that are suitable for YBCO-coated conductors. Using the ISD method, we have grown biaxially textured MgO films at deposition rates of 20-100 Angstrom/sec. Electron microscopy of the ISD-MgO films revealed columnar grains topped off by MgO (002) planes, and X-ray pole figure analysis showed that the (002) planes are tilted with respect to the substrate normal, giving ISD-MgO films a roof-tile surface morphology.

NTIS

*Crystal Growth; YBCO Superconductors; Electron Microscopy; Superconducting Films*

**20030003831** Argonne National Lab., IL USA

**New Generation of Superconducting Solenoids for Heavy-Ion Linac Application**

Ostroumov, P. N.; Kim, S. H.; Lessner, E. S.; Shepard, K. W.; Laxdal, R. E.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-799847; No Copyright; Avail: National Technical Information Service (NTIS)

The beam dynamics of superconducting (SC) heavy-ion linacs operating in the velocity range below  $0.4c$  require a compact accelerating-focusing lattice. The use of SC solenoids together with SC RF resonators within a common cryostat can solve the real-estate problem. The solenoids must have low fringe fields to avoid magnetic-flux capture in the SC RF resonators. Also, incorporating dipole steering coils together with the SC solenoids in one magnet assembly can increase the compactness of the linac lattice. R&D work has been carried out to determine the feasibility of combining the three elements of high solenoid field, low fringe field, and integral dipole field, into one compact package. A 9-Tesla magnet has been initially designed and will be prototyped, with the goal of eventually developing 14-Tesla solenoids of similar design. The most important design issues are: (1) to minimize stray field in the RF cavity region using SC bucking coils and (2) to achieve adequate mechanical stability of the transverse dipole windings in the presence of forces produced by the solenoid/bucking coil assembly. The assembly, including terminals, switches, and protection circuit, are designed to fit inside a 25-cm diameter helium reservoir. The results of the preliminary design of the solenoid, including numerical simulations of the beam dynamics, are reported.

NTIS

*Solenoids; Superconductivity; Linear Accelerators; Magnetic Flux*

77

**PHYSICS OF ELEMENTARY PARTICLES AND FIELDS**

*Includes quantum mechanics; theoretical physics; and statistical mechanics. For related information see also 72 Atomic and Molecular Physics, 73 Nuclear Physics, and 25 Inorganic, Organic and Physical Chemistry.*

**20030002234** George Washington Univ., Center for Nuclear Studies, Washington, DC USA

**Excited Baryons and Chiral Symmetry Breaking of QCD**

Lee, F. X.; Aug. 14, 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801037; No Copyright; Avail: National Technical Information Service (NTIS)

$N^*$  masses in the spin-1/2 and spin-3/2 sectors are computed using two non-perturbative methods: lattice QCD (Quantum Chromodynamics) and QCD sum rules. States with both positive and negative parity are isolated via parity projection methods.

The basic pattern of the mass splittings is consistent with experiments. The mass splitting within the same parity pair is directly linked to the chiral symmetry breaking QCD.

NTIS

*Quantum Chromodynamics; Baryons*

**20030002237** Stanford Linear Accelerator Center, Stanford, CA USA

**Overview of the X-band R and D Program**

Raubenheimer, T. O.; Aug. 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-800060; SLAC-PUB-9442; No Copyright; Avail: National Technical Information Service (NTIS)

An electron/positron linear collider with a center-of-mass energy between 0.5 and 1 TeV is recognized as an important complement to the physics program of the LHC (Large Hadron Collider). The Next Linear Collider (NLC) is being designed by a US collaboration (FNAL, LBNL, LLNL, and SLAC) which is working closely with the Japanese collaboration that is designing the Japanese Linear Collider (JLC). The NLC/JLC main linacs are based on normal conducting 11 GHz rf. This paper will discuss the status of the NLC design. Results from the ongoing R&D (research and development) programs, including the recently uncovered high gradient damage problem, will be discussed along with changes to the optical design and collider layout which were made to enhance the collider capabilities.

NTIS

*Linear Accelerators; Particle Collisions; Klystrons*

**20030002369** Stanford Linear Accelerator Center, Stanford, CA USA

**Supersymmetry Changing Bubbles in String Theory**

Kachru, S.; Liu, X.; Schulz, M.; Trivedi, S. P.; May 20, 2002; 18p; In English

Report No.(s): DE2002-799926; SLAC-PUB-9205; TIFR-TH-02-17; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We give examples of string compactifications in 4d Minkowski space with different amounts of supersymmetry that can be connected by spherical domain walls. The tension of these domain walls is tunably lower than the 4d Planck scale. The 'stringy' description of these walls is known in terms of certain configurations of wrapped Dirichlet and NS branes.

NTIS

*Bubbles; String Theory; Minkowski Space*

**20030003684** Stanford Linear Accelerator Center, USA

**High-Dimensional Quantum Hall Effect in String Theory**

Fabinger, M.; Jun. 29, 2002; 20p; In English

Report No.(s): DE2002-799919; SLAC/PUB-9117; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We construct a string theory realization of the 4+1d quantum Hall effect recently discovered by Zhang and Hu. The string theory picture contains coincident D4- branes forming an S4 and having D0-branes (i.e. instantons) in their world-volume. The charged particles are modeled as string ends. Their configuration space approaches in the large n limit a CP3, which is an S2 fibration over S4, the extra S2 being made out of the Chan-Paton degrees of freedom. An alternative matrix theory description involves the fuzzy S4. We also find that there is a hierarchy of quantum Hall effects in odd-dimensional space times, generalizing the known cases in 2 + 1d and 4 + 1d.

NTIS

*Instantons; Quantum Hall Effect; String Theory; Charged Particles*

**20030003685** Stanford Univ., Stanford, CA USA

**Bouncing Brane Cosmologies from Warped String Compactifications**

Kachru, S.; McAllister, L.; May 30, 2002; 26p; In English

Report No.(s): DE2002-799924; SLAC-PUB-9201; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We study the cosmology induced on a brane probing a warped throat region in a Calabi-Yau compactification of type IIB string theory. For the case of a BPS D3-brane probing the Klebanov-Strassler warped deformed conifold, the cosmology described by a suitable brane observer is a bouncing, spatially at Friedmann-Robertson-Walker universe with time varying Newton's constant, which passes smoothly from a contracting to an expanding phase. In the Klebanov-Tseytlin approximation to the Klebanov-Strassler solution the cosmology would end with a big crunch singularity. In this sense, the warped deformed conifold provides a string theory resolution of a spacelike singularity in the brane cosmology. The four-dimensional effective action

appropriate for a brane observer is a simple scalar-tensor theory of gravity. In this description of the physics, a bounce is possible because the relevant energy-momentum tensor can classically violate the null energy condition.

NTIS

*Cosmology; String Theory; Singularity (Mathematics); Gravitation*

**20030003686** Weizmann Inst. of Science, Dept. of Particle Physics, Rehovot, Israel

**Clean Time-Dependent String Backgrounds from Bubble Baths**

Aharony, O.; Fabinger, M.; Horowitz, G. T.; Silverstein, E.; Apr. 2002; 44p; In English

Report No.(s): DE2002-799925; SLAC-PUB-9203; WIS/16/02-APR-DPP; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We consider the set of controlled time-dependent backgrounds of general relativity and string theory describing 'bubbles of nothing', obtained via double analytic continuation of black hole solutions. We analyze their quantum stability, uncover some novel features of their dynamics, identify their causal structure and observables, and compute their particle production spectrum. We present a general relation between squeezed states, such as those arising in cosmological particle creation, and nonlocal theories on the string worldsheet. The bubble backgrounds have various aspects in common with de Sitter space, Rindler space, and moving mirror systems, but constitute controlled solutions of general relativity and string theory with no external forces. They provide a useful theoretical laboratory for studying issues of observables in systems with cosmological horizons, particle creation, and time-dependent string perturbation theory.

NTIS

*String Theory; Time Dependence; Quantum Mechanics; Bubble Chambers; Perturbation Theory*

**20030003687** Stanford Linear Accelerator Center, USA

**Instability of 3d Null Singularities**

Lawrence, A.; Jul. 24, 2002; 14p; In English

Report No.(s): DE2002-799928; SU-ITP-02/18; SLAC-PUB-9213; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

String propagation on a three-dimensional Lorentzian string orbifold with a null singularity has been studied by Horowitz and Steif, and more recently by Liu, Moore and Seiberg. We analyze the target space as a classical gravitational background. The singularity becomes spacelike when an arbitrarily small amount of matter is thrown at the singularity. This can be seen directly by constructing a Vaidya-type solution, or by studying the null singularity as a limit of the  $M = 0$ ,  $J = 0$  BTZ black hole metric.

NTIS

*Singularity (Mathematics); Stability; Propagation; String Theory*

**20030003688** Stanford Linear Accelerator Center, USA

**Coupling in Pseudo-Supersymmetry**

Klein, M.; Jul. 05, 2002; 34p; In English

Report No.(s): DE2002-799934; SLAC-PUB-9234; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

We analyze theories in which a supersymmetric sector is coupled to a supersymmetry breaking sector described by a non-linear realization. We show how to consistently couple  $N = 1$  supersymmetric matter to non-supersymmetric matter in such a way that all interactions are invariant under non-linear supersymmetry transformations. We extend this formalism to couple  $N = 2$  supersymmetric matter to  $N = 1$  superfields that lack  $N_i = 2$  partners but transform in a non-linear representation of the  $N = 2$  algebra. In particular, we show how to couple an  $N = 2$  vector to  $N = 1$  chiral fields in a consistent way. This has important applications to effective field theories describing the interactions of D-brane world volume fields with bulk fields. We apply our method to study systems where different sectors break different halves of supersymmetry, which appear naturally in models of intersecting branes.

NTIS

*Nonlinearity; Supersymmetry; Coupling; Field Theory (Physics)*

**SOCIAL AND INFORMATION SCIENCES (GENERAL)**

*Includes general research topics related to sociology; educational programs and curricula.*

**20030002455** Embry-Riddle Aeronautical Univ., Applied Aviation Sciences Dept., USA

**Evaluating Education and Science at the KSC Visitor Complex**

Erickson, Lance K., Embry-Riddle Aeronautical Univ., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

As part of a two-year NASA-ASEE project, a preliminary evaluation and subsequent recommendations were developed to improve the education and science content of the Kennedy Space Center Visitor Complex exhibits. Recommendations for improvements in those exhibits were based on qualitative descriptions of the exhibits, on comparisons to similar exhibit collections, and on available evaluation processes. Because of the subjective nature of measuring content in a broad group of exhibits and displays, emphasis is placed on employing a survey format for a follow-on, more quantitative evaluation. The use of an external organization for this evaluation development is also recommended to reduce bias and increase validity.

Author

*Education; Evaluation; Space Operations Center (NASA)*

**20030003834** NASA Marshall Space Flight Center, Huntsville, AL USA

**Issues in Informal Education: Event-Based Science Communication Involving Planetaria and the Internet**

Adams, M., NASA Marshall Space Flight Center, USA; Gallagher, D. L., NASA Marshall Space Flight Center, USA; Whitt, A., Fernbank Science Center, USA; [2002]; 2p; In English; Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

For the past four years the Science Directorate at Marshall Space Flight Center has carried out a diverse program of science communication through the web resources on the Internet. The program includes extended stories about NASA science, a curriculum resource for teachers tied to national education standards, on-line activities for students, and webcasts of real-time events. Events have involved meteor showers, solar eclipses, natural very low frequency radio emissions, and amateur balloon flights. In some cases broadcasts accommodate active feedback and questions from Internet participants. We give here, examples of events, problems, and lessons learned from these activities.

Author

*Education; Internets; Planetariums; Communication; Science*

**ADMINISTRATION AND MANAGEMENT**

*Includes management planning and research.*

**20030002356** Sandia National Labs., Albuquerque, NM USA

**LOCA 1.0: Library of Continuation Algorithms: Theory and Implementation Manual**

Salinger, A. G.; Bou-Rabee, N. M.; Pawlowski, R. P.; Wilke, E. D.; Burroughs, E. A.; Mar. 2002; 86p; In English Report No.(s): DE2002-800778; SAND2002-0396; No Copyright; Avail: Department of Energy Information Bridge, Microfiche

LOCA, the Library of Continuation Algorithms, is a software library for performing stability analysis of large-scale applications. LOCA enables the tracking of solution branches as a function of a system parameter, the direct tracking of bifurcation points, and, when linked with the ARPACK library, a linear stability analysis capability. It is designed to be easy to implement around codes that already use Newton's method to converge to steady-state solutions. The algorithms are chosen to work for linear equations, and to run on distributed memory parallel machines. This manual presents LOCA's continuation and bifurcation analysis algorithms, and instructions on how to implement LOCA with an application code.

NTIS

*Computer Programs; Libraries; Algorithms*

**20030003816** President's Information Technology Advisory Committee, Washington, DC USA

**Transforming Access to Government through Information Technology**

Sep. 2000; 34p; In English

Report No.(s): PB2003-101777; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

The President's Information Technology Advisory Committee (PITAC) took special note of your December 1999 executive memorandum promoting electronic government, as well as recent announcements such as the launch of the FirstGov website for one-stop access to government information and services. We share your vision to create an 'Information Age' government made more efficient, effective, and accessible through information technology. In fact, our 1999 report, Information Technology Research: Investing in Our Future, identified the relationship between government and citizens as one of the vital areas of our national life where information technology offers the potential to dramatically transform current practices in ways that will greatly benefit all Americans. Thus, we are pleased to enclose Transforming Access to Government Through Information Technology, the first in a series of follow-ups to our 1999 report. This latest report highlights our findings and recommendations on how the government can provide leadership by solving key IT technology challenges, improving public access to Federal resources as well as re-engineering and simplifying internal and external governmental transactions. Our goal is to define a program that will provide our citizens with full and easy electronic access to their government regardless of their physical location, level of computer literacy or physical abilities.

NTIS

*Information Systems; Governments; Information Flow*

**82**

**DOCUMENTATION AND INFORMATION SCIENCE**

*Includes information management; information storage and retrieval technology; technical writing; graphic arts; and micrography. For computer documentation see 61 Computer Programming and Software.*

**20030002289** Lockheed Martin Corp., USA

**PIMS-Universal Payload Information Management**

Elmore, Ralph, Lockheed Martin Corp., USA; [2002]; 2p; In English; Space Ops Conference, 9-12 Oct. 2002, Houston, TX, USA; No Copyright; Avail: Issuing Activity; Abstract Only

As the overall manager and integrator of International Space Station (ISS) science payloads and experiments, the Payload Operations Integration Center (POIC) at Marshall Space Flight Center had a critical need to provide an information management system for exchange and management of ISS payload files as well as to coordinate ISS payload related operational changes. The POIC's information management system has a fundamental requirement to provide secure operational access not only to users physically located at the POIC, but also to provide collaborative access to remote experimenters and International Partners. The Payload Information Management System (PIMS) is a ground based electronic document configuration management and workflow system that was built to service that need. Functionally, PIMS provides the following document management related capabilities: 1. File access control, storage and retrieval from a central repository vault. 2. Collect supplemental data about files in the vault. 3. File exchange with a PMS GUI client, or any FTP connection. 4. Files placement into an FTP accessible dropbox for pickup by interfacing facilities, included files transmitted for spacecraft uplink. 5. Transmission of email messages to users notifying them of new version availability. 6. Polling of intermediate facility dropboxes for files that will automatically be processed by PIMS. 7. Provide an API that allows other POIC applications to access PIMS information. Functionally, PIMS provides the following Change Request processing capabilities: 1. Ability to create, view, manipulate, and query information about Operations Change Requests (OCRs). 2. Provides an adaptable workflow approval of OCRs with routing through developers, facility leads, POIC leads, reviewers, and implementers. Email messages can be sent to users either involving them in the workflow process or simply notifying them of OCR approval progress. All PIMS document management and OCR workflow controls are coordinated through and routed to individual user's "to do" list tasks. A user is given a task when it is their turn to perform some action relating to the approval of the Document or OCR. The user's available actions are restricted to only functions available for the assigned task. Certain actions, such as review or action implementation by non-PIMS users, can also be coordinated through automated emails.

Author

*Configuration Management; Graphical User Interface; Information Management; Management Systems; Payload Integration*

**20030002319** Pacific Air Forces, Hickam AFB, HI USA

**Modification Program Management, PACAF Instruction 3-101, Acquisition, Supersedes PACAFI63-101, 4 Feb 2000**

May 10, 2002; 11p; In English

Report No.(s): AD-A407749; PACAF-63-01; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

This instruction implements AFPD 63-1, Acquisition System and portions of Department of Defense (DoD) Directive 5000.1, DoD Instruction 5000.2, and DoD manual 5000.2-M. It delineates responsibilities, provides procedures, and defines HQ PACAF policy for processing need and requirement documentation for tactical, cargo, helicopter and special purpose aircraft, including developing programming and funding strategy to facilitate implementation of modifications and upgrades. It does not apply to command, control, communications, computer and intelligence modifications and upgrades. It further assures coordinated staff action during all modification and upgrade management processes to include appropriate documentation requirements. Responsibilities and procedures for the development and processing of Mission Need Statements (MNS), Operational Requirements Documents (ORD), AF Form 1067 and general modification instructions are provided in Air Force Instruction 63-1101, ATCh 4. This instruction does not apply to Air National Guard (ANG) or Air Force Reserve Command (AFRC) units or members.

DTIC

*Management; Military Operations; Documents; Revisions; Education*

**20030002349** Defense Acquisition Univ., Fort Belvoir, VA USA

**Knowledge Management and Information Technology (Know-IT Encyclopedia)**

Pollock, Neal; Sep. 2002; 385p; In English

Report No.(s): AD-A407692; No Copyright; Avail: CASI; A17, Hardcopy; A04, Microfiche

As knowledge management (KM) and information technology (IT) have developed and grown, numerous technical terms and phrases have evolved that many may find difficult to understand. This encyclopedia is an attempt to create and distribute a knowledge-level tool. Much of it is tacit knowledge taken from the author's experience on-the-job at the Program Executive Office for Information Technology (PEO-IT), the Department of the Navy (DON) Chief Information Office, and from courses taken at the Information Resources Management College to achieve certifications (CIO and National Security Telecommunications and Information Systems Security Instruction NSTISSI 4011).

DTIC

*Telecommunication; Knowledge Representation; Defense Program*

**20030002400** Naval Research Lab., Marine Geosciences Div., Stennis Space Center, MS USA

**Spatio-Temporal Data Mining and Knowledge Discovery: Issues Overview**

Ladner, Roy; Petry, Frederick; Jun. 2002; 21p; In English

Report No.(s): AD-A407803; NRL/BC/7440--02-1003; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Data mining or knowledge discovery refers to a variety of techniques having the intent of uncovering useful patterns and associations from large databases. The initial steps of data mining are concerned with preparation of data, including data cleaning intended to resolve errors and missing data and integration of data from multiple heterogeneous sources. Next are the steps needed to prepare for actual data mining including the selection of the specific data relevant to the task and the transformation of this data into a format required by the data mining approach. Finally specific data mining algorithms such as class description, association rules and classification clustering are applied. There are specific characteristics of spatial and temporal data, as found in GIS and multi-media data, that make knowledge discovery in this domain more complex than in mining ordinary data such as found in typical business sales applications. Here we provide a survey of work in spatio-temporal data mining emphasizing the special characteristics. An overview is given of different sources and types of geospatial, oceanographic and meteorological data and the associated issues inherent in their use in knowledge discovery.

DTIC

*Information Retrieval; Geographic Information Systems; Data Integration*

**20030002468** Bethune-Cookman Coll., Computer Science Dept., Daytona Beach, FL USA

**PRMS Data Warehousing Prototype**

Guruvadoo, Eranna K., Bethune-Cookman Coll., USA; 2000 Final Administrative Report NASA/ASEE Summer Faculty Fellowship Program; June 2002; 1p; In English

Contract(s)/Grant(s): NAG10-280; No Copyright; Avail: Issuing Activity; Abstract Only

Project and Resource Management System (PRMS) is a web-based, mid-level management tool developed at KSC to provide a unified enterprise framework for Project and Mission management. The addition of a data warehouse as a strategic component

to the PRMS is investigated through the analysis, design and implementation processes of a data warehouse prototype. As a proof of concept, a demonstration of the prototype with its OLAP's technology for multidimensional data analysis is made. The results of the data analysis and the design constraints are discussed. The prototype can be used to motivate interest and support for an operational data warehouse.

Author

*Resources Management; Management Systems; Project Management*

**20030002762** NASA Langley Research Center, Hampton, VA USA

**Technical Report Interchange Through Synchronized OAI Caches**

Liu, Xiaming, Old Dominion Univ., USA; Maly, Kurt, Old Dominion Univ., USA; Zubair, Mohammad, Old Dominion Univ., USA; Tang, Rong, Old Dominion Univ., USA; Padshah, Mohammad Imran, Old Dominion Univ., USA; Roncaglia, George, NASA Langley Research Center, USA; Rocker, JoAnne, NASA Langley Research Center, USA; Nelson, Michael, NASA Langley Research Center, USA; vonOfenheim, William, NASA Langley Research Center, USA; Luce, Richard, Los Alamos National Lab., USA; [2002]; 14p; In English; 6th European Conference on Research and Advanced Technology for Digital Libraries, 16-18 Sep. 2002, Rome, Italy; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

The Technical Report Interchange project is a cooperative experimental effort between NASA Langley Research Center, Los Alamos National Laboratory, Air Force Research Laboratory, Sandia National Laboratory and Old Dominion University to allow for the integration of technical reports. This is accomplished using the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) and having each site cache the metadata from the other participating sites. Each site also implements additional software to ingest the OAI-PMH harvested metadata into their native digital library (DL). This allows the users at each site to see an increased technical report collection through the familiar DL interfaces and take advantage of whatever value added are provided by the native DL.

Author

*Data Management; Protocol (Computers)*

**20030003731** NASA Ames Research Center, Moffett Field, CA USA

**Data Access Technology Workshop Position Paper**

Hinke, Thomas H., NASA Ames Research Center, USA; Oct. 01, 2002; 7p; In English; EOSDIS Data Access Technology Workshop, 8-9 Oct. 2002, Upper Marlboro, MD, USA

Contract(s)/Grant(s): RTOP 704-40-31; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

This paper addresses the seven questions that were requested of attendees prior to attending the Data Access Technology Workshop that is scheduled for October 8-9, 2002. Each of the questions is addressed in the following seven sections. The seven questions are: 1) What emerging technologies do you feel would best enhance user access to EOSDIS data and why? 2) How do you envision these technologies being used? How should they be used in combination with each other? 3) Can technologies be readily leveraged to achieve these results today? If not, when do you think they will be viable? 4) What investments do you think EOSDIS should make in these technologies today? Over the next 5 years? 5) What are reasonable cost expectations for leveraging these technologies as you've suggested? 6) What are the anticipated impacts on end users if these technologies are deployed, including investments required? 7) What unique researcher data access requirements need to be supported?

Author

*Technology Assessment; Access Control; EOS Data and Information System*

**20030004017** Defence Science and Technology Organisation, Air Operations Div., Fishermans Bend, Australia

**Integrated Data Acquisition System (IDAS)**

Harvey, J. F., Defence Science and Technology Organisation, Australia; Cameron, K., Defence Science and Technology Organisation, Australia; Spataro, M. A., Defence Science and Technology Organisation, Australia; Holland, O. F., Defence Science and Technology Organisation, Australia; Bird, F. J., Defence Science and Technology Organisation, Australia; Kent, S. A., Defence Science and Technology Organisation, Australia; Israel, M. M., Defence Science and Technology Organisation, Australia; May 2002; 54p; In English; Original contains color illustrations

Report No.(s): DSTO-GD-0325; DODA-AR-012-337; Copyright; Avail: Issuing Activity

A data acquisition system based on commercially available personal computer hardware is described. This system was developed to meet the requirements of the Royal Australian Navy in conduct of flight trials with helicopters operating at sea from

ships fitted with helicopter flight decks. All aspects of the system are controlled by software, enabling rapid setup of sample rates, gains, and filter characteristics. Data may be displayed in real-time, and further analysis of recorded data performed post-flight.

Author

*Data Acquisition; Military Helicopters; Computers; Computer Programs; Navy*

## 89

### ASTRONOMY

*Includes observations of celestial bodies, astronomical instruments and techniques; radio, gamma-ray, x-ray, ultraviolet, and infrared astronomy; and astrometry.*

**20030002352** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA USA

**Discovery of Associated Absorption Lines in an X-Ray Warm Absorber: Hubble Space Telescope Observations of PG 1114+445**

Mathur, Smita, Harvard-Smithsonian Center for Astrophysics, USA; Wilkes, Belinda, Harvard-Smithsonian Center for Astrophysics, USA; Elvis, Martin, Harvard-Smithsonian Center for Astrophysics, USA; The Astrophysical Journal; Aug. 10, 1998; Volume 503, pp. L23-L26; In English

Contract(s)/Grant(s): NAS8-39073; NAG5-8913; NAG5-3249; GO-06484.01-95A; Copyright; Avail: Issuing Activity

The unified picture of X-ray/UV absorbers offers a unique opportunity to probe the nuclear environment of active galactic nuclei. To test the unified absorber scenario and to understand the physical properties of the absorber, we obtained the first UV spectrum of PG 1114+445 using the Hubble Space Telescope (HST) Faint Object Spectrograph. PG 1114+445 is known to have an X-ray ionized ('warm') absorber, so that UV absorption is predicted. The HST spectrum clearly shows strong UV absorption lines due to Ly $\alpha$ , C iv, and N v, blueshifted by approximately 530 km s(exp -1) with respect to the quasar redshift. Since both X-ray and UV absorbers are rare in radio-quiet quasars, these observations argue strongly that the X-ray and UV absorbers are closely physically related, perhaps identical. We place constraints on the parameters of the absorber and conclude that the mass outflow rate is comparable to the accretion rate in PG 1114+445.

Author

*Absorption Spectra; Quasars; Line Spectra; X Ray Absorption; Spectrum Analysis; Ultraviolet Spectroscopy*

**20030002353** NASA Goddard Space Flight Center, Greenbelt, MD USA

**Strong X-Ray Absorption in a Broad Absorption Line Quasar: PHL 5200**

Mathur, Smita, Harvard-Smithsonian Center for Astrophysics, USA; Elvis, Martin, Harvard-Smithsonian Center for Astrophysics, USA; Singh, K. P., NASA Goddard Space Flight Center, USA; The Astrophysical Journal; Dec. 10, 1995; Volume 455, pp. L9-L12; In English

Contract(s)/Grant(s): NAS8-39073; NAG5-8913; NAGW-2201; NAG5-2563; NAGW-4490; Copyright; Avail: Issuing Activity

We present ASCA observations of the z=1.98 prototype broad absorption line quasar (BALQSO): PHL 5200. The source detected in both SIS and GIS. A power-law spectrum ( $\alpha(\text{sub } \epsilon)=0.6(\text{sup } 0.9)(\text{sub } -0.6)$ ) with large intrinsic absorption ( $N(\text{sub } H)=1.3(\text{sup } 2.3)(\text{sub } -1.1)\times 10(\text{exp } 23)\text{cm}(\text{exp } -2)$ ) best describes the spectrum. Excess column density over the local Galactic value is required at the 99% confidence level. This detection suggests that although BALQSOs are X-ray-quiet, it is strong absorption in the BAL region that makes them appear faint to low-energy X-ray experiments. The required intrinsic absorbing column density is 2-3 orders of magnitude larger than earlier estimates of column densities in BALQSOs. This implies that the BAL systems are much more highly ionized than was previously thought.

Author

*X Ray Absorption; Line Spectra; Quasars; Ionization*

**20030002354** Ohio State Univ., Dept. of Astronomy, Columbus, OH USA

**Far-Ultraviolet Spectroscopic Explorer Observations of the Narrow-Line Seyfert 1 Galaxy Arakelian 564**

Romano, P., Ohio State Univ., USA; Mathur, S., Ohio State Univ., USA; Pogge, R. W., Ohio State Univ., USA; Peterson, B. M., Ohio State Univ., USA; Kuraszkiwicz, J., Harvard-Smithsonian Center for Astrophysics, USA; The Astrophysical Journal; Oct. 10, 2002; Volume 578, No. 1, pp. 64-73; In English

Contract(s)/Grant(s): NAS5-32985; NAG5-8913; NAG5-10320; Copyright; Avail: Issuing Activity

We present a 63 ks FUSE observation of the narrow-line Seyfert 1 galaxy Arakelian 564. The spectrum is dominated by the strong emission in the O VI  $\lambda\lambda 1032, 1038$  resonance doublet. Strong, heavily saturated absorption troughs due to Lyman series of hydrogen, O VI, and C III  $\lambda 977$  at velocities near the systemic red shift of Ark 564 are also observed. We

used the column densities of O VI and C III, in conjunction with the published column densities of species observed in the UV and X-ray bands to derive constraints on the physical parameters of the absorber through photoionization modeling. The available data suggest that the UV and X-ray absorbers in Ark 564 are physically related and possibly identical. The combination of constraints indicates that the absorber is characterized by a narrow range in total column density  $N(\text{sub H})$  and  $U$ , centered at  $\log V(\text{sub H})$  is approximately 21 and  $\log U$  is approximately -1.5, and may be spatially extended along the line of sight.

Author

*Seyfert Galaxies; Active Galactic Nuclei; Absorption Spectra; Far UV Spectroscopic Explorer*

**20030002363** Ohio State Univ., Astronomy Dept., Columbus, OH USA

**Absorbing Outflows in AGN Final Report**

Mathur, Smita, Ohio State Univ., USA; [2002]; 5p; In English

Contract(s)/Grant(s): NAG5-8913; No Copyright; Avail: Issuing Activity; Abstract Only

The goal of this program was a comprehensive multiwavelength study of absorption phenomena in active galactic nuclei (AGN). These include a variety of associated absorption systems: X-ray warm absorbers, X-ray cold absorbers. UV absorbers with high ionization lines, MgII absorbers, red quasars and BALQSOs. The aim is to determine the physical conditions in the absorbing outflows, study their inter-relations and their role in AGN. We designed several observing programs to achieve this goal: X-ray spectroscopy, UV spectroscopy, FLAY spectroscopy and X-ray imaging. We were very successful towards achieving the goal over the five year period as shown through following observing programs and papers. Copies of a few papers are attached with this report.

Author

*Active Galactic Nuclei; Absorption Spectroscopy; Spectrum Analysis; Absorption Spectra*

**20030002366** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA USA

**The X-Ray Warm Absorber in NGC 3516**

Mathur, Smita, Harvard-Smithsonian Center for Astrophysics, USA; Wilkes, Belinda, Harvard-Smithsonian Center for Astrophysics, USA; Aldcroft, Thomas, Harvard-Smithsonian Center for Astrophysics, USA; The Astrophysical Journal; Mar. 20, 1997; Volume 478, pp. 182-189; In English

Contract(s)/Grant(s): NAS5-30934; NAS8-39073; NAG5-8913; NAGW-4490; Copyright; Avail: Issuing Activity

The Seyfert 1 galaxy, NGC 3516 has been the subject of many absorption line studies at both ultra-violet and X-ray wavelengths. In the UV, strong, broad, variable associated metal line absorption with velocity width approximately 2000 km s<sup>(exp -1)</sup> is thought to originate in gas with  $N(\text{sub H})$  greater than or approximately  $10(\text{exp } 10)\text{cm}(\text{exp } -2)$  lying between 0.01 and 9 pc from the central active nucleus. The Ginga X-ray data are consistent with several possibilities: a warm absorber and a cold absorber combined either with partial covering or an unusually strong reflection spectrum. We present ROSAT observations of NGC 3516 which show a strong detection of a warm absorber dominated by a blend of O VII/O VIII edges at approximately 0.8 keV with  $N(\text{sub H})$  approximately  $7 \times 10(\text{exp } 21)\text{cm}(\text{exp } -2)$ , and  $U:8-12$ . We argue that NGC 3516 contains an outflowing 'XUV' absorber showing the presence of X-ray absorption edges which are consistent with the presence of broad absorption lines in the old IUE spectra and their disappearance in the new UV observations. Our dynamical model suggests that the O VII absorption edge will continue to weaken compared to the O VIII edge, an easily testable prediction with future missions like AXAF. Eventually the source would be transparent to the X-rays unless a new absorption system is produced.

Author

*Seyfert Galaxies; Line Spectra; X Ray Absorption; Active Galactic Nuclei; X Ray Astronomy; X Ray Spectra*

**20030002371** Ohio State Univ., Dept. of Astronomy, Columbus, OH USA

**Discovery of Associated Absorption Lines in an X-Ray Warm Absorber: Hubble Space Telescope Faint Object Spectrograph Observations of MR 2251-178**

Monier, Eric M., Ohio State Univ., USA; Mathur, Smita, Ohio State Univ., USA; Wilkes, Belinda, Harvard-Smithsonian Center for Astrophysics, USA; Elvis, Martin, Harvard-Smithsonian Center for Astrophysics, USA; The Astrophysical Journal; Oct. 01, 2001; Volume 559, pp. 675-679; In English

Contract(s)/Grant(s): NAS5-26555; NAG5-8913; Copyright; Avail: Issuing Activity

The presence of a 'warm absorber' was first suggested to explain spectral variability in an X-ray spectrum of the radio-quiet quasi-stellar object (QSO) MR 2251-178. A unified picture, in which X-ray warm absorbers and 'intrinsic' UV absorbers are the same, offers the opportunity to probe the nuclear environment of active galactic nuclei. To test this scenario and understand the physical properties of the absorber, we obtained a UV spectrum of MR 2251-178 with the Faint Object Spectrograph on board the Hubble Space Telescope (HST). The HST spectrum clearly shows absorption due to Ly $\alpha$ , N v, and C IV, blueshifted by

300 km s(exp -1) from the emission redshift of the QSO. The rarity of both X-ray and UV absorbers in radio-quiet QSOs suggests these absorbers are physically related, if not identical. Assuming the unified scenario, we place constraints on the physical parameters of the absorber and conclude the mass outflow rate is essentially the same as the accretion rate in MR 2251-178.

Author

*Active Galactic Nuclei; X Ray Absorption; Line Spectra; X Ray Spectra; X Ray Spectroscopy; Absorption Spectra*

**20030002372** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA USA

**Multiple Velocity Components in the C IV Absorption Line of NGC 5548**

Mathur, Smita, Harvard-Smithsonian Center for Astrophysics, USA; Elvis, Martin, Harvard-Smithsonian Center for Astrophysics, USA; Wilkes, Belinda, Harvard-Smithsonian Center for Astrophysics, USA; *The Astrophysical Journal*; Jul. 10, 1999; Volume 519, pp. 605-609; In English

Contract(s)/Grant(s): NAS8-39073; NAG5-8913; NAG5-3249; GO-06485.01-95A; Copyright; Avail: Issuing Activity

We have observed the much-studied Seyfert 1 galaxy NGC 5548 with the Goddard High-Resolution Spectrograph (GHRS) on the Hubble Space Telescope (HST). Our 14 ks observation covers the C IV emission line at a resolution of greater than 20,000. Our purpose was to study the absorption line found at lower resolution by IUE and the HST Faint Object Spectrograph. We found that the C IV absorption line resolves into six separate doublets with equivalent widths of 0.07-0.38 Angstrom. The absorption lines have blueshifts relative to the systemic velocity of the galaxy of 380-1250 km s(exp -1), except for one, which has a redshift of 250 km s(exp -1), suggesting both inflow and outflow. The inflowing component may be related to the accretion flow into the nuclear black hole. All the doublet lines are resolved by the GHRS. Three doublets are narrow, with FWHM greater than or approximately 100 km s(exp -1), and three are broad, FWHM approximately 160-290 km s(exp -1). We find evidence of partial covering by the narrow absorption lines. Either (but not both) of the two strongest broad doublets could be from the same material that produces the X-ray ionized absorber seen in soft X-rays. The remaining five systems must be at least 10 times less ionized (and so of lower total column density) to remain consistent with the X-ray spectra.

Author

*Seyfert Galaxies; Ultraviolet Radiation; Line Spectra; X Ray Spectra; X Ray Absorption*

**20030002375** Harvard-Smithsonian Center for Astrophysics, Cambridge, MA USA

**X-Ray Absorption Toward the Einstein Ring Source PKS 1830-211**

Mathur, Smita, Harvard-Smithsonian Center for Astrophysics, USA; Nair, Sunita, Manchester Univ., UK; *The Astrophysical Journal*; Jul. 20, 1997; Volume 484, pp. 140-144; In English

Contract(s)/Grant(s): NAGW-4490; NAG5-8913; Copyright; Avail: Issuing Activity

PKS 1830-211 is an unusually radio-loud gravitationally lensed quasar. In the radio spectrum, the system appears as two compact, dominant features surrounded by relatively extended radio emission that forms an Einstein ring. As the line of sight to it passes close to our Galactic center, PKS 1830-211 has not been detected in wave bands other than the radio and X-ray so far. Here we present X-ray data of PKS 1830-211 observed with ROSAT Position Sensitive Proportional Counter. The X-ray spectrum shows that absorption in excess of the Galactic contribution is highly likely, which at the redshift of the lensing galaxy ( $z(\text{sub } t)=0.886$ ) corresponds to  $N(\text{sub } H)=3.5((\text{sup } 0.6)(\text{sub } -0.5))\times 10(\text{exp } 22)$  atoms sq cm. The effective optical extinction is large,  $A(\text{sub } V)(\text{observed})$  is greater than or approximately 5.8. When corrected for this additional extinction, the two-point optical to X-ray slope  $\alpha(\text{sub } \text{ox})$  of PKS 1830-211 lies just within the observed range of quasars. It is argued here that both compact images must be covered by the X-ray absorber(s) that we infer to be the lensing galaxy (galaxies). The dust-to-gas ratio along the line of sight within the lensing galaxy is likely to be somewhat larger than for our Galaxy.

Author

*X Ray Absorption; X Ray Astronomy; Radio Sources (Astronomy); Active Galactic Nuclei; X Ray Detectors*

**20030002465** NASA Marshall Space Flight Center, Huntsville, AL USA

**Chandra X-Ray Observations of the Jovian System**

Elsner, R. F., NASA Marshall Space Flight Center, USA; Waite, J. H., Michigan Univ., USA; Cray, F., Michigan Univ., USA; Majeed, T., Michigan Univ., USA; Gladstone, G. R., Southwest Research and Development Co., USA; Lewis, W. S., Southwest Research and Development Co., USA; Ford, P. G., Massachusetts Inst. of Tech., USA; Howell, R. R., Wyoming Univ., USA; Johnson, R. E., Virginia Univ., USA; Bhardwaj, A., Indian Space Research Organization, India; [2002]; 1p; In English; 34th Meeting on the Division for Planetary Science of the American Astronomical Society, 6-11 Oct. 2002, Birmingham, AL, USA; No Copyright; Avail: Issuing Activity; Abstract Only

High-spatial resolution Chandra x-ray observations have demonstrated that most of Jupiter's northern auroral x-rays come from a hot spot located significantly poleward of the latitudes connected to the inner magnetosphere. This hot spot appears fixed

in magnetic latitude and longitude and coincides with a region exhibiting anomalous ultraviolet and infrared emissions. The hot spot also exhibited approximately 45 minute quasi-periodic oscillations, a period similar to those reported for high-latitude radio and energetic electron bursts observed by near-Jupiter spacecraft. These results invalidate the idea that jovian auroral x-ray emissions are mainly excited by steady precipitation of energetic heavy ions from the inner magnetosphere. Instead, the x-rays appear to result from currently unexplained processes in the outer magnetosphere that produce highly localized and highly variable emissions over an extremely wide range of wavelengths. The Chandra observations also revealed for the first time x-ray emission (about 0.1 GW) from the Io Plasma Torus, as well as very faint x-ray emission (about 1-2 MW) from the Galilean moons Io, Europa, and possibly Ganymede. The emission from the moons is almost certainly due to Kalpha emission of surface atoms (and possibly impact atoms) excited by the impact of highly energetic protons, oxygen, and sulfur atoms and ions from the Torus. The Torus emission is less well understood at present, although bremsstrahlung from the non-thermal tail of the electron distribution may provide a significant fraction. In any case, further observations, already accepted and in the process of being planned, with Chandra, some with the moderate energy resolution of the CCD camera, together with simultaneous Hubble Space Telescope observations and hopefully ground-based IRTF observations should soon provide greater insight into these various processes.

Author

*Jupiter (Planet); Jupiter Atmosphere; X Rays; Detection; Ultraviolet Emission; Energetic Particles*

**20030002476** NASA Marshall Space Flight Center, Huntsville, AL USA

**A Giant Warm Baryonic Halo for the Coma Cluster**

Bonamente, Max, Alabama Univ., USA; Lieu, Richard, Alabama Univ., USA; Joy, Marshall K., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Several deep PSPC observations of the Coma cluster unveil a very large-scale halo of soft X-ray emission, substantially in excess of the well know radiation from the hot intra-cluster medium. The excess emission, previously reported in the central cluster regions through lower-sensitivity EUVE and ROSAT data, is now evident out to a radius of 2.5 Mpc, demonstrating that the soft excess radiation from clusters is a phenomenon of cosmological significance. The spectrum at these large radii cannot be modeled non-thermally, but is consistent with the original scenario of thermal emission at warm temperatures. The mass of this plasma is at least on par with that of the hot X-ray emitting plasma, and significantly more massive if the plasma resides in low-density filamentary structures. Thus the data lend vital support to current theories of cosmic evolution, which predict greater than 50 percent by mass of today's baryons reside in warm-hot filaments converging at clusters of galaxies.

Author

*Baryons; X Rays; Detection; Thermal Emission*

**20030002507** University of Southern California, Dept. of Electrical Engineering, Los Angeles, CA USA

**Unconventional Laser Guide Stars and Wavefront Correction of Blue Starlight *Final Report***

Hellwarth, Robert W.; May 28, 2002; 10p; In English

Contract(s)/Grant(s): F49620-98-1-0374

Report No.(s): AD-A407962; AFRL-SR-AR-TR-02-0349; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

In this project we established by theory and experiment (1) that a 1/4 Joule, 20 ns, ultraviolet laser pulse could create (near 20 km altitude) a return signal to the transmitting telescope that would appear, for 20 ns, to have a brightness temperature of millions of degrees, and thus serve as a guide star for high-order corrections of blue starlight, (2) that a much lower energy (approx. one hundred microjoules) femtosecond laser pulse could create an upward-traveling pulse near the tropopause with its wavelength shifted from the driving pulse, (3) that exact, finite-energy, pulse solutions of Maxwell's equations can have an electric (or magnetic) field with zero y-component everywhere in space, (4) that Maxwell's equations place no limit on the smallness of extinction experienced by a focused pulse of finite energy passing through finite crossed polarizers, and (5) that wavefront correctors based on photo-refractive spatial-light-modulators are unlikely to have their speed-of-response improved.

DTIC

*Laser Guidance; Adaptive Optics*

**20030002527** NASA Marshall Space Flight Center, Huntsville, AL USA

**Chandra Observations of Magnetic White Dwarfs and Their Theoretical Implications**

Musielak, Z. E., NASA Marshall Space Flight Center, USA; Noble, M., NASA Marshall Space Flight Center, USA; Porter, J. G., NASA Marshall Space Flight Center, USA; Winget, D. E., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Observations of cool DA and DB white dwarfs have not yet been successful in detecting coronal X-ray emission but observations of late-type dwarfs and giants show that coronae are common for these stars. to produce coronal X-rays, a star must

have dynamo-generated surface magnetic fields and a well-developed convection zone. There is strong observational evidence that the DA star LHS 1038 and the DB star GD 358 have weak and variable surface magnetic fields. Since these fields are likely to be generated by dynamo action and since both stars have well-developed convection zones, theory predicts detectable levels of coronal X-rays from these white dwarfs. However, we present analysis of Chandra observations of both stars showing no detectable X-ray emission. The derived upper limits for the X-ray fluxes provide strong constraints on theories of formation of coronae around magnetic white dwarfs.

Author

*White Dwarf Stars; X Ray Astrophysics Facility; Observation; Coronas*

**20030004008** California Univ., Lawrence Berkeley National Lab., Berkeley, CA USA

**Integral Field Spectrograph for SNAP Supernova Studies**

Ealet, A.; Prieto, E.; Bonissent, A.; Malina, R.; Bernstein, G.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-802039; No Copyright; Avail: National Technical Information Service (NTIS)

A well-adapted spectrograph concept has been developed for the SNAP (SuperNova/Acceleration Probe) experiment. The goal is to ensure proper identification of Type Ia supernovae and to standardize the magnitude of each candidate by determining explosion parameters. An instrument based on an integral field method with the powerful concept of imager slicing has been designed and is presented in this paper. The spectrograph concept is optimized to have very high efficiency and low spectral resolution ( $R$  approximately 100), constant through the wavelength range (0.35-1.7mm), adapted to the scientific goals of the mission.

NTIS

*Supernovae; Spectrographs*

**20030004012** Ohio State Univ., Dept. of Astronomy, Columbus, OH USA

**Surprises from a Deep ASCA Spectrum of the Broad Absorption Line Quasar PHL 5200**

Mathur, Smita, Ohio State Univ., USA; Matt, G., Rome Univ., Italy; Green, P. J., Harvard-Smithsonian Center for Astrophysics, USA; Elvis, M., Harvard-Smithsonian Center for Astrophysics, USA; Singh, K. P., Tata Inst. of Fundamental Research, India; Astrophysical Journal; Apr. 10, 2002; Volume 55, pp. L13-L16; In English

Contract(s)/Grant(s): NAG5-9270; NAG5-8913; Copyright; Avail: Issuing Activity

We present a deep (approx. 85 ks) ASCA observation of the prototype broad absorption line quasar (BALQSO) PHL 5200. This is the best X-ray spectrum of a BALQSO yet. We find the following: (1) The source is not intrinsically X-ray weak. (2) The line-of-sight absorption is very strong, with  $N(\text{sub H}) = 5 \times 10^{23}/\text{sq cm}$ . (3) The absorber does not cover the source completely; the covering fraction is approx. 90%. This is consistent with the large optical polarization observed in this source, implying multiple lines of sight. The most surprising result of this observation is that (4) the spectrum of this BALQSO is not exactly similar to other radio-quiet quasars. The hard X-ray spectrum of PHL 5200 is steep, with the power-law spectral index  $\alpha$  approx. 1.5. This is similar to the steepest hard X-ray slopes observed so far. At low redshifts, such steep slopes are observed in narrow-line Seyfert 1 (NLS1) galaxies, believed to be accreting at a high Eddington rate. This observation strengthens the analogy between BALQSOs and NLS1 galaxies and supports the hypothesis that BALQSOs represent an early evolutionary state of quasars. It is well accepted that the orientation to the line of sight determines the appearance of a quasar: age seems to play a significant role as well.

Author

*Quasars; Line Spectra; Absorption Spectra; X Ray Spectra; X Ray Astronomy*

90

ASTROPHYSICS

*Includes cosmology; celestial mechanics; space plasmas; and interstellar and interplanetary gases and dust.*

**20030002337** NASA Ames Research Center, Moffett Field, CA USA

**Organic Solid Matter as a Coloring Agent in Outer Solar System Bodies**

Cruikshank, D. P., NASA Ames Research Center, USA; DalleOre, C. M., NASA Ames Research Center, USA; Roush, T. L., NASA Ames Research Center, USA; Khare, B. N., NASA Ames Research Center, USA; Jun. 30, 2002; 1p; In English; DPS Conference, Oct. 2002, Birmingham, AL, USA

Contract(s)/Grant(s): RTOP 344-32-20-01; No Copyright; Avail: Issuing Activity; Abstract Only

Small bodies in the outer Solar System OSS, exhibit a range of color, or slope of the reflectance in the photovisual spectral region, ranging from neutral to very red, sometimes with and sometimes without distinct absorption bands. These objects range in geometric albedo from 0.03 to 1.0, with the higher albedo objects typically showing clear evidence of water ice. Water ice has also been found in a few objects with albedo 0.1 or less. We explore here the identification of the material or materials that color these icy and non-icy surfaces through scattering models that incorporate minerals, meteoritic material, and organic solids (tholins) produced in the laboratory by energy deposition in ices and gases. These models must match not only the color in the photovisual region, but the spectral reflectance properties throughout the near-infrared. Among some classes of objects, such as Kuiper Belt objects, the coloring agent may be a single material that is present in greater or lesser abundance, thus accounting for the range in color from neutral to very red. This may also apply to the Centaur objects, the Jovian Trojans, and the outer-main belt asteroids, each taken as a separate class. If so, each class may be colored to varying degrees by a different material, or they all might be colored by a common material that is widespread throughout the OSS, from 3 to 50 AU, and beyond. In this paper, we model the reflectances of Kuiper Belt objects, Centaurs, Trojans, outer ARAB asteroids, and planetary satellites. Our models show that the reddest surfaces cannot be colored by minerals or meteoritic materials, but can be matched throughout the photovisual and near-infrared by organic solids, specifically certain tholins.

Author

*Organic Solids; Color; Solar System; Absorption Spectra; Gas Giant Planets; Kuiper Belt; Spectral Reflectance*

**20030002339** NASA Ames Research Center, Moffett Field, CA USA

**Laboratory Studies of Extraterrestrial Ices and PAHs: Making an Astrobiological Silk Purse Out of An Interstellar Sow's Ear**

Hudgins, Douglas M., NASA Ames Research Center, USA; Aug. 28, 2002; 1p; In English; 34th COSPAR Scientific Assembly, 10-19 Oct. 2002, Houston, TX, USA; Sponsored by Committee on Space Research, Unknown

Contract(s)/Grant(s): RTOP 344-50-92-02; No Copyright; Avail: Issuing Activity; Abstract Only

Tremendous strides have been made in our understanding of interstellar material over the past twenty years thanks to significant, parallel developments in observational astronomy and laboratory astrophysics. Today, the composition of dust in the ISM is reasonably well constrained to cold, micron-sized particles of various refractory materials. Shrouded within the protective confines of cold, opaque molecular clouds--the birthplace of stars and planets--these particles secrete mantles of mixed molecular ices whose major components are also well constrained. Finally, amidst the molecular inventory of these ice mantles are likely to be found polycyclic aromatic hydrocarbons (PAHs), whose telltale infrared signature I is now recognized throughout the Universe. However, of what significance is this scenario to the origin of life in our solar system--or any other? The major components of the icy materials observed in interstellar clouds and in our own solar system are uniformly quite simple. In addition, despite the fact that PAHs likely represent the single largest molecular reservoir of organic carbon in evolving planetary systems, they are not what would be considered "biogenic" molecules. Although interesting from a chemical and astrophysical standpoint, in the absence of a mechanism by which these materials can be transformed into more biochemically significant structures, they are of little Astrobiological significance. In this talk, we will begin with a brief review of the nature and abundance of the "raw" population of PAHs and PAH-related materials in the ISM. From there, we will move on to explore our laboratory simulations of the photochemical evolution of realistic mixed molecular ices under conditions which simulate those encountered in the ISM and in evolving planetary systems. Particular attention will be paid to the surprisingly complex array of organic species that are produced in these ices from such a deceptively simple inventory of starting materials. In addition, we will explore the chemistry of PAHs under these conditions and consider its potential for transforming that rich repository of pre-biotic organic "ore" into materials of greater importance to Astrobiology.

Author

*Astrophysics; Biological Evolution; Carbon; Ice; Interstellar Matter; Molecular Clouds*

**20030002391** NASA Ames Research Center, Moffett Field, CA USA

**The Exobiological Role of Interstellar Polycyclic Aromatic Hydrocarbons and Ices**

Hudgins, Douglas M., NASA Ames Research Center, USA; Aug. 22, 2002; 1p; In English; 34th COSPAR Scientific Assembly, 10-19 Oct. 2002, Houston, TX, USA; Sponsored by Committee on Space Research, Unknown

Contract(s)/Grant(s): RTOP 344-50-92-02; No Copyright; Avail: Issuing Activity; Abstract Only

Tremendous strides have been made in our understanding of interstellar material over the past twenty years thanks to significant, parallel developments in observational astronomy and laboratory astrophysics. Before this time, the composition of interstellar dust was largely guessed-at, the presence of ices in interstellar clouds ignored, and the notion that large, gas phase, carbon rich molecules might be abundant and widespread throughout the interstellar medium (ISM) considered impossible. Today, the composition of dust in the ISM is reasonably well constrained to micron-sized cold refractory materials comprised of

amorphous and crystalline silicates mixed with an amorphous carbonaceous material containing aromatic structural units and short, branched aliphatic chains. Shrouded within the protective confines of cold, opaque molecular clouds--the birthplace of stars and planets--these cold dust particles secrete mantles of mixed molecular ices whose compositions are also well constrained. Finally, amidst the molecular inventory of these ice mantles are likely to be found polycyclic aromatic hydrocarbons (PAHs), shockingly large molecules by the standards of interstellar chemistry, the telltale infrared spectral signature of which is now recognized throughout the Universe. In the first part of this talk, we will review the spectroscopic evidence that forms the basis for the currently accepted abundance and ubiquity of PANs in the ISM. We will then look at a few specific examples which illustrate how experimental and theoretical data can be applied to interpret the interstellar spectra and track how the PAN population evolves as it passes from its formation site in the circumstellar outflows of dying stars, through the various phases of the ISM, and into forming planetary systems. Nevertheless, despite the fact that PANs likely represent the single largest molecular reservoir of organic carbon in evolving planetary systems, they are not what would be considered "biogenic" molecules. Although interesting from a chemical and astrophysical standpoint, in the absence of a mechanism by which this population can be dislodged from the precipitous thermodynamic well afforded by their extensive aromatic networks, they are of little Astrobiological significance. Consequently, for the remainder of the talk, we will consider the photochemical evolution of PANs under conditions similar to those found in the ISM and in proto-planetary systems with an eye toward means by which this rich repository of pre-biotic organic "ore" might be converted into materials of greater importance to Astrobiology.

Author

*Exobiology; Polycyclic Aromatic Hydrocarbons; Ice; Interstellar Chemistry; Interstellar Matter; Cosmic Dust; Carbonaceous Materials*

**20030002524** NASA Marshall Space Flight Center, Huntsville, AL USA

**Charge Sharing and Charge Loss in a Cadmium-Zinc-Telluride Fine-Pixel Detector Array**

Gaskin, J. A., Alabama Univ., USA; Sharma, D. P., NASA Marshall Space Flight Center, USA; Ramsey, B. D., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Because of its high atomic number, room temperature operation, low noise, and high spatial resolution a Cadmium-Zinc-Telluride (CZT) multi-pixel detector is ideal for hard x-ray astrophysical observation. As part of on-going research at MSFC (Marshall Space Flight Center) to develop multi-pixel CdZnTe detectors for this purpose, we have measured charge sharing and charge loss for a 4x4 (750micron pitch), Imm thick pixel array and modeled these results using a Monte-Carlo simulation. This model was then used to predict the amount of charge sharing for a much finer pixel array (with a 300micron pitch). Future work will enable us to compare the simulated results for the finer array to measured values.

Author

*Tellurides; X Rays; Detection; Arrays; Dielectric Loss; Energy Dissipation; Charge Distribution; Simulation*

**20030002664** Minnesota Univ., Dept. of Astronomy, Minneapolis, MN USA

**Infrared Imaging Polarimetry of Comets *Final Report, 1 Oct. 1998 - 30 Sep. 2002***

Jones, Terry Jay, Minnesota Univ., USA; [2002]; 2p; In English

Contract(s)/Grant(s): NAG5-7906; No Copyright; Avail: CASI; A01, Hardcopy; A01, Microfiche

This paper presents a final report on the observation of comets using infrared imaging polarimetry. A theoretical program to model the observations is also presented.

CASI

*Comets; Infrared Imagery; Polarimetry; Imaging Techniques; Mathematical Models*

**20030002687** NASA Marshall Space Flight Center, Huntsville, AL USA

**Video Observations Encompassing the 2002 Leonid Storm: First Results and a Revised Photometric Procedure for Video Meteor Analysis**

Cooke, William J., Computer Sciences Corp., USA; Suggs, Robert, NASA Marshall Space Flight Center, USA; Swift, Wesley, Raytheon Co., USA; Gural, Peter S., Science Applications International Corp., USA; Brown, Peter, University of Western Ontario, Canada; [2002]; 1p; In English; Asteroids, Comets and Meteors 2002 Conference, 29 Jul. - 2 Aug. 2002, Berlin, Germany Contract(s)/Grant(s): NAS8-60000; No Copyright; Avail: Issuing Activity; Abstract Only

During the 2001 Leonid storm, Marshall Space Flight Center, with the cooperation of the University of Western Ontario and the USA Air Force, deployed 6 teams of observers equipped with intensified video systems to sites located in North America, the Pacific, and Mongolia. The campaign was extremely successful, with the entire period of enhanced Leonid activity (over 16 hours) captured on video tape in a consistent manner. We present the first results from the analysis of this unique, 2 terabyte data set and discuss the problems involved in reducing large amounts of video meteor data. In particular, the question of how to determine

meteor masses though photometric analysis will be re-examined, and new techniques will be proposed that eliminate some of the deficiencies suffered by the techniques currently employed in video meteor analysis.

Author

*Video Tapes; Video Data; Meteoroids; Image Analysis*

**20030003644** Colorado Univ., Boulder, CO USA

**Dynamics of Charged Dust Near Surfaces in Space**

Colwell, Joshua, Colorado Univ., USA; Horanyi, Mihaly, Colorado Univ., USA; Sickafoose, Amanda, Colorado Univ., USA; Robertson, Scott, Colorado Univ., USA; Sixth Microgravity Fluid Physics and Transport Phenomena Conference; November 2002; Volume 1, pp. 395-416; In English; Also announced as 20030003624; No Copyright; Avail: CASI; A03, Hardcopy; A10, Microfiche

Objects in plasma, such as planetary bodies in the solar wind, charge to a floating potential determined by the balance between charging currents in the local plasma environment. In cases where secondary electron emission and photoemission are weak, objects will become negatively charged due to electron collection and will be surrounded by a plasma sheath. Solar ultraviolet radiation can produce a photoelectron sheath above the sunlit surface of airless planetary bodies. In both cases an electric field is present near the surface that can accelerate charged dust particles near the surface. Dust may be stably levitated if the electric force balances the gravitational force. Experiments in a plasma sheath have shown that particles can be stably levitated with surface potentials consistent with those expected on planetary surfaces. Our experiments have also shown that particles can be lifted off the surface by the electric field without any additional disturbance. This may explain the separation of dust from the surfaces of larger particles in Saturn's rings observed as 'spokes' by local plasma presumably generated by an impact. Observations of smooth deposits of regolith in crater bottoms on the asteroid 433 Eros by the NEAR spacecraft suggest a transport mechanism for regolith. Levitation of charged dust and transport in an inhomogeneous electric field is a possible explanation for the distribution of regolith on Eros and other asteroids. More generally, acceleration of charged dust in the near-surface sheath can lead to loss of fine-grained particles from objects with weak gravitational accelerations. We have carried out experiments on charging, levitation, and transport of dust in plasma and photoelectron sheaths. A tungsten filament beneath the surface plate creates the primary electrons that ionize gas in the chamber. When the surface is biased to a sufficiently high voltage (-40V to -80V), dust particles are lifted off the surface. Some of these particles, depending on size and mass, become stably levitated a few cm above the surface. On objects with weaker surface gravity the particle size-dependent levitation height is higher. In addition to levitation our experimental studies show that dust can be transported horizontally over a uniform surface in a uniform plasma sheath. We conducted experiments where a surface is partially covered by dust grains and partially clean. After cycling the plasma on and off, net transport of dust to the initially dust-free portions of the surface is observed. Further experiments will include topographical features on the surface simulating craters and rocks, and we will quantify the horizontal transport of dust in the sheath as a function of grain properties and plasma properties. Simple numerical simulations also show a net transport of dust when inhomogeneities in the sheath are introduced. We calculate the trajectories of individual dust grains using a numerical integrator that simultaneously solves for the charge on the particle. The forces on the particle are gravity downward and the electric force resulting from the grain charge and the electric field normal to the model surface that is produced by the sheath. Although there are no horizontal forces in our initial simulations, horizontal transport occurs as a result of a combination of initial horizontal velocity components for dust lifted off the surface, the effects of topography, and discontinuities in the photoelectron sheath at the terminator. When dust particles enter shadow the sheath vanishes in this model, and the particle falls to the surface under the effects of gravity. In our simulations this leads to an accumulation of dust at the terminator. Dust also accumulates at the borders of topographical features such as blocks and craters.

Author

*Space Plasmas; Planetary Surfaces; Dust; Electric Fields*

**20030004057** Fermi National Accelerator Lab., Batavia, IL USA

**Optical, Infrared and Radio Properties of Extragalactic Sources Observed by SDSS, 2MASS and FIRST Surveys**

Ivezic, Z.; Becker, R. H.; Blanton, M.; Fan, X.; Finlator, K.; Nov. 01, 2001; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-802170; FERMILAB/CONF-01/401A; No Copyright; Avail: National Technical Information Service (NTIS)

The increasing availability of large scale digital sky surveys spanning many wavelengths offers an unprecedented view of the universe. The positional matching of such surveys is of obvious scientific interest. Not only can wide wavelength coverage provide a comprehensive description of the various classes of astrophysical object, but characterizing the most populous families can help isolating more peculiar, and usually more interesting objects. In this contribution we discuss the matching of early Sloan

Digital Sky Survey (SDSS) data with Two Micron All Sky Survey (2MASS) and Faint Images of the Radio Sky at Twenty-cm (FIRST) surveys.

NTIS

*Infrared Astronomy; Radio Astronomy; Sky Surveys (Astronomy); Galaxies*

91

## LUNAR AND PLANETARY SCIENCE AND EXPLORATION

*Includes planetology; selenology; meteorites; comets; and manned and unmanned planetary and lunar flights. For spacecraft design or space stations see 18 Spacecraft Design, Testing and Performance.*

**20030002226** NASA Langley Research Center, Hampton, VA USA

### **Application of Accelerometer Data to Mars Odyssey Aerobraking and Atmospheric Modeling**

Tolson, R. H., George Washington Univ., USA; Keating, G. M., George Washington Univ., USA; George, B. E., George Washington Univ., USA; Escalera, P. E., George Washington Univ., USA; Werner, M. R., George Washington Univ., USA; Dwyer, A. M., NASA Langley Research Center, USA; Hanna, J. L., NASA Langley Research Center, USA; [2002]; 14p; In English; AIAA/AAS Astrodynamic Specialist Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA; Original contains color illustrations

Report No.(s): AIAA Paper 2002-4533; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Aerobraking was an enabling technology for the Mars Odyssey mission even though it involved risk due primarily to the variability of the Mars upper atmosphere. Consequently, numerous analyses based on various data types were performed during operations to reduce these risk and among these data were measurements from spacecraft accelerometers. This paper reports on the use of accelerometer data for determining atmospheric density during Odyssey aerobraking operations. Acceleration was measured along three orthogonal axes, although only data from the component along the axis nominally into the flow was used during operations. For a one second count time, the RMS noise level varied from 0.07 to 0.5 mm/s<sup>2</sup> permitting density recovery to between 0.15 and 1.1 kg per cu km or about 2% of the mean density at periapsis during aerobraking. Accelerometer data were analyzed in near real time to provide estimates of density at periapsis, maximum density, density scale height, latitudinal gradient, longitudinal wave variations and location of the polar vortex. Summaries are given of the aerobraking phase of the mission, the accelerometer data analysis methods and operational procedures, some applications to determining thermospheric properties, and some remaining issues on interpretation of the data. Pre-flight estimates of natural variability based on Mars Global Surveyor accelerometer measurements proved reliable in the mid-latitudes, but overestimated the variability inside the polar vortex.

Author

*Accelerometers; 2001 Mars Odyssey; Aerobraking; Atmospheric Models; Mars Atmosphere; Atmospheric Density; Radio Tracking; Numerical Analysis; Trajectory Analysis*

**20030002667** Brown Univ., Providence, RI USA

### **Kinetics of Melting and Dissolution in Lunar Materials *Final Report, 1 May 2000 - 31 Oct. 2002***

Hess, Paul C., Brown Univ., USA; [2002]; 7p; In English

Contract(s)/Grant(s): NAG5-8174; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

An understanding of the petrogenesis of lunar magmas, particularly mare basalts and the parent magmas to the Mg-rich suite, remains an unfulfilled goal. The fact is not surprising given the complexity of the problem. On the Moon, the source region for lunar magmas is not primitive mantle but rather a series of cumulate rocks that vary widely in both mineralogy and major and minor element contents. The stratigraphy of the cumulate mantle is not likely to be very regular given that the cumulate pile is formed initially in an unstable configuration and subsequent thermal and compositional heterogeneities on a number of length scales. These lithologic heterogeneities, the large range of pressures and temperatures over which melts are generated on the Moon, and the close juxtaposition of cumulate rock with widely varying solidii introduce significant complications to the nature of the melting relations that control melt generation. These factors, coupled with the likelihood that polybaric fractional melting of varying efficiencies ultimately control the composition of planetary progress, are ample reasons why the lunar magmas remain the enigma they are. To make progress, phase equilibria studies must be coupled with a detailed understanding of the time scales and the dynamics of crystal and melt reequilibration processes.

Author

*Lunar Rocks; Lunar Geology; Melting; Stratigraphy; Kinetics; Loads (Forces)*

**20030002755** NASA Langley Research Center, Hampton, VA USA

**Supersonic Aerodynamic Characteristics of Proposed Mars '07 Smart Lander Configurations**

Murphy, Kelly J., NASA Langley Research Center, USA; Horvath, Thomas J., NASA Langley Research Center, USA; Erickson, Gary E., NASA Langley Research Center, USA; Green, Joseph M., Mississippi State Univ., USA; [2002]; 16p; In English; AIAA Atmospheric Flight Mechanics Conference and Exhibit, 5-8 Aug. 2002, Monterey, CA, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Report No.(s): AIAA Paper 2002-4409; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

Supersonic aerodynamic data were obtained for proposed Mars '07 Smart Lander configurations in NASA Langley Research Center's Unitary Plan Wind Tunnel. The primary objective of this test program was to assess the supersonic aerodynamic characteristics of the baseline Smart Lander configuration with and without fixed shelf/tab control surfaces. Data were obtained over a Mach number range of 2.3 to 4.5, at a free stream Reynolds Number of  $1 \times 10^{(exp 6)}$  based on body diameter. All configurations were run at angles of attack from -5 to 20 degrees and angles of sideslip of -5 to 5 degrees. These results were complemented with computational fluid dynamic (CFD) predictions to enhance the understanding of experimentally observed aerodynamic trends. Inviscid and viscous full model CFD solutions compared well with experimental results for the baseline and 3 shelf/tab configurations. Over the range tested, Mach number effects were shown to be small on vehicle aerodynamic characteristics. Based on the results from 3 different shelf/tab configurations, a fixed control surface appears to be a feasible concept for meeting aerodynamic performance metrics necessary to satisfy mission requirements.

Author

*Aerodynamic Characteristics; Tabs (Control Surfaces); Computational Fluid Dynamics; Wind Tunnel Tests; Aeroshells; Performance Prediction; Design Analysis; Spacecraft Models*

**20030003716** NASA Glenn Research Center, Cleveland, OH USA

**Atmospheric Flight on Venus**

Landis, Geoffrey A., NASA Glenn Research Center, USA; Colozza, Anthony, Analex Corp., USA; LaMarre, Christopher M., Illinois Univ., USA; June 2002; 17p; In English; 40th Aerospace Sciences Meeting and Exhibit, 14-17 Jan. 2002, Reno, NV, USA; Sponsored by American Inst. of Aeronautics and Astronautics, USA

Contract(s)/Grant(s): RTOP 755-A4-11

Report No.(s): NASA/TM-2002-211467; E-13213; NAS 1.15:211467; AIAA Paper 2002-0819; Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche; Distribution as joint owner in the copyright; Distribution as joint owner in the copyright

We propose a solar-powered aircraft system for the exploration of Venus. The atmosphere of Venus provides several advantages for flying a solar-powered aircraft. At the top of the cloud level, the solar intensity is comparable to or greater than terrestrial solar intensities. The atmospheric pressure makes flight much easier than on planets such as Mars. Also, the slow rotation of Venus allows an airplane to be designed for flight within continuous sunlight, eliminating the need for energy storage for nighttime flight. These factors make Venus a prime choice for a long-duration solar-powered aircraft. Fleets of solar-powered aircraft could provide an architecture for efficient and low-cost comprehensive coverage for a variety of scientific missions.

Author

*Venus Atmosphere; Solar Powered Aircraft*

**20030003718** NASA Ames Research Center, Moffett Field, CA USA

**A Closed Mars Analog Simulation: The Approach of Crew 5 At the Mars Desert Research Station**

Clancey, William J., NASA Ames Research Center, USA; Nov. 01, 2002; 24p; In English; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

For twelve days in April 2002 we performed a closed simulation in the Mars Desert Research Station, isolated from other people, as on Mars, while performing systematic surface exploration and life support chores. Email provided our only means of contact; no phone or radio conversations were possible. All mission-related messages were mediated by a remote mission support team. This protocol enabled a systematic and controlled study of crew activities, scheduling, and use of space. The analysis presented here focuses on two questions: Where did the time go-why did people feel rushed and unable to complete their work? How can we measure and model productivity, to compare habitat designs, schedules, roles, and tools? Analysis suggests that a simple scheduling change-having lunch and dinner earlier, plus eliminating afternoon meetings-increased the available productive time by 41%.

Author

*Mars Bases; Environment Simulation; Space Habitats; Spacecrews; Scheduling*

**20030003754** Lunar and Planetary Inst., Houston, TX USA

**RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation**

2002; ISSN 0161-5297; 154p; In English, 6-8 Nov. 2002, Cocoa Beach, FL, USA; Sponsored by Lunar and Planetary Inst., USA; Also announced as 20030003755 through 20030003764

Contract(s)/Grant(s): NASW-4574

Report No.(s): LPI-Contrib-1152; No Copyright; Avail: CASI; A08, Hardcopy; A02, Microfiche

The Revolutionary Aerospace Systems Concepts-Academic Linkage (RASC-AL) is a program of the Lunar and Planetary Institute (LPI) in collaboration with the Universities Space Research Association's (USRA) ICASE institute through the NASA Langley Research Center. The RASC-AL key objectives are to develop relationships between universities and NASA that lead to opportunities for future NASA research and programs, and to develop aerospace systems concepts and technology requirements to enable future NASA missions. The program seeks to look decades into the future to explore new mission capabilities and discover what's possible. NASA seeks concepts and technologies that can make it possible to go anywhere, at anytime, safely, reliably, and affordably to accomplish strategic goals for science, exploration, and commercialization. University teams were invited to submit research topics from the following themes: Human and Robotic Space Exploration, Orbital Aggregation & Space Infrastructure Systems (OASIS), Zero-Emissions Aircraft, and Remote Sensing. RASC-AL is an outgrowth of the HEDS-UP (University Partners) Program sponsored by the LPI. HEDS-UP was a program of the Lunar and Planetary Institute designed to link universities with NASA's Human Exploration and Development of Space (HEDS) enterprise. The first RASC-AL Forum was held November 5-8, 2002, at the Hilton Cocoa Beach Oceanfront Hotel in Cocoa Beach, Florida. Representatives from 10 university teams presented student research design projects at this year's Forum. Each team contributed a written report and these reports are presented.

Derived from text

*Aerospace Systems; NASA Space Programs; Remote Sensing; Design Analysis; Research and Development*

**20030003755** Colorado School of Mines, Golden, CO USA

**Martian Weather Station**

Burnett, William, Colorado School of Mines, USA; Bush, J. David, Colorado School of Mines, USA; Harwell, Kendall, Colorado School of Mines, USA; Jones, Alan, Colorado School of Mines, USA; Kaneta, Joyce, Colorado School of Mines, USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 7-22; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

As the Earth's population continues to grow and resources continue to dwindle, humankind has looked to other planets for possible colonization. With current technology, colonization of Mars is the most viable option. Although general facts about Mars are known, such as its low temperatures, low pressure, and atmospheric density, more specific information is needed. To this end, team ARES from the Colorado School of Mines has designed a module to measure atmospheric conditions. Our module is capable of measuring temperature, pressure, wind speed, and particle concentration. The module will take measurements every minute and the data will be transmitted twice daily to an orbiting satellite. In order to provide overlap in case of interference during transmission time, because of occurrences such as dust storms, the data will be stored for 24 hours. Our design is an expanding modular structure, similar to a Hoberman Micro Sphere by Hoberman Designs, Inc, in which the instruments are protected from the harsh atmospheric conditions yet are still able to take measurements. The interior will consist of eight octants. A rod attached to opposite sides of the frame expands upon landing, opening the frame. A swivel mechanism at the middle of the rod allows the octets to orient themselves. The bottom four octets will house the instruments, computer, and batteries while the top four will be solar panels and have the antennae. This design is adaptable to various shell designs; also, it is both strong enough to survive and able to orient itself after deployment.

Author

*Weather Stations; Mars Surface; Systems Engineering; Spacecraft Modules; Mars Atmosphere; Meteorological Instruments*

**20030003760** Princeton Univ., Dept. of Mechanical and Aerospace Engineering, NJ USA

**Integrated Robotic Team for Martian Water Collection**

Alemany, Kristina, Princeton Univ., USA; Bethke, Kristen, Princeton Univ., USA; Bhatt, Niraj, Princeton Univ., USA; Bollman, Brent, Princeton Univ., USA; Viventi, Jonathan, Princeton Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 78-93; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

This paper is in response to a request for papers from the Lunar and Planetary Institute for the annual conference of its Revolutionary Aerospace Systems Concepts-Academic Linkage program. An integrated robotic team for the collection of

subsurface Martian water ice was designed, based on the 2001 Mars Odyssey discovery of the signatures of a significant amount of water ice on Mars. Gamma-ray spectrometer readings indicate that in large regions near the Martian poles, the soil between 60 and 100 cm beneath the surface contains 40% to 73% water ice by volume. The extraction and transport of this water would enable human habitation and exploration on Mars because water can be consumed by humans and chemically transformed into hydrogen and oxygen fuel. This study adopted the philosophy that a team of small robots can perform this collection task more efficiently and more reliably than one large, multi-task robot. A concept was designed for a team of small autonomous robots that traverse the Martian soil to detect, extract, and transport ice to a central holding and processing location. The team consists of drilling rovers that penetrate the Martian surface, collect frozen water and soil, and deliver this ice/soil mixture to quicker, less massive transporting rovers. A top-level design of the entire robotic team was produced.

Author

*Aerospace Systems; Robotics; Mars Exploration; Water; Mars (Planet); Mars Surface Samples*

**20030003763** Maryland Univ., Dept. of Aerospace Engineering, College Park, MD USA

**Project Endurance: Six 90-day Missions on the Lunar Surface**

Battaglia, Theresa, Maryland Univ., USA; Clark, James, Maryland Univ., USA; Collins, Michael, Maryland Univ., USA; Gupta, Suneal, Maryland Univ., USA; Herrmann, Todd, Maryland Univ., USA; Hykin, Drew, Maryland Univ., USA; Kimball, Mark, Maryland Univ., USA; Kujawa, Brian, Maryland Univ., USA; Lee, Benjamin, Maryland Univ., USA; Lui, Yan, Maryland Univ., USA; RASC-AL (Revolutionary Aerospace Systems Concepts-Academic Linkage): 2002 Advanced Concept Design Presentation; 2002, pp. 122-135; In English; Also announced as 20030003754; No Copyright; Avail: CASI; A03, Hardcopy; A02, Microfiche

In the hopes of paving the way for a permanently inhabited moon base, a six-mission program was designed, with missions being flown yearly from 2013 to 2018. Each mission will consist of a "habitat module" and an "ascent/descent module." These modules will be launched on a Delta IV rocket and a Space Shuttle, and will then connect with booster stages in LEO before finally reaching the moon. Throughout each mission, four crew members will explore the lunar surface in detail, conducting various scientific experiments over their 90-day stay, with the goal of expanding knowledge of the lunar environment. Missions will explore both the near and far sides of the moon, with communication satellites providing a link to far side missions.

Author

*Lunar Environment; Lunar Surface; Communication Satellites; Space Missions; NASA Space Programs*

**20030003817** Malin Space Science Systems, San Diego, CA USA

**Light-Toned, Layered Outcrops of Northern Terra Meridiani Mars: Viking, Phobos 2, and Mars Global Surveyor Observations, 1996-2002**

Edgett, Kenneth S., Malin Space Science Systems, USA; Oct. 08, 2002; 7p; In English

Contract(s)/Grant(s): JPL-959060; JPL-1200780; NASW-01004; NAG5-4296; No Copyright; Avail: CASI; A02, Hardcopy; A01, Microfiche

Locating outcrops of sedimentary rock on Mars is an important step toward deciphering the planet's geologic and climatologic record. Sedimentary rock representing the earliest martian environments, are of particular interest in this context. This is a report about a vast exposure of material proposed to be martian sedimentary rock. The outcrops cover an area (approximately sq 300,000 km) roughly the size of the Colorado Plateau in North America (approximately 260,000 sq km). The materials occur in northern Terra Meridiani, near of one of the four sites being considered for a 2004 NASA Mars Exploration Rover (MER) landing. The landing ellipse, centered at deg S, deg W, lies in a region exhibiting smooth and rough (at meter scale) dark-toned surfaces, with scattered light-toned patches. Stratigraphically, the dark-toned materials at the MER site lie unconformably on top of a previously-eroded, light-toned surface; the light-toned patches in the landing ellipse are geologic windows down to this lower stratigraphic unit. North of the landing ellipse, the light-toned materials are well-exposed because the darker materials have been removed, stranding outlier remnants in a few locations. The light-toned materials are layered, vertically heterogeneous, and exhibit lateral continuity over hundreds of kilometers. Eroded layers produce cliffs; some outcrops are expressed as mesas, buttes, and spires; and impact craters ranging in diameter from a few meters to tens of kilometers are interbedded with the layers. The purpose of this report is to summarize the results of greater than 6 years of photogeologic investigation into the nature of the light-toned outcrops of northern Terra Meridiani. The work is a 'snapshot' of progress made toward eventual geologic mapping and establishment of the stratigraphic sequence for the materials through 30 September 2002, a day prior to the first release of Mars Odyssey Thermal Emission Imaging System (THEMIS) data to the NASA Planetary Data System (PDS). The main body of data examined were Mars Global Surveyor (MGS) Mars Orbiter Camera (MOC) images acquired through 30 September 2002. The data also include 2 Viking orbiter images, a Phobos 2 Termoscan image, MGS Mars Orbiter Laser Altimeter (MOLA) topographic observations, and the products of published Viking Infrared Thermal Mapper

(IRTM) and Mars Global Surveyor (MGS) Thermal Emission Spectrometer (TES) analyses. Through September 2002, over 126,000 MOC images had been acquired, and greater than 600 of the MOC narrow angle (1.5-12 m/pixel) images occur within the portions of Terra Meridiani and southwestern Arabia Terra.

Author

*Mars Surface; Planetary Geology; Stratigraphy; Mapping; Remote Sensing; Topography; Outcrops*

## 92 SOLAR PHYSICS

*Includes solar activity, solar flares, solar radiation and sunspots. For related information see 93 Space Radiation.*

**20030002473** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Electron Pitch-Angle Distribution in Pressure Balance Structures Measured by Ulysses/SWOOPS**

Yamauchi, Yohei, NASA Marshall Space Flight Center, USA; Suess, Steven T., NASA Marshall Space Flight Center, USA; Sakurai, Takashi, NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; No Copyright; Avail: Issuing Activity; Abstract Only

Pressure balance structures (PBSs) are a common feature in the high-latitude solar wind near solar minimum. From previous studies, PBSs are believed to be remnants of coronal plumes. Yamauchi et al [2002] investigated the magnetic structures of the PBSs, applying a minimum variance analysis to Ulysses/Magnetometer data. They found that PBSs contain structures like current sheets or plasmoids, and suggested that PBSs are associated with network activity such as magnetic reconnection in the photosphere at the base of polar plumes. We have investigated energetic electron data from Ulysses/SWOOPS to see whether bi-directional electron flow exists and we have found evidence supporting the earlier conclusions. We find that 45 of 53 PBSs show local bi-directional or isotropic electron flux or flux associated with current-sheet structure. Only five events show the pitch-angle distribution expected for Alfvénic fluctuations. We conclude that PBSs do contain magnetic structures such as current sheets or plasmoids that are expected as a result of network activity at the base of polar plumes.

Author

*Electron Distribution; Pitch (Inclination); Plasmas (Physics); Solar Wind; Ulysses Mission; Angular Distribution; Pressure*

**20030002632** NASA Marshall Space Flight Center, Huntsville, AL USA

### **Initiation of Coronal Mass Ejections by Tether-Cutting Reconnection**

Moore, Ronald L., NASA Marshall Space Flight Center, USA; Sterling, Alphonse C., NASA Marshall Space Flight Center, USA; Falconer, David A., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; SHINE 2002 Workshop, 18-22 Aug. 2002, Banff, Alberta, Canada; No Copyright; Avail: Issuing Activity; Abstract Only

We present and interpret examples of the eruptive motion and flare brightening observed in the onset of magnetic explosions that produce coronal mass ejections. The observations are photospheric magnetograms and sequences of coronal and/or chromospheric images. In our examples, the explosion is apparently driven by the ejective eruption of a sigmoidal sheared-field flux rope from the core of an initially closed bipole. This eruption is initiated (triggered and unleashed) by reconnection located either (1) internally, low in the sheared core field, or (2) externally, at a magnetic null above the closed bipole. The internal reconnection is commonly called 'tether-cutting' reconnection, and the external reconnection is commonly called 'break-out' reconnection. We point out that break-out reconnection amounts to external tether cutting. In one example, the eruptive motion of the sheared core field starts several minutes prior to any detectable brightening in the coronal images. We suggest that in this case the eruption is triggered by internal tether-cutting reconnection that at first is too slow and/or too localized to produce detectable heating in the coronal images. This work is supported by NASA's Office of Space Science through its Solar & Heliospheric Physics Supporting Research & Technology program and its Sun-Earth Connection Guest Investigator program.

Author

*Coronal Mass Ejection; Solar Flares; Solar Corona; Magnetic Signatures; Image Analysis; Heat; Detection*

93  
SPACE RADIATION

*Includes cosmic radiation; and inner and outer Earth radiation belts. For biological effects of radiation on plants and animals see 52 Aerospace Medicine. For theory see 73 Nuclear Physics.*

**20030002464** NASA Marshall Space Flight Center, Huntsville, AL USA

**The BATSE Earth Occultation Catalog of Low Energy Gamma Ray Sources**

Harmon, B. A., NASA Marshall Space Flight Center, USA; WilsonHodge, C. A., NASA Marshall Space Flight Center, USA; Fishman, G. J., NASA Marshall Space Flight Center, USA; Paciesas, W., NASA Marshall Space Flight Center, USA; [2002]; 1p; In English; X-Ray Surveys in the Light of the New Observatories, 4-6 Sep. 2002, Santander, Spain; No Copyright; Avail: Issuing Activity; Abstract Only

The Burst and Transient Source Experiment (BATSE), aboard the Compton Gamma Ray Observatory (CGRO), provided a record of the hard X-ray/low energy gamma ray sky between April 1991 and June 2000. During that time, a catalog of known sources was derived from existing catalogs such as HEAO A-4, as well as new transient sources discovered with BATSE and other X-ray monitors operating in the CGRO era. The Earth Occultation Technique was used to monitor a combination of these sources, mostly galactic, totaling to about 175 objects. The catalog will present the global properties of these sources and their probability of detection ( $> 10$  mCrab, 20-100 keV) with BATSE. Systematic errors due to unknown sources or background components are included. cursory analyses to search for new transients (35-80 mCrab in the 20-100 keV band) and super-orbital periods in known binary sources are also presented. Whole mission light curves and associated data production/analysis tools are being delivered to the HEASARC for public use.

Author

*Gamma Ray Bursts; Gamma Ray Observatory; Spaceborne Telescopes; Gamma Rays; Occultation; Astronomical Catalogs*

**20030002525** NASA Langley Research Center, Hampton, VA USA

**Cross-Section Parameterizations for Pion and Nucleon Production From Negative Pion-Proton Collisions**

Norbury, John W., Wisconsin Univ., USA; Blattnig, Steve R., Wisconsin Univ., USA; Norman, Ryan, Wisconsin Univ., USA; Tripathi, R. K., NASA Langley Research Center, USA; December 2002; 46p; In English

Contract(s)/Grant(s): NCC1-354; NGT-152217; RTOP 755-06-00-03

Report No.(s): NASA/TP-2002-211766; L-18210; NAS 1.60:211766; No Copyright; Avail: CASI; A03, Hardcopy; A01, Microfiche

Ranft has provided parameterizations of Lorentz invariant differential cross sections for pion and nucleon production in pion-proton collisions that are compared to some recent data. The Ranft parameterizations are then numerically integrated to form spectral and total cross sections. These numerical integrations are further parameterized to provide formula for spectral and total cross sections suitable for use in radiation transport codes. The reactions analyzed are for charged pions in the initial state and both charged and neutral pions in the final state.

Author

*Nucleons; Parameterization; Pions; Pair Production; Ionic Collisions; Scattering Cross Sections*

**20030002670** NASA Langley Research Center, Hampton, VA USA

**Exclusive Reactions Involving Pions and Nucleons**

Norbury, John W., Wisconsin Univ., USA; Blattnig, Steve R., Wisconsin Univ., USA; Tripathi, R. K., NASA Langley Research Center, USA; December 2002; 52p; In English

Contract(s)/Grant(s): NCC1-354; NGT1-52217; RTOP 755-06-00-03

Report No.(s): NASA/TP-2002-211957; L-18213; NAS 1.60:211957; No Copyright; Avail: CASI; A04, Hardcopy; A01, Microfiche

The HZETRN code requires inclusive cross sections as input. One of the methods used to calculate these cross sections requires knowledge of all exclusive processes contributing to the inclusive reaction. Conservation laws are used to determine all possible exclusive reactions involving strong interactions between pions and nucleons. Inclusive particle masses are subsequently determined and are needed in cross-section calculations for inclusive pion production.

Author

*Particle Interactions; Pions; Nucleons; Strong Interactions (Field Theory); Cross Sections*

**20030003804** Argonne National Lab., IL USA

**Other Atmospheric Neutrino Experiments**

Goodman, M.; 2002; In English; This document is color dependent and/or in landscape layout. It is currently only available on CD-ROM

Report No.(s): DE2002-801574; No Copyright; Avail: National Technical Information Service (NTIS)

The history and recent progress of atmospheric neutrinos are reviewed. An emphasis is placed on results from experiments other than Super-Kamiokande.

NTIS

*Neutrinos; Oscillations*

**99**

**GENERAL**

*Includes aeronautical, astronautical, and space science related histories, biographies, and pertinent reports too broad for categorization; histories or broad overviews of NASA programs such as Apollo, Gemini, and Mercury spacecraft, Earth Resources Technology Satellite (ERTS), and Skylab; NASA appropriations hearings.*

**20030004255** NASA, Washington, DC USA

**Looking Backward, Looking Forward: Forty Years of US Human Spaceflight Symposium**

Garber, Stephen J., Editor, NASA, USA; May 08, 2001; 243p; In English, 8 May 2001, Washington, DC, USA; Sponsored by George Washington Univ., USA

Report No.(s): NASA/SP-2002-4107; NAS 1.21:4107; LC-2002014550; ISBN 0-16-067595-2; No Copyright; Avail: CASI; A11, Hardcopy; A03, Microfiche

This symposium reflects on forty years of U.S. Human Spaceflight, its role over the next four decades and beyond. The topics include: 1) Perspectives on the Past Forty Years of Human Spaceflight; 2) The Experience of Spaceflight; 3) Perspectives on the Next Forty Years of Human Spaceflight; and 4) The International Space Station and the Future of Human Spaceflight.

CASI

*Manned Space Flight; Conferences; NASA Space Programs; Histories*

# Subject Term Index

## Numbers

2001 MARS ODYSSEY, 223

## A

ABSORBENTS, 40, 44

ABSORPTION SPECTRA, 215, 216, 217, 219, 220

ABSORPTION SPECTROSCOPY, 216

ABSORPTIVITY, 187

ABUNDANCE, 130

ACCELERATORS, 62, 207

ACCELEROMETERS, 223

ACCESS CONTROL, 214

ACCIDENT PREVENTION, 161

ACCIDENTS, 88

ACCUMULATIONS, 111, 134

ACOUSTIC ATTENUATION, 187

ACOUSTIC MEASUREMENT, 186

ACOUSTIC PROPERTIES, 188, 189

ACOUSTICS, 88

ACTIVATED CARBON, 162

ACTIVE GALACTIC NUCLEI, 216, 217

ACTIVITY (BIOLOGY), 145

ACTIVITY CYCLES (BIOLOGY), 157

ACTUATORS, 138, 200

ADAPTIVE CONTROL, 28, 64, 72, 168

ADAPTIVE OPTICS, 218

ADENOSINE DIPHOSPHATE, 140

ADENOSINE TRIPHOSPHATE, 140

ADHESION, 207

ADVECTION, 74

AERIAL PHOTOGRAPHY, 119

AERIAL RECONNAISSANCE, 11

AEROACOUSTICS, 17, 186

AEROBRAKING, 223

AERODYNAMIC CHARACTERISTICS, 3, 20, 71, 224

AERODYNAMIC COEFFICIENTS, 13

AERODYNAMIC CONFIGURATIONS, 14

AERODYNAMIC DRAG, 3, 4, 5

AERODYNAMIC FORCES, 3

AERODYNAMIC NOISE, 86, 188

AERODYNAMICS, 17

AERONAUTICAL ENGINEERING, 1

AERONAUTICS, 1

AEROSHELLS, 224

AEROSOLS, 125, 132

AEROSPACE ENGINEERING, 24, 28

AEROSPACE MEDICINE, 154

AEROSPACE SCIENCES, 1, 58

AEROSPACE SYSTEMS, 225, 226

AEROTHERMODYNAMICS, 10, 17

AFRICA, 102

AGRICULTURAL AIRCRAFT, 11

AGRICULTURE, 113, 114, 119

AIR BREATHING ENGINES, 17, 19

AIR DEFENSE, 66, 168

AIR FLOW, 19, 128, 154

AIR TRAFFIC, 7

AIR TRAFFIC CONTROL, 8, 9, 20

AIR TRAFFIC CONTROLLERS (PERSONNEL), 8, 9

AIR TRANSPORTATION, 7, 9

AIR WATER INTERACTIONS, 132

AIRCRAFT, 12

AIRCRAFT ACCIDENT INVESTIGATION, 6

AIRCRAFT ACCIDENTS, 6, 21

AIRCRAFT CARRIERS, 10

AIRCRAFT CONFIGURATIONS, 4

AIRCRAFT DESIGN, 1, 15

AIRCRAFT ENGINES, 19

AIRCRAFT MAINTENANCE, 6

AIRCRAFT MODELS, 14

AIRCRAFT NOISE, 188, 189

AIRCRAFT PILOTS, 6, 16, 155

AIRFOIL PROFILES, 4

AIRPORT SECURITY, 7

ALERTNESS, 155, 156

ALGAE, 135

ALGEBRA, 170

ALGORITHMS, 3, 88, 166, 173, 176, 179, 182, 197, 211

ALIGNMENT, 198

ALLERGIC DISEASES, 148

ALLOYS, 206

ALTERNATIVES, 58

ALUMINUM, 27

ALUMINUM ALLOYS, 98

ALUMINUM-LITHIUM ALLOYS, 46

AMORPHOUS MATERIALS, 65, 68

ANALOGIES, 182

ANALYZING, 171

ANEMIAS, 155

ANGLE OF ATTACK, 3

ANGULAR DISTRIBUTION, 227

ANILINE, 77

ANIMALS, 118, 119, 122

ANOMALIES, 134

ANTIBODIES, 147

ANTIPROTONS, 194, 196

APERTURES, 27

APPLICATIONS PROGRAMS (COMPUTERS), 30, 100, 136, 186

AQUICULTURE, 115, 117

ARCHAEOLOGY, 105

ARCHITECTURE (COMPUTERS), 8, 164, 165, 174, 177

ARCTIC REGIONS, 134

ARGON, 41

ARIZONA, 106

ARRAYS, 221

ARTIFICIAL INTELLIGENCE, 166

ARTIFICIAL SATELLITES, 28, 29, 32, 34

ASSEMBLIES, 120

ASSOCIATION REACTIONS, 207

ASTEROIDS, 101

ASTRONAUT TRAINING, 29

ASTRONAUTS, 22, 160

ASTRONOMICAL CATALOGS, 228

ASTROPHYSICS, 220

ATLANTIS (ORBITER), 26

ATMOSPHERIC ATTENUATION, 189

ATMOSPHERIC CHEMISTRY, 126

ATMOSPHERIC CIRCULATION, 146

ATMOSPHERIC COMPOSITION, 126

ATMOSPHERIC DENSITY, 223

ATMOSPHERIC ENTRY, 2, 179

ATMOSPHERIC MODELS, 124, 125, 130, 132, 133, 223

ATMOSPHERIC MOISTURE, 133

ATMOSPHERIC RADIATION, 130, 132

ATMOSPHERIC TEMPERATURE, 126

ATOMIC ENERGY LEVELS, 194

ATOMIC PHYSICS, 194

ATOMIC STRUCTURE, 194

ATOMIC THEORY, 196

ATTENUATION, 71

AUGMENTATION, 115

AURORAL ZONES, 131  
AURORAS, 127  
AUSTENITIC STAINLESS STEELS, 45  
AUTOMATIC CONTROL, 7  
AUTONOMY, 58, 59  
AVALANCHES, 128

## B

BACKSCATTERING, 193  
BALLUTES, 2  
BARYONS, 209, 218  
BASE FLOW, 4  
BAYES THEOREM, 194  
BEAM INTERACTIONS, 190  
BEETLES, 120  
BENZOIC ACID, 86  
BIOENGINEERING, 65, 136  
BIOGRAPHY, 1  
BIOINSTRUMENTATION, 154  
BIOLOGICAL DIVERSITY, 112, 113,  
114, 115, 116, 117, 118, 119, 120,  
121, 122, 123  
BIOLOGICAL EFFECTS, 154  
BIOLOGICAL EVOLUTION, 140, 220  
BIOMASS BURNING, 126  
BIRDS, 113, 120, 122, 142  
BIREFRINGENCE, 50  
BIRTH, 137, 140, 142  
BLADE TIPS, 95  
BLOCK COPOLYMERS, 37  
BLOCKING, 154  
BLOOD, 142  
BLOOD FLOW, 151  
BLOOD PRESSURE, 142  
BLOOD VESSELS, 151  
BODY FLUIDS, 153  
BODY-WING CONFIGURATIONS, 3  
BOEING 777 AIRCRAFT, 4  
BOILING, 81, 82  
BONE MINERAL CONTENT, 149  
BONES, 149  
BOOMS (EQUIPMENT), 49  
BOSONS, 191  
BOUNDARIES, 207  
BOUNDARY CONDITIONS, 72, 188  
BOUNDARY ELEMENT METHOD, 64  
BOUNDARY LAYERS, 71  
BRAIN, 140  
BRAKING, 21  
BRAZING, 34  
BREADBOARD MODELS, 35  
BREEDING (REPRODUCTION), 113  
BRIDGES (STRUCTURES), 133  
BROADBAND, 149, 189  
BROWNIAN MOVEMENTS, 152

BRUSHES, 117  
BUBBLE CHAMBERS, 210  
BUBBLES, 43, 80, 81, 82, 83, 209  
BUCKLING, 100, 101  
BULKHEADS, 101  
BUNCHING, 207  
BUOYANCY, 82

## C

C (PROGRAMMING LANGUAGE), 99  
CADMIUM TELLURIDES, 110  
CAFFEINE, 156  
CALCIUM OXIDES, 40  
CALIBRATING, 88  
CANARD CONFIGURATIONS, 20  
CANCER, 135, 136, 137, 138, 139, 141,  
142, 143, 144, 145, 146, 147, 148,  
149, 150, 151  
CAPACITANCE, 60  
CAPILLARY TUBES, 69  
CARBON, 46, 220  
CARBON DIOXIDE, 40, 41, 85, 130,  
146  
CARBON DIOXIDE REMOVAL, 43, 85  
CARBON FIBERS, 48  
CARBON MONOXIDE, 43  
CARBON NANOTUBES, 39, 68, 87  
CARBON-CARBON COMPOSITES, 38  
CARBONACEOUS MATERIALS, 221  
CARDIOVASCULAR SYSTEM, 124,  
140, 151  
CARGO, 36  
CARTESIAN COORDINATES, 20  
CATALYSTS, 53  
CATAPULTS, 25  
CAVITIES, 190, 207  
CELL DIVISION, 155  
CELLS (BIOLOGY), 140, 145, 150, 154  
CENTRAL PROCESSING UNITS, 168  
CERAMICS, 90, 100  
CERTIFICATION, 189  
CHANNEL WINGS, 14  
CHARGE DISTRIBUTION, 191, 221  
CHARGED PARTICLES, 209  
CHARRING, 34  
CHEMICAL ANALYSIS, 44  
CHEMICAL EVOLUTION, 127  
CHEMICAL LASERS, 92  
CHEMICAL REACTIONS, 44, 46, 48  
CHEMOTHERAPY, 138, 144  
CHESAPEAKE BAY (US), 116, 118, 120  
CHLORIDES, 41, 44  
CHLOROPHYLLS, 111  
CHROMIUM, 45  
CHROMOSOMES, 141  
CIRCADIAN RHYTHMS, 153, 157, 158  
CIRCUITS, 66  
CIVIL AVIATION, 5  
CLEARANCES, 95  
CLIMATE, 106, 112, 132, 134  
CLIMATE MODELS, 125, 126, 132  
CLIMATOLOGY, 124, 134  
CLIMBING FLIGHT, 14  
CLINICAL MEDICINE, 138  
CLOSED ECOLOGICAL SYSTEMS,  
162  
CLOUD COVER, 132  
CLOUD PHYSICS, 130  
COALESCING, 57, 82  
COATINGS, 100  
COAXIAL FLOW, 36  
CODERS, 200  
COEFFICIENTS, 39  
COGNITIVE PSYCHOLOGY, 141  
COLLISIONS, 195  
COLLOIDS, 55, 56, 73, 74  
COLOR, 220  
COMBINATORIAL ANALYSIS, 183  
COMBUSTION, 42  
COMBUSTION CHAMBERS, 17, 40  
COMETS, 221  
COMMAND AND CONTROL, 61, 168  
COMMERCE, 169  
COMMERCIAL AIRCRAFT, 20  
COMMUNICATION, 211  
COMMUNICATION EQUIPMENT, 168  
COMMUNICATION NETWORKS, 30,  
60, 61, 166  
COMMUNICATION SATELLITES, 109,  
226  
COMPATIBILITY, 52  
COMPILERS, 64, 168, 171  
COMPLEX SYSTEMS, 118  
COMPONENTS, 64  
COMPOSITE MATERIALS, 48, 50  
COMPOSITE PROPELLANTS, 53  
COMPOSITE STRUCTURES, 16, 39,  
87, 100  
COMPOSITION (PROPERTY), 38, 46  
COMPRESSED GAS, 161  
COMPRESSIBLE FLUIDS, 71  
COMPRESSION LOADS, 100  
COMPRESSION TESTS, 96  
COMPRESSORS, 185  
COMPTON EFFECT, 194  
COMPUTATION, 92, 164, 174, 177, 194  
COMPUTATIONAL FLUID DYNAM-  
ICS, 2, 13, 19, 24, 31, 32, 45, 67, 71,  
87, 154, 171, 174, 179, 186, 189,  
203, 224

COMPUTATIONAL GRIDS, 72, 125, 179, 180  
 COMPUTER AIDED DESIGN, 179  
 COMPUTER GRAPHICS, 163  
 COMPUTER INFORMATION SECURITY, 165, 170, 176, 178  
 COMPUTER NETWORKS, 60, 61, 63, 173, 176  
 COMPUTER PROGRAMMING, 168, 169, 170, 172  
 COMPUTER PROGRAMS, 101, 168, 169, 171, 172, 173, 174, 176, 211, 215  
 COMPUTER SYSTEMS PROGRAMS, 64, 163  
 COMPUTER TECHNIQUES, 175  
 COMPUTERIZED SIMULATION, 2, 15, 24, 29, 31, 34, 39, 59, 67, 111, 154, 166  
 COMPUTERS, 65, 215  
 CONCENTRATION (COMPOSITION), 152  
 CONCRETES, 44  
 CONDENSED MATTER PHYSICS, 55, 56  
 CONDUCTIVITY, 104  
 CONFERENCES, 136, 150, 196, 202, 229  
 CONFIGURATION MANAGEMENT, 212  
 CONFIGURATIONS, 12  
 CONSERVATION, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 123  
 CONSERVATION LAWS, 3  
 CONSTELLATIONS, 60  
 CONSTRUCTION, 122  
 CONSUMABLES (SPACECREW SUPPLIES), 160  
 CONTAMINANTS, 103  
 CONTINUITY (MATHEMATICS), 98  
 CONTRACTION, 140  
 CONTROL, 198  
 CONTROL SURFACES, 96  
 CONTROL SYSTEMS DESIGN, 162, 178  
 CONTROL THEORY, 178, 207  
 CONTROLLERS, 25, 178  
 CONVECTION, 124, 126  
 CONVECTION-DIFFUSION EQUATION, 181  
 CONVECTIVE FLOW, 133  
 COOLANTS, 45  
 COPPER ALLOYS, 34  
 CORAL REEFS, 135  
 CORE FLOW, 154  
 CORONAL MASS EJECTION, 227  
 CORONAS, 219

CORROSION, 44  
 CORROSION TESTS, 12  
 COSMIC DUST, 221  
 COSMOLOGY, 210  
 COST EFFECTIVENESS, 111  
 COST REDUCTION, 4  
 COUETTE FLOW, 84  
 COUPLED MODES, 91  
 COUPLING, 193, 210  
 COVARIANCE, 86  
 CP VIOLATION, 195  
 CRACK INITIATION, 45  
 CRACK PROPAGATION, 46  
 CRACKING (FRACTURING), 52  
 CRACKS, 99  
 CRANES, 94  
 CRASHWORTHINESS, 10  
 CREEP PROPERTIES, 45  
 CRITERIA, 98  
 CRITICAL LOADING, 100  
 CRITICAL TEMPERATURE, 83  
 CROSS SECTIONS, 228  
 CROSSLINKING, 207  
 CRYOGENIC COOLING, 208  
 CRYOGENIC TEMPERATURE, 200  
 CRYOGENICS, 126, 200  
 CRYSTAL GROWTH, 49, 205, 207, 208  
 CRYSTAL MORPHOLOGY, 45, 55, 205  
 CRYSTAL STRUCTURE, 50, 208  
 CRYSTALLIZATION, 56, 148, 207  
 CRYSTALS, 90  
 CUES, 166  
 CULTURAL RESOURCES, 105, 116  
 CUMULUS CLOUDS, 130  
 CURVATURE, 198  
 CYCLOTRONS, 196  
 CYLINDRICAL SHELLS, 101

## D

DAMAGE, 12, 98  
 DAMAGE ASSESSMENT, 93, 119  
 DAMPING, 98, 99  
 DAMS, 142  
 DATA ACQUISITION, 40, 88, 215  
 DATA BASES, 13, 30, 87, 113  
 DATA FLOW ANALYSIS, 30  
 DATA INTEGRATION, 213  
 DATA MANAGEMENT, 175, 180, 214  
 DATA PROCESSING, 129, 131, 168  
 DATA STORAGE, 99, 171  
 DATA SYSTEMS, 60  
 DATA TRANSMISSION, 63  
 DECISION MAKING, 117, 166

DECISION SUPPORT SYSTEMS, 136, 166, 175, 183  
 DECOMMISSIONING, 59  
 DEEP SPACE, 22  
 DEFECTS, 89, 100  
 DEFENSE PROGRAM, 170, 213  
 DEFLECTION, 13  
 DEFORMATION, 45, 129, 185  
 DEGRADATION, 46, 51, 145  
 DEICING, 21  
 DELTA WINGS, 13  
 DENSITOMETERS, 149  
 DEOXYRIBONUCLEIC ACID, 152, 154  
 DEPLOYMENT, 25  
 DEPOSITION, 38, 46, 85, 104  
 DESIGN ANALYSIS, 15, 35, 40, 62, 68, 91, 92, 99, 224, 225  
 DESIGN OPTIMIZATION, 95  
 DESYNCHRONIZATION (BIOLOGY), 157  
 DETECTION, 59, 92, 97, 173, 218, 221, 227  
 DEUTERIUM COMPOUNDS, 86  
 DIAGNOSIS, 88  
 DIAGRAMS, 90  
 DIELECTRIC LOSS, 221  
 DIELECTRIC PROPERTIES, 68  
 DIELECTRICS, 62, 90  
 DIFFERENTIAL EQUATIONS, 84  
 DIGITAL SYSTEMS, 104  
 DIGITAL TELEVISION, 60  
 DINING PHILOSOPHERS PROBLEM, 173  
 DIODES, 92  
 DIPHENYL COMPOUNDS, 86  
 DIRECT NUMERICAL SIMULATION, 67, 186  
 DIRECTIONAL SOLIDIFICATION (CRYSTALS), 27, 45  
 DISCRETIZATION (MATHEMATICS), 183  
 DISEASES, 138, 150  
 DISKS (SHAPES), 46  
 DISLOCATIONS (MATERIALS), 45, 199, 207  
 DISPERSIONS, 80  
 DISPLAY DEVICES, 16, 23, 30, 178  
 DISSIPATION, 172  
 DISSOCIATION, 43  
 DISTRIBUTED INTERACTIVE SIMULATION, 165  
 DISTRIBUTED PROCESSING, 180  
 DIURNAL VARIATIONS, 126  
 DOCUMENTS, 213  
 DOSIMETERS, 99  
 DRAG REDUCTION, 4, 5

DRAINAGE, 103, 123  
DREDGED MATERIALS, 70  
DRILLING, 58, 110  
DRONE AIRCRAFT, 11  
DROPS (LIQUIDS), 56, 57, 69, 74, 152  
DRUGS, 142, 155, 156  
DUNES, 128  
DURABILITY, 50  
DUST, 148, 222  
DUSTY PLASMAS, 185  
DWELL, 112  
DYNAMIC CHARACTERISTICS, 90  
DYNAMIC LOADS, 102  
DYNAMIC MODELS, 42, 94  
DYNAMIC RESPONSE, 50, 204  
DYNAMIC STRUCTURAL ANALYSIS,  
29, 35, 100

## E

EARTH CRUST, 129  
EARTH GRAVITATION, 106  
EARTH LIMB, 130  
EARTH RESOURCES, 116  
EARTH SCIENCES, 106  
EARTH SURFACE, 92, 128  
EARTH-MOON SYSTEM, 101  
EARTHQUAKES, 180  
ECOLOGY, 105  
ECOSYSTEMS, 112, 113, 114, 116, 118,  
120, 162, 171  
EDUCATION, 9, 58, 145, 211, 213  
EFFECTORS, 3  
EGRESS, 6  
EJECTORS, 18  
EL NINO, 134  
ELASTIC PROPERTIES, 39  
ELASTIC SCATTERING, 194  
ELASTOMERS, 48, 50, 51  
ELECTRIC BATTERIES, 207  
ELECTRIC DIPOLES, 68  
ELECTRIC FIELD STRENGTH, 73  
ELECTRIC FIELDS, 73, 74, 77, 131, 222  
ELECTRIC GENERATORS, 187  
ELECTRIC POTENTIAL, 131, 140  
ELECTRIC PROPULSION, 34  
ELECTRICAL PROPERTIES, 41, 64  
ELECTRICAL RESISTIVITY, 68  
ELECTROCHEMICAL CELLS, 108  
ELECTROCHEMICAL CORROSION,  
44  
ELECTRODES, 63  
ELECTROHYDRODYNAMICS, 74  
ELECTROMAGNETIC ACCELERATION,  
202, 203  
ELECTROMAGNETIC PULSES, 61

ELECTROMAGNETIC RADIATION,  
203  
ELECTROMAGNETIC SCATTERING,  
64  
ELECTROMAGNETIC SHIELDING, 50  
ELECTROMETERS, 89  
ELECTRON ACCELERATORS, 184,  
195  
ELECTRON BEAMS, 191, 192  
ELECTRON BUNCHING, 185  
ELECTRON CLOUDS, 190  
ELECTRON DISTRIBUTION, 227  
ELECTRON ENERGY, 24, 184  
ELECTRON GUNS, 99  
ELECTRON MICROSCOPY, 208  
ELECTRON-POSITRON PAIRS, 196  
ELECTRONIC EQUIPMENT, 66, 110  
ELECTRONIC MAIL, 178  
ELECTRONIC MODULES, 35  
ELECTRONIC WARFARE, 66  
ELECTROSTATICS, 131, 206  
EMBEDDED COMPUTER SYSTEMS,  
165  
EMERGENCIES, 143  
EMERGENCY LANDING, 6  
EMITTANCE, 185  
ENCEPHALITIS, 142  
ENDANGERED SPECIES, 115, 116, 121  
ENDEAVOUR (ORBITER), 26  
ENERGETIC PARTICLES, 218  
ENERGY ABSORPTION, 11  
ENERGY CONSUMPTION, 89, 110  
ENERGY CONVERSION, 109  
ENERGY DISSIPATION, 221  
ENERGY GAPS (SOLID STATE), 193  
ENERGY POLICY, 110  
ENERGY STORAGE, 108  
ENERGY TECHNOLOGY, 109  
ENGINE TESTS, 35, 95  
ENGINEERING MANAGEMENT, 168  
ENVIRONMENT EFFECTS, 137  
ENVIRONMENT MANAGEMENT, 117,  
119  
ENVIRONMENT PROTECTION, 116  
ENVIRONMENT SIMULATION, 224  
ENVIRONMENTAL SURVEYS, 25  
ENZYMES, 138, 146, 147, 151  
EOS DATA AND INFORMATION SYS-  
TEM, 214  
EPITHELIUM, 154  
EPOXY COMPOUNDS, 53  
EQUILIBRIUM FLOW, 83  
ERROR ANALYSIS, 97, 180, 182  
ERRORS, 173  
ESTIMATES, 127  
ESTIMATING, 118

ESTROGENS, 138, 151  
ESTUARIES, 120, 121  
ETALONS, 93  
EUROPE, 57  
EUTECTICS, 45  
EVACUATING, 143  
EVACUATING (TRANSPORTATION), 6  
EVALUATION, 37, 40, 89, 97, 211  
EVOLVABLE HARDWARE, 166, 173  
EXCIMER LASERS, 200  
EXCITATION, 185, 193  
EXHAUST EMISSION, 126  
EXHAUST GASES, 126  
EXHAUST NOZZLES, 13, 31  
EXHAUST SYSTEMS, 20  
EXOBIOLGY, 164, 221  
EXPERIMENT DESIGN, 17, 135, 163  
EXPERIMENTATION, 33  
EXPLOSIVES, 37, 54  
EXPLOSIVES DETECTION, 5  
EXPONENTIAL FUNCTIONS, 86  
EXPOSURE, 140  
EXTRAVEHICULAR ACTIVITY, 26,  
159, 160, 162  
EXTRAVEHICULAR MOBILITY  
UNITS, 159, 160  
EYE DISEASES, 154

## F

F-111 AIRCRAFT, 12  
FABRICATION, 11, 30, 38, 47, 49, 110,  
143, 200, 207  
FAILURE, 97  
FAILURE ANALYSIS, 3, 39  
FAN BLADES, 188  
FAR ULTRAVIOLET RADIATION, 50  
FAR UV SPECTROSCOPIC  
EXPLORER, 216  
FATIGUE (BIOLOGY), 153, 159, 160  
FATIGUE (MATERIALS), 45, 51, 98  
FATIGUE LIFE, 12  
FATTY ACIDS, 146  
FEASIBILITY, 33  
FEASIBILITY ANALYSIS, 30  
FEED SYSTEMS, 24  
FEEDBACK, 76  
FEEDBACK CONTROL, 59, 76, 178,  
200  
FEMALES, 136, 140, 141  
FERROFLUIDS, 84  
FERTILITY, 150  
FETUSES, 142  
FIELD EFFECT TRANSISTORS, 65  
FIELD TESTS, 166  
FIELD THEORY (PHYSICS), 210

FIELD-PROGRAMMABLE GATE ARRAYS, 64, 165, 168, 173  
FIGHTER AIRCRAFT, 99  
FILM THICKNESS, 75, 154  
FINITE ELEMENT METHOD, 64, 94, 100, 181  
FINS, 71  
FIRE EXTINGUISHERS, 58  
FIRES, 58  
FISHERIES, 113, 115  
FISHES, 115, 120, 121  
FLIGHT CHARACTERISTICS, 155, 186  
FLIGHT CONDITIONS, 186  
FLIGHT CONTROL, 2, 15  
FLIGHT INSTRUMENTS, 12  
FLIGHT MANAGEMENT SYSTEMS, 7, 8  
FLIGHT OPERATIONS, 22, 159  
FLIGHT SAFETY, 15  
FLIGHT TESTS, 4, 186  
FLIGHT TRAINING, 15  
FLOOD PLAINS, 104  
FLORIDA, 102, 106, 107  
FLOW DISTRIBUTION, 19, 32, 40, 67, 71, 85, 92, 152  
FLOW EQUATIONS, 85  
FLOW MEASUREMENT, 86, 125, 186  
FLOW STABILITY, 84  
FLOW VELOCITY, 81, 125  
FLOW VISUALIZATION, 67, 85  
FLUE GASES, 162  
FLUID DYNAMICS, 43, 71, 72, 73, 83, 84, 85, 152  
FLUID FILMS, 154  
FLUID FLOW, 34, 45, 72, 85, 96  
FLUID MANAGEMENT, 85  
FLUID MECHANICS, 42, 56  
FLUIDICS, 31, 47, 69, 70  
FLUIDIZED BED PROCESSORS, 78  
FLUX DENSITY, 83  
FLYBY MISSIONS, 26  
FOAMS, 16, 49, 51  
FOCUSING, 201  
FOOD, 163  
FOOD PROCESSING, 161  
FOOD PRODUCTION (IN SPACE), 160  
FOREST MANAGEMENT, 112  
FORESTS, 120, 121, 122, 123  
FORM FACTORS, 191  
FRACTALS, 184  
FREE ELECTRON LASERS, 94  
FREQUENCIES, 184, 189  
FRICTION FACTOR, 128  
FRICTION MEASUREMENT, 21  
FRICTION STIR WELDING, 96

FUEL CELLS, 10  
FUEL CONSUMPTION, 54  
FUEL TANKS, 161  
FUELS, 52  
FULL SCALE TESTS, 11  
FURNACES, 27

## G

GALAXIES, 223  
GALERKIN METHOD, 181  
GALILEAN SATELLITES, 101  
GALLIUM COMPOUNDS, 89  
GALLIUM NITRIDES, 207  
GAMMA RAY BURSTS, 228  
GAMMA RAY OBSERVATORY, 228  
GAMMA RAYS, 185, 228  
GANTRY CRANES, 97  
GAS DETECTORS, 89  
GAS DYNAMICS, 85  
GAS EXCHANGE, 146  
GAS FLOW, 78, 80, 85  
GAS GIANT PLANETS, 101, 220  
GAS IONIZATION, 194  
GAS JETS, 86  
GAS MIXTURES, 153  
GAS-GAS INTERACTIONS, 85  
GAS-SOLID INTERACTIONS, 78  
GASEOUS DIFFUSION, 85  
GASEOUS ROCKET PROPELLANTS, 36  
GASES, 93  
GASOLINE, 54  
GELS, 48  
GENE EXPRESSION, 144, 151  
GENE THERAPY, 138  
GENERAL AVIATION AIRCRAFT, 16  
GENERAL OVERVIEWS, 196  
GENES, 136, 140, 143, 147  
GENETIC CODE, 120  
GENETICS, 112, 141, 152  
GEODETIC SURVEYS, 129  
GEODYNAMICS, 129  
GEOGRAPHIC INFORMATION SYSTEMS, 213  
GEOLOGICAL SURVEYS, 115  
GEOLOGY, 102  
GEOMORPHOLOGY, 127  
GEOPHYSICS, 102, 189  
GLASS FIBERS, 16  
GLOBAL POSITIONING SYSTEM, 9  
GLYCOLS, 77  
GOES SATELLITES, 131  
GOVERNMENTS, 103, 212  
GRADIENTS, 77

GRANULAR MATERIALS, 44, 79, 128  
GRAPHIC ARTS, 23  
GRAPHICAL USER INTERFACE, 212  
GRASSLANDS, 121  
GRAVITATION, 210  
GRAVITATIONAL EFFECTS, 81  
GRAVITATIONAL FIELDS, 84  
GRAVITATIONAL INSTABILITY, 77, 85  
GRAVITY WAVES, 126, 127  
GREENLAND, 133, 134  
GRID GENERATION (MATHEMATICS), 20, 180  
GROUND BASED CONTROL, 20  
GROUND TESTS, 30  
GROUND WATER, 102, 103, 104, 106, 107, 108  
GROWTH, 135  
GUIDE VANES, 188  
GULF OF MEXICO, 110  
GUN PROPELLANTS, 53  
GUNS (ORDNANCE), 203

## H

HABITATS, 115, 120, 121, 123, 171  
HADRONS, 191, 196  
HAFNIUM, 185  
HALL THRUSTERS, 35, 36  
HALOPHILES, 164  
HEALTH, 27, 88, 150  
HEAT, 227  
HEAT AFFECTED ZONE, 47  
HEAT FLUX, 80, 81  
HEAT MEASUREMENT, 52  
HEAT RESISTANT ALLOYS, 46  
HEAT TRANSFER, 56, 72, 80, 82  
HEATING, 52  
HEATING EQUIPMENT, 27  
HEAVY IONS, 197  
HELICOPTER WAKES, 14  
HELIUM ISOTOPES, 194  
HEMATOPOIETIC SYSTEM, 155  
HERBICIDES, 122  
HETERODYNING, 88  
HETEROGENEITY, 120  
HEURISTIC METHODS, 183  
HIGGS BOSONS, 191  
HIGH ALTITUDE, 128  
HIGH CURRENT, 37  
HIGH PRESSURE, 43, 44, 98  
HIGH RESOLUTION, 128  
HIGH SPEED, 172  
HIGH TEMPERATURE ENVIRONMENTS, 27

HIGH TEMPERATURE SUPERCONDUCTORS, 207  
HIGH TEMPERATURE TESTS, 18, 96  
HIGH THRUST, 36  
HIGHWAYS, 133  
HISTORIES, 103, 229  
HOLES (MECHANICS), 58  
HORMONES, 146  
HTPB PROPELLANTS, 52  
HUMAN FACTORS ENGINEERING, 16, 22, 155, 157, 158, 163  
HUMAN PERFORMANCE, 29, 158, 159, 160  
HYDRAULIC EQUIPMENT, 47, 69  
HYDRAULIC FLUIDS, 47  
HYDRAULIC JETS, 21  
HYDRAULICS, 104  
HYDRAZINES, 41  
HYDROCARBON FUELS, 54  
HYDROCARBONS, 54  
HYDRODYNAMICS, 70  
HYDROELECTRICITY, 117  
HYDROGEN, 36  
HYDROGEN ATOMS, 44  
HYDROGEN PEROXIDE, 52  
HYDROGEOLOGY, 104  
HYDROLOGY, 102, 103, 104, 106, 107  
HYDROPHONES, 187  
HYPERBARIC CHAMBERS, 40  
HYPERSONIC FLIGHT, 17  
HYPERSONIC NOZZLES, 32  
HYPERSONIC VEHICLES, 10  
HYPERVELOCITY IMPACT, 92

## I

ICE, 134, 220, 221  
IGNITION, 203  
ILLUMINATING, 163  
IMAGE ANALYSIS, 38, 129, 133, 162, 222, 227  
IMAGE PROCESSING, 64, 71, 131  
IMAGING TECHNIQUES, 60, 91, 119, 145, 185, 221  
IMMUNOLOGY, 155  
IMPACT, 188  
IMPLOSIONS, 204  
IN SITU MEASUREMENT, 135  
IN SITU RESOURCE UTILIZATION, 43  
IN VITRO METHODS AND TESTS, 151  
IN VIVO METHODS AND TESTS, 135  
INCINERATORS, 162  
INDIUM, 42  
INDUSTRIAL MANAGEMENT, 167  
INDUSTRIAL PLANTS, 23

INEQUALITIES, 182  
INERTIAL CONFINEMENT FUSION, 204  
INERTIAL FUSION (REACTOR), 204  
INFECTIOUS DISEASES, 142  
INFLATABLE SPACE STRUCTURES, 90  
INFLATABLE STRUCTURES, 49, 94, 95  
INFLUENZA, 140  
INFORMATION FLOW, 212  
INFORMATION MANAGEMENT, 8, 118, 175, 212  
INFORMATION RETRIEVAL, 213  
INFORMATION SYSTEMS, 175, 177, 180, 212  
INFRARED ASTRONOMY, 223  
INFRARED IMAGERY, 221  
INFRARED RADIATION, 92, 199  
INFRARED SCANNERS, 126  
INFRARED SPECTROMETERS, 126  
INJECTION, 194  
INJECTION MOLDING, 48  
INJECTORS, 36, 194  
INSTALLING, 6  
INSTANTONS, 209  
INSULATORS, 90  
INTAKE SYSTEMS, 18  
INTEGRITY, 118  
INTERFACIAL TENSION, 45, 69, 82, 154  
INTERFEROMETERS, 201, 203  
INTERFEROMETRY, 59  
INTERLAYERS, 199  
INTERNATIONAL SPACE STATION, 22, 24, 25, 26, 31, 78, 205  
INTERNETS, 166, 180, 211  
INTERPOLATION, 98, 178  
INTERSTELLAR CHEMISTRY, 221  
INTERSTELLAR MATTER, 220, 221  
INTRUSION, 111, 169, 176  
INVENTORIES, 113, 114  
INVERTEBRATES, 162  
INVERTERS, 110  
INVISCID FLOW, 188  
ION ACCELERATORS, 197  
ION BEAMS, 197, 204  
ION SOURCES, 204  
IONIC COLLISIONS, 228  
IONIZATION, 215  
IONIZATION GAGES, 89  
IONOSONDES, 128  
IONOSPHERES, 127  
IRON, 141  
IRRADIANCE, 112  
ISOTOPE EFFECT, 44

ISOTROPIC TURBULENCE, 80  
ITERATION, 172, 176

## J

JAMMING, 66  
JAVA (PROGRAMMING LANGUAGE), 173, 174  
JET AIRCRAFT, 10  
JET AIRCRAFT NOISE, 20  
JET ENGINES, 40  
JET FLOW, 125  
JET LAG, 157, 158  
JETS, 197  
JOINTS (ANATOMY), 159, 160  
JUPITER (PLANET), 218  
JUPITER ATMOSPHERE, 218

## K

KEELS, 16  
KEVLAR (TRADEMARK), 16  
KINETIC ENERGY, 130  
KINETICS, 223  
KLYSTRONS, 209  
KNOWLEDGE REPRESENTATION, 213  
KORTEWEG-DEVRIES EQUATION, 181  
KUIPER BELT, 220

## L

LABORATORIES, 160  
LAMELLA (METALLURGY), 45  
LAMINATES, 38, 90, 199  
LAND MANAGEMENT, 116  
LANDFORMS, 105  
LANDING GEAR, 67  
LARGE SPACE STRUCTURES, 95  
LASER ABLATION, 200  
LASER APPLICATIONS, 71, 88, 92  
LASER CAVITIES, 93  
LASER DAMAGE, 93  
LASER DOPPLER VELOCIMETERS, 88  
LASER GUIDANCE, 218  
LASER MATERIALS, 48  
LASER OUTPUTS, 92  
LASER POWER BEAMING, 109  
LASER WEAPONS, 92  
LASERS, 92  
LATTICES, 199  
LEADING EDGE SLATS, 186  
LENNARD-JONES POTENTIAL, 39  
LENS DESIGN, 201  
LENSES, 66, 201

LEVITATION, 206  
 LIAPUNOV FUNCTIONS, 97  
 LIBRARIES, 131, 211  
 LIFE CYCLE COSTS, 183  
 LIFE SCIENCES, 92  
 LIFE SUPPORT SYSTEMS, 146, 162  
 LIFT, 2  
 LIFT DRAG RATIO, 3  
 LIFTING BODIES, 3  
 LIGHT (VISIBLE RADIATION), 42  
 LIGHT SCATTERING, 77, 152  
 LIGHT WATER REACTORS, 45  
 LIGHTING EQUIPMENT, 29  
 LINE SPECTRA, 215, 216, 217, 219  
 LINEAR ACCELERATORS, 191, 195, 208, 209  
 LINEAR PARAMETER-VARYING CONTROL, 178  
 LINEAR SYSTEMS, 200  
 LIPIDS, 55  
 LIQUID BRIDGES, 76  
 LIQUID CHROMATOGRAPHY, 152  
 LIQUID CRYSTALS, 86  
 LIQUID METALS, 56  
 LIQUID PHASES, 53  
 LIQUID PROPELLANT ROCKET ENGINES, 34  
 LIQUID-GAS MIXTURES, 83  
 LIQUIDS, 37, 99  
 LITHIUM BATTERIES, 64  
 LITHOGRAPHY, 66  
 LOADS (FORCES), 29, 35, 39, 94, 223  
 LOCOMOTION, 59  
 LOGIC CIRCUITS, 65  
 LOGIC DESIGN, 165  
 LOGISTICS, 31  
 LONGITUDINAL STABILITY, 190  
 LOW ALTITUDE, 60  
 LOW NOISE, 188  
 LOW PRESSURE, 146  
 LOW TEMPERATURE, 109, 208  
 LUMINESCENCE, 52  
 LUNAR ENVIRONMENT, 226  
 LUNAR EXPLORATION, 109  
 LUNAR GEOLOGY, 223  
 LUNAR ROCKS, 223  
 LUNAR ROVING VEHICLES, 109  
 LUNAR SURFACE, 226  
 LUNGS, 153, 154  
 LYSOZYME, 152, 205

**M**

MACROMOLECULES, 55  
 MAGNETIC FLUX, 208  
 MAGNETIC PROPERTIES, 106  
 MAGNETIC SIGNATURES, 227  
 MAGNETIC SUSPENSION, 24  
 MAGNETOHYDRODYNAMICS, 34, 84  
 MAGNETRONS, 184  
 MAGNETS, 84  
 MAINTENANCE, 27, 89, 121, 198  
 MAMMALS, 140  
 MAMMARY GLANDS, 135, 136, 137, 138, 139, 141, 142, 143, 144, 145, 146, 147, 148, 149, 150, 151  
 MAN ENVIRONMENT INTER-ACTIONS, 135  
 MANAGEMENT, 213  
 MANAGEMENT INFORMATION SYSTEMS, 167  
 MANAGEMENT METHODS, 113  
 MANAGEMENT PLANNING, 118  
 MANAGEMENT SYSTEMS, 212, 214  
 MANNED SPACE FLIGHT, 22, 229  
 MANUFACTURING, 109  
 MAPPING, 105, 227  
 MARINE ENVIRONMENTS, 189  
 MARKET RESEARCH, 33  
 MARS (PLANET), 36, 58, 226  
 MARS ATMOSPHERE, 41, 89, 223, 225  
 MARS BASES, 224  
 MARS ENVIRONMENT, 164  
 MARS EXPLORATION, 43, 226  
 MARS SURFACE, 128, 164, 225, 227  
 MARS SURFACE SAMPLES, 58, 226  
 MARSHLANDS, 123  
 MARYLAND, 114, 120, 122  
 MASERS, 93  
 MATERIALS HANDLING, 94  
 MATERIALS RECOVERY, 85  
 MATERIALS SCIENCE, 109  
 MATERIALS SELECTION, 52  
 MATHEMATICAL MODELS, 22, 24, 27, 39, 48, 49, 86, 90, 91, 93, 100, 111, 125, 126, 163, 166, 189, 203, 207, 221  
 MATRICES, 192  
 MATTER-ANTIMATTER PROPULSION, 196  
 MEAN, 127  
 MEASURE AND INTEGRATION, 182  
 MEASUREMENT, 14  
 MEASURING INSTRUMENTS, 52, 205  
 MECHANICAL ENGINEERING, 28, 94  
 MECHANICAL PROPERTIES, 38, 46, 48, 100, 205  
 MECHANICAL TWINNING, 45  
 MEDICAL SCIENCE, 137  
 MEDICAL SERVICES, 88, 143  
 MEDICINE, 136, 150  
 MELTING, 37, 223  
 MEMBRANE STRUCTURES, 29, 30, 181  
 MEMBRANES, 41, 140  
 MEMORY (COMPUTERS), 171, 177  
 MERCURY (METAL), 204  
 MESONS, 190  
 MESSAGES, 177  
 METAL PLATES, 200  
 METALLURGY, 46  
 METASTASIS, 147, 150  
 METEORIDS, 222  
 METEOROLOGICAL INSTRUMENTS, 131, 225  
 METEOROLOGICAL PARAMETERS, 130, 132  
 METEOROLOGICAL RADAR, 131  
 METEOROLOGICAL SERVICES, 133  
 METEOROLOGY, 124  
 METHODOLOGY, 90  
 METHYL COMPOUNDS, 44, 53  
 METHYL POLYSILOXANES, 75  
 MICROCHANNELS, 47, 69, 70  
 MICROELECTROMECHANICAL SYSTEMS, 47, 62, 69, 93  
 MICROELECTRONICS, 29, 111  
 MICROGRAVITY, 55, 56, 57, 72, 73, 76, 78, 79, 80, 82, 84, 85, 151, 154, 205  
 MICROINSTRUMENTATION, 69, 70  
 MICROPARTICLES, 73, 74, 185  
 MICROPOROSITY, 205  
 MICROPROCESSORS, 29, 171  
 MICROSATELLITES, 60  
 MICROSCOPY, 55, 56, 74, 87  
 MICROSTRUCTURE, 45, 46  
 MICROWAVE EQUIPMENT, 65  
 MICROWAVE POWER BEAMING, 109  
 MICROWAVES, 184  
 MIDDLE EAST, 102  
 MILITARY HELICOPTERS, 1, 215  
 MILITARY OPERATIONS, 11, 157, 158, 213  
 MILITARY TECHNOLOGY, 32, 143  
 MINIATURIZATION, 66, 69  
 MINIMUM DRAG, 3  
 MINKOWSKI SPACE, 209  
 MIRRORS, 198, 201  
 MISSILES, 20  
 MISSION PLANNING, 22  
 MITOCHONDRIA, 120  
 MIXING, 48  
 MIXING LAYERS (FLUIDS), 40  
 MOBILE COMMUNICATION SYSTEMS, 63  
 MODELS, 25, 28, 42, 154  
 MODULATION, 76, 145  
 MODULUS OF ELASTICITY, 38

MOLECULAR BEAMS, 193  
MOLECULAR CLOUDS, 220  
MOLECULAR DYNAMICS, 56, 140, 152  
MOLECULAR GASES, 194  
MOLECULAR INTERACTIONS, 39, 193, 205, 207  
MOLECULAR IONS, 194  
MOMENTS OF INERTIA, 185  
MONITORS, 27, 102  
MOTION PERCEPTION, 166  
MOVING TARGET INDICATORS, 59  
MULTIDISCIPLINARY RESEARCH, 31  
MULTISENSOR FUSION, 177  
MUONS, 184  
MUSCULOSKELETAL SYSTEM, 155

## N

NACELLES, 19  
NANOCOMPOSITES, 68  
NANOCRYSTALS, 49  
NANOFABRICATION, 49, 50  
NANOINDENTATION, 50  
NANOSATELLITES, 28  
NANOSTRUCTURE (CHARACTERISTICS), 39, 68  
NANOTECHNOLOGY, 206  
NASA PROGRAMS, 22, 73  
NASA SPACE PROGRAMS, 1, 225, 226, 229  
NAVIER-STOKES EQUATION, 3, 19, 67, 182, 186  
NAVY, 183, 215  
NEODYMIUM, 91  
NERVOUS SYSTEM, 148  
NEURAL NETS, 111  
NEUROLOGY, 141  
NEUROPHYSIOLOGY, 140  
NEUTRAL PARTICLES, 190  
NEUTRINOS, 229  
NEUTRON SCATTERING, 51  
NEW MEXICO, 102  
NEW YORK, 107  
NICKEL ALLOYS, 46  
NICKEL HYDROGEN BATTERIES, 108  
NIGHT VISION, 163  
NITRATES, 123  
NITRIC OXIDE, 32, 53  
NITROGEN, 41  
NOISE (SOUND), 187  
NOISE INTENSITY, 187  
NOISE MEASUREMENT, 188  
NOISE PREDICTION, 86  
NOISE PREDICTION (AIRCRAFT), 186

NOISE REDUCTION, 20, 186, 189  
NOISE SPECTRA, 86  
NONLINEAR FEEDBACK, 39  
NONLINEAR FILTERS, 72  
NONLINEAR OPTICS, 50  
NONLINEAR SYSTEMS, 90  
NONLINEARITY, 39, 84, 173, 188, 210  
NOZZLE FLOW, 31, 32, 40  
NUCLEAR ENERGY, 97  
NUCLEAR FUSION, 197  
NUCLEAR MAGNETIC RESONANCE, 86  
NUCLEATE BOILING, 80  
NUCLEATION, 205  
NUCLEONS, 228  
NUMERICAL ANALYSIS, 42, 63, 66, 72, 78, 84, 85, 100, 133, 172, 183, 190, 194, 223  
NUMERICAL CONTROL, 72  
NUTRIENTS, 162  
NUTRITIONAL REQUIREMENTS, 160

## O

OBJECT-ORIENTED PROGRAMMING, 175  
OBSERVATION, 219  
OCCULTATION, 228  
OCEAN DYNAMICS, 124, 134  
OFFSHORE ENERGY SOURCES, 110  
OIL POLLUTION, 110  
ONCOGENES, 145  
OPERATING SYSTEMS (COMPUTERS), 170  
OPERATING TEMPERATURE, 41  
OPTICAL EQUIPMENT, 199  
OPTICAL MATERIALS, 199, 201  
OPTICAL PROPERTIES, 41, 64, 68, 90, 125  
OPTICAL RADAR, 131  
OPTICAL RESONATORS, 50  
OPTIMIZATION, 27, 64, 167, 171, 181  
ORBITS, 27, 28  
ORGANIC SOLIDS, 220  
ORGANISMS, 124, 162  
ORGANOMETALLIC COMPOUNDS, 37  
OSCILLATIONS, 5, 190, 229  
OUTCROPS, 227  
OXAZOLE, 86  
OXIDES, 37  
OXYGEN, 36, 123  
OZONE DEPLETION, 128

## P

PACIFIC OCEAN, 124, 134

PACKAGING, 161, 163  
PAINTS, 52  
PAIR PRODUCTION, 228  
PALEOBIOLOGY, 92  
PANELS, 100  
PARALLEL PROCESSING (COMPUTERS), 173, 174  
PARALLEL PROGRAMMING, 177  
PARAMAGNETISM, 93  
PARAMETER IDENTIFICATION, 28, 35  
PARAMETERIZATION, 39, 126, 228  
PARITY, 191  
PARTIAL DIFFERENTIAL EQUATIONS, 181  
PARTIAL PRESSURE, 42  
PARTICLE ACCELERATORS, 191, 197  
PARTICLE COLLISIONS, 190, 191, 209  
PARTICLE DECAY, 184  
PARTICLE ENERGY, 196  
PARTICLE IMAGE VELOCIMETRY, 14, 80  
PARTICLE INTERACTIONS, 128, 228  
PARTICLE THEORY, 190  
PARTICLES, 55, 77, 78, 80  
PARTICULATES, 187  
PASSENGERS, 6  
PATIENTS, 150  
PAVEMENTS, 21, 37  
PAYLOAD INTEGRATION, 212  
PAYLOADS, 25  
PENNSYLVANIA, 106  
PEPTIDES, 144  
PERFORMANCE, 8, 19, 174  
PERFORMANCE PREDICTION, 20, 35, 49, 52, 53, 89, 159, 224  
PERFORMANCE TESTS, 18, 40, 49, 198  
PERSONNEL, 62  
PERTURBATION, 77  
PERTURBATION THEORY, 210  
PH, 37, 123  
PHARMACOLOGY, 155, 156, 157  
PHASE SEPARATION (MATERIALS), 83, 205  
PHASE TRANSFORMATIONS, 45, 47, 72, 79, 83, 84  
PHENOLIC RESINS, 48  
PHOSPHATES, 123  
PHOTOELECTRON SPECTROSCOPY, 51, 89  
PHOTOGRAMMETRY, 90  
PHOTOMICROGRAPHY, 73  
PHOTONICS, 50  
PHOTONS, 90, 193, 194, 195, 201  
PHOTOVOLTAIC CELLS, 110

PHOTOVOLTAIC EFFECT, 110  
PHYSICAL CHEMISTRY, 54  
PHYSICAL SCIENCES, 55, 73  
PHYSICS, 93  
PHYSIOLOGY, 155  
PIEZOELECTRICITY, 68  
PILOT PERFORMANCE, 7, 12  
PILOT SUPPORT SYSTEMS, 7  
PILOTLESS AIRCRAFT, 11  
PILOTS (PERSONNEL), 153  
PIONS, 191, 228  
PITCH (INCLINATION), 227  
PIXELS, 178  
PLANETARIUMS, 211  
PLANETARY ENVIRONMENTS, 22  
PLANETARY GEOLOGY, 227  
PLANETARY IONOSPHERES, 128  
PLANETARY SURFACES, 222  
PLANETARY WAVES, 128  
PLANNING, 8, 117  
PLANTS (BOTANY), 124  
PLASMA ENGINES, 32, 203  
PLASMA PHYSICS, 202  
PLASMA POTENTIALS, 24  
PLASMA PROPULSION, 36  
PLASMA TEMPERATURE, 24  
PLASMAS (PHYSICS), 5, 34, 94, 202, 203, 227  
PLATES (TECTONICS), 129  
PLATING, 45  
PLUMES, 125  
PNEUMATIC CONTROL, 14  
POLAR REGIONS, 109  
POLARIMETRY, 28, 221  
POLARIZATION, 93, 195  
POLARIZATION (SPIN ALIGNMENT), 68  
POLARIZATION CHARACTERISTICS, 68  
POLLUTION MONITORING, 103  
POLYACETYLENE, 48  
POLYBUTADIENE, 53  
POLYCRYSTALS, 55  
POLYCYCLIC AROMATIC HYDROCARBONS, 221  
POLYETHYLENES, 37  
POLYIMIDES, 51, 68  
POLYMER BLENDS, 37  
POLYMERIZATION, 48  
POLYMERS, 38, 50  
POLYMORPHISM, 141  
POLYNOMIALS, 98  
POLYPEPTIDES, 149  
POLYPROPYLENE, 50, 51  
POPULATIONS, 120, 121  
POROSITY, 189

POROUS MATERIALS, 205  
POSITRONS, 190, 195  
POTENTIAL FLOW, 43  
POWERED LIFT AIRCRAFT, 14  
PRECIPITATION (METEOROLOGY), 131, 133  
PREDICTION ANALYSIS TECHNIQUES, 161, 181  
PREDICTIONS, 88  
PREFLIGHT ANALYSIS, 28  
PREGNANCY, 142  
PRESERVING, 163  
PRESSURE, 227  
PRESSURE MEASUREMENT, 87  
PRESSURE OSCILLATIONS, 125  
PROBABILITY DENSITY FUNCTIONS, 69  
PROBABILITY THEORY, 15, 118, 181, 183  
PROBLEM SOLVING, 166, 183  
PROCUREMENT, 183  
PROFILOMETERS, 201  
PROGRAM VERIFICATION (COMPUTERS), 174  
PROGRESS, 195  
PROJECT MANAGEMENT, 171, 214  
PROPAGATION, 210  
PROPELLANT TANKS, 101  
PROPELLANTS, 37  
PROPULSION, 25, 32, 54  
PROPULSION SYSTEM CONFIGURATIONS, 42  
PROPULSION SYSTEM PERFORMANCE, 18, 24, 95  
PROTECTION, 116, 117, 123  
PROTECTIVE COATINGS, 49  
PROTEIN CRYSTAL GROWTH, 205, 206  
PROTEINS, 136, 144, 146, 147, 148, 151, 152  
PROTOBIOLOGY, 120  
PROTOCOL (COMPUTERS), 63, 214  
PROTOTYPES, 33  
PSYCHOLOGY, 145  
PULMONARY FUNCTIONS, 154  
PULSE DETONATION ENGINES, 19  
PULSE GENERATORS, 61, 65  
PULSED LASERS, 38, 61, 93  
PULSED PLASMA THRUSTERS, 34, 202, 203  
PULSEJET ENGINES, 18

## Q

QUALITATIVE ANALYSIS, 97  
QUALITY, 163  
QUALITY CONTROL, 167

QUANTUM CHEMISTRY, 44  
QUANTUM CHROMODYNAMICS, 191, 195, 209  
QUANTUM HALL EFFECT, 209  
QUANTUM MECHANICS, 210  
QUARKS, 194  
QUASARS, 215, 219

## R

RADAR, 60  
RADAR DATA, 134  
RADAR IMAGERY, 60  
RADIATION DOSAGE, 50, 154  
RADIATION EFFECTS, 196  
RADIATION MEASUREMENT, 130, 132  
RADIATIVE TRANSFER, 192  
RADICALS, 44  
RADIO ASTRONOMY, 223  
RADIO FREQUENCIES, 194  
RADIO SOURCES (ASTRONOMY), 217  
RADIO TRACKING, 223  
RADIO TRANSMISSION, 61  
RADIOACTIVE DECAY, 194  
RADIOMETERS, 91, 130  
RADIOTELEPHONES, 61, 62  
RANDOM VARIABLES, 183  
RANGE SAFETY, 26  
RAPID QUENCHING (METALLURGY), 46  
RARE GAS COMPOUNDS, 42  
RATS, 142  
REACTION KINETICS, 43  
REAL TIME OPERATION, 88, 177  
REATTACHED FLOW, 87  
RECEIVERS, 27  
RECONFIGURABLE HARDWARE, 165  
REENTRY VEHICLES, 3, 96  
REGENERATION (PHYSIOLOGY), 146  
REGENERATORS, 208  
REGIONS, 200  
REGRESSION ANALYSIS, 161  
REGULATORS, 113  
RELIABILITY, 25  
RELIABILITY ANALYSIS, 131, 177  
RELIABILITY ENGINEERING, 98  
REMOTE SENSING, 105, 129, 130, 131, 133, 134, 142, 199, 225, 227  
REMOTE SENSORS, 200  
REQUIREMENTS, 63  
RESEARCH, 57  
RESEARCH AND DEVELOPMENT, 32, 73, 95, 110, 225  
RESEARCH FACILITIES, 23, 196, 199, 200

RESEARCH VEHICLES, 4, 15  
RESERVOIRS, 142  
RESONANCE, 18  
RESOURCES MANAGEMENT, 113,  
114, 117, 169, 171, 214  
RESTORATION, 112, 113, 116, 123  
REUSABLE LAUNCH VEHICLES, 22,  
24  
REUSABLE SPACECRAFT, 36  
REVERBERATION, 187  
REVISIONS, 213  
REYNOLDS AVERAGING, 67  
REYNOLDS EQUATION, 67  
REYNOLDS NUMBER, 4  
RHEOLOGY, 50, 55, 74  
RIPPLES, 83  
RISK, 6, 110, 169, 171  
ROADS, 122  
ROBOTICS, 59, 162, 226  
ROBOTS, 59  
ROCK MECHANICS, 102  
ROCKET ENGINE CONTROL, 52  
ROCKET ENGINE DESIGN, 35, 36, 95  
ROCKET ENGINES, 48  
ROCKET NOZZLES, 48  
ROCKET PROPELLANTS, 52  
ROCKS, 102  
ROLLING MOMENTS, 20  
ROTARY WING AIRCRAFT, 186  
ROTARY WINGS, 14  
ROTOR AERODYNAMICS, 188  
ROTOR BLADES (TURBOMACHIN-  
ERY), 14, 95  
ROTOR DYNAMICS, 14  
ROTORS, 72, 188  
ROVING VEHICLES, 162  
RUNGE-KUTTA METHOD, 182  
RUNWAY CONDITIONS, 21  
RUSSIAN FEDERATION, 110

## S

SAFETY, 6, 97, 163  
SAFETY MANAGEMENT, 26  
SALINITY, 111, 123  
SATELLITE DESIGN, 60  
SATELLITE IMAGERY, 119  
SATELLITE NETWORKS, 26, 109  
SATELLITE OBSERVATION, 125, 134  
SATELLITE SOUNDING, 130  
SCALE MODELS, 35, 181  
SCATTERING, 55, 192  
SCATTERING CROSS SECTIONS, 228  
SCATTEROMETERS, 91  
SCHEDULING, 178, 224  
SCHOOLS, 58

SCIENCE, 211  
SCIENTIFIC VISUALIZATION, 87  
SCREECH TONES, 3  
SEALING, 37, 95  
SEALS (STOPPERS), 18, 96  
SEATS, 11  
SECURITY, 176  
SEDIMENT TRANSPORT, 104  
SEDIMENTS, 108  
SEGMENTED MIRRORS, 198  
SELENIUM, 42  
SELF ASSEMBLY, 74  
SEMANTICS, 172  
SEMICONDUCTING FILMS, 206  
SEMICONDUCTOR DEVICES, 61  
SEMICONDUCTOR LASERS, 204  
SEMICONDUCTORS (MATERIALS),  
64  
SENSITIVITY ANALYSIS, 39  
SEPARATED FLOW, 87  
SEPARATION, 77  
SEPARATORS, 41  
SERVICE LIFE, 161, 163  
SEYFERT GALAXIES, 216, 217  
SHADOWGRAPH PHOTOGRAPHY, 77  
SHAPE CONTROL, 95  
SHEAR LAYERS, 172  
SHEAR PROPERTIES, 43, 79  
SHEARING, 77  
SHELLS (STRUCTURAL FORMS), 100  
SHIPS, 183  
SHOCK LAYERS, 172  
SHOCK TUBES, 43  
SHOCK WAVES, 71  
SHORT TAKEOFF AIRCRAFT, 14  
SHRINKAGE, 38  
SIGNAL TO NOISE RATIOS, 26  
SIGNS AND SYMPTOMS, 158  
SILICON CARBIDES, 41  
SILICON DIOXIDE, 65  
SILICON NITRIDES, 100  
SILVICULTURE, 123  
SIMULATION, 56, 67, 79, 131, 200, 221  
SIMULATORS, 199  
SINGULARITY (MATHEMATICS), 210  
SITUATIONAL AWARENESS, 7  
SKY SURVEYS (ASTRONOMY), 223  
SLEEP, 157, 159  
SLEEP DEPRIVATION, 153, 155, 156,  
158, 159  
SMART MATERIALS, 68  
SOFTWARE ENGINEERING, 8, 92,  
125, 165, 166, 167, 168, 169, 170,  
171, 172, 175, 176  
SOIL MAPPING, 105, 123  
SOIL MOISTURE, 91

SOILS, 122  
SOLAR ARRAYS, 194  
SOLAR CELLS, 33, 64, 110, 111  
SOLAR CORONA, 227  
SOLAR ENERGY ABSORBERS, 50  
SOLAR FLARES, 227  
SOLAR GENERATORS, 33, 109  
SOLAR POWERED AIRCRAFT, 224  
SOLAR RADIATION, 112  
SOLAR SAILS, 29, 30  
SOLAR SYSTEM, 101, 162, 220  
SOLAR WIND, 227  
SOLENOIDS, 208  
SOLID OXIDE FUEL CELLS, 109  
SOLID PHASES, 41  
SOLID PROPELLANTS, 53  
SOLID STATE, 109  
SOLID STATE LASERS, 204  
SOLID SURFACES, 57  
SOLUTIONS, 205  
SOUND FIELDS, 187  
SOUND PRESSURE, 125  
SOUND PROPAGATION, 188  
SOUTH CAROLINA, 108  
SPACE BASED RADAR, 91  
SPACE ERECTABLE STRUCTURES,  
94  
SPACE EXPLORATION, 22, 155, 162  
SPACE FLIGHT, 1, 153, 154  
SPACE FLIGHT FEEDING, 160  
SPACE HABITATS, 224  
SPACE MISSIONS, 29, 161, 226  
SPACE OPERATIONS CENTER  
(NASA), 211  
SPACE PLASMAS, 24, 194, 222  
SPACE RATIONS, 160  
SPACE SHUTTLE PAYLOADS, 31  
SPACE SHUTTLES, 22  
SPACE TEMPERATURE, 126  
SPACE TRANSPORTATION SYSTEM,  
25, 26  
SPACE-TIME CE/SE METHOD, 3  
SPACEBORNE EXPERIMENTS, 55, 82  
SPACEBORNE TELESCOPES, 50, 228  
SPACECRAFT CABIN  
ATMOSPHERES, 29  
SPACECRAFT CHARGING, 24  
SPACECRAFT CONTROL, 2  
SPACECRAFT DESIGN, 10, 24, 36  
SPACECRAFT LAUNCHING, 24  
SPACECRAFT MODELS, 224  
SPACECRAFT MODULES, 24, 225  
SPACECRAFT PERFORMANCE, 196  
SPACECRAFT PROPULSION, 36  
SPACECREW TRANSFER, 26  
SPACECREWS, 26, 159, 224

SPATIAL RESOLUTION, 200  
SPECTRAL EMISSION, 112  
SPECTRAL REFLECTANCE, 135, 220  
SPECTROGRAPHS, 219  
SPECTROMETERS, 43  
SPECTROSCOPIC ANALYSIS, 51  
SPECTROSCOPY, 191  
SPECTRUM ANALYSIS, 135, 215, 216  
SPHERES, 83, 193  
SPILLING, 110  
SPIN, 93  
SPLICING, 144  
SPRAY CHARACTERISTICS, 71  
SPRAYERS, 69  
STABILITY, 42, 51, 72, 78, 210  
STABILIZATION, 76  
STAINLESS STEELS, 49  
STANDARD MODEL (PARTICLE PHYSICS), 192, 196  
STANDARDS, 97, 104, 168  
STATIC MODELS, 97, 176  
STATORS, 72  
STEAM, 187  
STEELS, 98  
STIFFNESS, 39, 49, 99, 100  
STIFFNESS MATRIX, 94  
STOICHIOMETRY, 206  
STORAGE RINGS (PARTICLE ACCELERATORS), 190, 191  
STORAGE STABILITY, 161  
STORAGE TANKS, 98  
STRAIN RATE, 39  
STRATIGRAPHY, 223, 227  
STRATOSPHERE, 126  
STRESS (PSYCHOLOGY), 140  
STRESS-STRAIN RELATIONSHIPS, 51  
STRESSES, 99  
STRIATION, 96  
STRING THEORY, 209, 210  
STRONG INTERACTIONS (FIELD THEORY), 228  
STRUCTURAL ANALYSIS, 49, 94, 99, 101, 173, 181, 207  
STRUCTURAL DESIGN, 52, 94, 100  
STRUCTURAL STABILITY, 95  
STRUCTURAL WEIGHT, 15  
STRUCTURES, 150  
STRUTS, 30  
STUDENTS, 9, 58  
SUBSONIC SPEED, 4  
SUBSTRATES, 56, 199  
SUN, 112, 181  
SUPERCOMPUTERS, 175, 178  
SUPERCONDUCTING FILMS, 208  
SUPERCONDUCTIVITY, 208

SUPERCONDUCTORS (MATERIALS), 207  
SUPERCOOLING, 206  
SUPERHIGH FREQUENCIES, 62  
SUPERNOVAE, 219  
SUPERSONIC COMBUSTION RAM-JET ENGINES, 17  
SUPERSONIC FLOW, 71  
SUPERSONIC JET FLOW, 40  
SUPERSONIC TURBINES, 19  
SUPERSYMMETRY, 210  
SUPPORT SYSTEMS, 168  
SURFACE EMITTING LASERS, 93  
SURFACE GEOMETRY, 98  
SURFACE PROPERTIES, 152, 188, 205  
SURFACE ROUGHNESS, 71  
SURFACE TEMPERATURE, 34  
SURFACE TENSION DRIVEN CONVECTION, 57  
SURFACE TREATMENT, 44, 122  
SURFACE VEHICLES, 4, 12  
SURFACE WATER, 102, 106, 107, 108  
SURVEILLANCE, 97  
SUSPENSIONS, 77  
SYMMETRY, 3  
SYNCHRONOUS PLATFORMS, 131  
SYNCHROTRON RADIATION, 201  
SYNTAX, 170  
SYNTHESIS (CHEMISTRY), 64, 207  
SYNTHESIS GAS, 53  
SYNTHETIC APERTURE RADAR, 59, 60  
SYSTEM FAILURES, 161  
SYSTEMS ENGINEERING, 11, 28, 31, 94, 168, 169, 172, 200, 225  
SYSTEMS INTEGRATION, 25

## T

TABS (CONTROL SURFACES), 224  
TACAN, 61  
TARGETS, 204  
TEAMS, 8  
TECHNOLOGY ASSESSMENT, 17, 24, 25, 33, 41, 168, 214  
TECHNOLOGY UTILIZATION, 15, 28, 68, 110, 168, 199  
TELECOMMUNICATION, 8, 26, 62, 63, 165, 213  
TELEMEDICINE, 137  
TELEMETRY, 26  
TELESCOPES, 198  
TELLURIDES, 221  
TEMPERATURE CONTROL, 33  
TEMPERATURE DEPENDENCE, 48  
TEMPERATURE DISTRIBUTION, 17, 34

TEMPERATURE EFFECTS, 34, 46, 208  
TEMPERATURE MEASUREMENT, 17, 32  
TEMPERATURE SENSORS, 89  
TENSILE STRENGTH, 50, 102  
TERRAIN, 127  
TERRORISM, 7  
TEST FACILITIES, 36, 163  
TEST RANGES, 169  
TEST STANDS, 61, 95  
TETRAGONS, 205  
TEXTURES, 111  
THAILAND, 117  
THEMATIC MAPPERS (LANDSAT), 119  
THEORETICAL PHYSICS, 192  
THERAPY, 149, 196  
THERMAL ANALYSIS, 27, 42, 48, 52, 96  
THERMAL EMISSION, 50, 218  
THERMAL MAPPING, 17  
THERMAL RESISTANCE, 48  
THERMAL STRESSES, 100  
THERMOCAPILLARY MIGRATION, 57  
THERMODYNAMIC CYCLES, 19  
THERMODYNAMIC EQUILIBRIUM, 83, 130  
THERMODYNAMIC PROPERTIES, 37  
THERMODYNAMICS, 37, 39, 93, 134  
THIN FILMS, 38, 48, 75, 90  
THREE DIMENSIONAL MODELS, 2, 19, 125, 179, 185, 201  
THRUST AUGMENTATION, 18, 20  
THRUST CHAMBERS, 34  
THRUSTORS, 32, 203  
TILT ROTOR AIRCRAFT, 188  
TIME DEPENDENCE, 181, 210  
TIME MEASUREMENT, 152  
TIN OXIDES, 110  
TIP SPEED, 14  
TITANIUM ALUMINIDES, 45  
TOLERANCES (MECHANICS), 6, 98  
TOPOGRAPHY, 127, 227  
TORQUE, 160  
TOWED BODIES, 2  
TOXICITY AND SAFETY HAZARD, 58  
TRACE ELEMENTS, 126  
TRACTION, 21  
TRAINING EVALUATION, 9  
TRAJECTORIES, 24, 179  
TRAJECTORY ANALYSIS, 8, 28, 223  
TRAJECTORY PLANNING, 8, 28  
TRANSPORT AIRCRAFT, 6  
TRANSPORT PROPERTIES, 72

TRANSPORTATION, 177  
TRAVEL, 7  
TRIANGLES, 182  
TROPICAL REGIONS, 150  
TROPOSPHERE, 131  
TROUGHES, 124  
TUMBLING MOTION, 101  
TUMORS, 150  
TUNING, 93  
TURBIDITY, 123  
TURBINE ENGINES, 95, 100  
TURBINES, 72, 95  
TURBOMACHINERY, 189  
TURBULENCE, 71, 72, 83, 86, 128, 133, 188  
TURBULENCE MODELS, 13, 67  
TURBULENT BOUNDARY LAYER, 5  
TURBULENT FLOW, 67, 72, 80, 83, 84  
TWO DIMENSIONAL MODELS, 34, 55  
TWO STAGE TURBINES, 19

## U

ULTRAHIGH FREQUENCIES, 94  
ULTRASONICS, 149  
ULTRAVIOLET EMISSION, 218  
ULTRAVIOLET RADIATION, 217  
ULTRAVIOLET SPECTROSCOPY, 215  
ULYSSES MISSION, 227  
UNCERTAIN SYSTEMS, 181  
UNITED STATES, 63  
UNSTEADY FLOW, 18, 19, 95, 186  
UNSTEADY STATE, 188  
UNSTRUCTURED GRIDS (MATHEMATICS), 3, 31, 182  
URBAN DEVELOPMENT, 120  
USER MANUALS (COMPUTER PROGRAMS), 64  
UTERUS, 142

## V

V/STOL AIRCRAFT, 13  
VACUUM, 27  
VACUUM CHAMBERS, 200  
VACUUM SYSTEMS, 12, 191  
VANES, 67  
VAPOR PHASES, 42  
VAPORS, 81, 82  
VARIANCE (STATISTICS), 127  
VARIATIONS, 127  
VASIMR (PROPULSION SYSTEM), 36  
VEGETATION, 123  
VELOCITY, 48  
VELOCITY DISTRIBUTION, 84  
VELOCITY MEASUREMENT, 32

VELOCITY MODULATION, 85  
VENUS ATMOSPHERE, 224  
VERTICAL TAKEOFF AIRCRAFT, 10  
VIBRATION DAMPING, 95  
VIDEO COMMUNICATION, 60  
VIDEO DATA, 166, 222  
VIDEO EQUIPMENT, 88  
VIDEO TAPES, 222  
VIRIAL COEFFICIENTS, 152  
VIRTUAL REALITY, 87  
VIRUSES, 135, 140  
VISCOSITY, 71  
VISCIOUS DRAG, 5  
VISCIOUS FLOW, 72  
VISUAL PERCEPTION, 29, 166  
VOICE COMMUNICATION, 166  
VORTEX GENERATORS, 67  
VORTICES, 2, 67, 83, 84  
VORTICITY, 14  
VULNERABILITY, 9

## W

WAKEFULNESS, 156, 157, 158  
WAKES, 14, 188  
WALL PRESSURE, 87  
WARHEADS, 54  
WASHINGTON, 107  
WATER, 226  
WATER POLLUTION, 103  
WATER QUALITY, 103  
WATER RESOURCES, 106, 107  
WATER RUNOFF, 103  
WATER SAMPLING, 103  
WATER VAPOR, 131  
WATERSHEDS, 116, 119, 122  
WAVE ATTENUATION, 189  
WAVE EXCITATION, 83  
WAVE FRONTS, 128  
WAVE FUNCTIONS, 42  
WAVE PROPAGATION, 185  
WEATHER FORECASTING, 128, 133, 134  
WEATHER STATIONS, 133, 225  
WEBSITES, 44  
WEIGHTLESSNESS, 83  
WELDED JOINTS, 37, 47, 96  
WETLANDS, 117, 122, 123  
WETTING, 57, 75  
WHITE DWARF STARS, 219  
WIDE AREA NETWORKS, 164, 174  
WILDLIFE, 113, 114, 116, 122, 127  
WIND TUNNEL TESTS, 4, 14, 32, 67, 72, 188, 224  
WINGS, 2, 12

WIRELESS COMMUNICATION, 61, 62, 109  
WORKLOADS (PSYCHOPHYSIOLOGY), 140, 157, 158  
WORLD WIDE WEB, 175

## X

X RAY ABSORPTION, 215, 216, 217  
X RAY ANALYSIS, 148  
X RAY ASTRONOMY, 216, 217, 219  
X RAY ASTROPHYSICS FACILITY, 219  
X RAY DETECTORS, 217  
X RAY OPTICS, 200  
X RAY SCATTERING, 50  
X RAY SPECTRA, 216, 217, 219  
X RAY SPECTROMETERS, 89  
X RAY SPECTROSCOPY, 217  
X RAYS, 66, 200, 201, 218, 221  
X-38 CREW RETURN VEHICLE, 96

## Y

YAG LASERS, 91  
YBCO SUPERCONDUCTORS, 37, 208

## Z

ZIEGLER CATALYST, 48  
ZINC, 141

# Personal Author Index

## A

Aarnio, P., 58  
Abdul-Aziz, Ali, 100  
Abelson, Harold, 65  
Abrego, A. I., 14  
Achari, A., 205  
Achari, Aniruddha, 148  
Ackerman, A. S., 132  
Acrivios, Andreas, 77  
Adams, M., 211  
Adetona, O., 95  
Afanasev, A., 194  
Aftosmis, Michael J., 20  
Agen, Rebecca, 8  
Agnew, Brandy O., 8  
Aharony, O., 210  
Aherne, Michael, 36  
Ahmad, Jasim U., 12  
Ainslie, K., 151  
Aksay, I. A., 73  
Akushevich, I., 194  
Aldcroft, Thomas, 216  
Alemany, Kristina, 225  
Alesini, D., 190  
Allan, Brian G., 67  
Allen, John R., 41  
Aloor, S., 96  
Alp, E. E., 200  
Altman, Neal, 167  
Anderson, Brian P., 2  
Andrawis, Alfred S., 60  
Andresen, Arild, 21  
Andresen, U. C., 85  
Ansari, Rafat R., 154  
Antoneen, Erik L., 33  
Antonsen, Erik, 202  
Antoun, T. H., 102  
Arbocz, Johann, 100  
Arbuzov, A., 184  
Archambault, Mark R., 68  
Armes, S. P., 37  
Armstrong, Roy, 134  
Ashour-Abdalla, M., 130  
Assoufid, L., 200, 201  
Atkins, Harold L., 185  
Augustein, Emily, 162  
Auslender, Aaron H., 17  
Aycock, Russell J., 176

## B

Babel, Henry, 46  
Babu, K. S., 192  
Bacskey, Allen S., 25  
Bae, J. M., 109  
Baer, L., 142  
Baer, L. A., 140  
Bahder, Thomas B., 99  
Bailey, A., 54  
Bailey, B. C., 85  
Bailey, Larry L., 8  
Baird, Joyce C., 45  
Balla, R. Jeffrey, 87  
Balombin, Joe, 81  
Balsara, N. P., 37  
Banavar, Jayanth R., 55  
Banerjee, Prithviraj, 168  
Baraniak, Andrew, 144  
Barbee, David, 162  
Barhydt, Richard, 7  
Barley, Bryan, 198  
Barmore, Bryan E., 7  
Barnwell, Elizabeth, 161  
Bartram, Scott M., 86  
Bartsch, Thomas M., 98  
Bastian, Matthew, 21  
Battaglia, Theresa, 226  
Bauer, Steven X. S., 189  
Bayer, I. S., 56  
Bayramian, A., 203  
Beach, R., 203  
Beal, L., 102  
Beaumont, Maurice, 155, 156  
Beck, L., 141  
Becker, R. H., 222  
Behringer, Robert P., 78  
Behun, V., 29  
Belcher, W. R., 104  
Belding, Richard, 112  
Bell, D., 141  
Belvin, W. K., 29  
Benassi, Thomas E., 122  
Bennett, Richard A., 129  
Bensalem, Saddek, 172  
Benski, Adrienne, 161  
Berejnov, Viatcheslav, 151  
Bergey, John, 171  
Beringer, Dennis B., 12  
Berkman, M. E., 2  
Bernal, S., 196

Bernstein, G., 219  
Bertolucci, S., 190  
Berton, G., 128  
Best, A. I., 189  
Best, Susan, 166  
Bethke, Kristen, 225  
Beveridge, Ross, 64  
Beysens, Daniel, 83  
Bezrukikh, P., 110  
Bharadwaj, V., 195  
Bhardwaj, A., 217  
Bhatt, Niraj, 225  
Bhatt, Ramakrishna T., 100  
Bhattacharyya, J., 101  
Bibeau, C., 203  
Bideau, D., 128  
Bieniosek, F. M., 196  
Bierer-Garrett, Lisa, 117  
Bieringer, Peter, 206  
Bilek, Anastacia M., 154  
Bird, F. J., 214  
Birkan, M., 34  
Biscari, C., 190  
Biswas, Rupak, 177  
Bjorken, J. D., 192  
Black, A. R., 19  
Black, Jonathan T., 90  
Blaha, Charles A., 90  
Blair, W. D., 61  
Blank, Amy, 161  
Blanton, M., 222  
Blattnig, Steve R., 228  
Blockstein, David E., 116  
Blockus, Linda, 138  
Blok, H. P., 191  
Bloustine, Joshua, 151  
Bocippio, D., 124  
Boehm, Wim, 64  
Bogue, D. R., 3  
Boice, L. Peter, 115  
Bollman, Brent, 225  
Bonamente, Max, 218  
Bonissent, A., 219  
Bonn, R., 110  
Borland, M., 185  
Boscolo, M., 190  
Bou-Rabee, N. M., 211  
Boulinier, Thierry, 118  
Bovbjerg, Dana, 145  
Bower, G. R., 191  
Bowers, Glen E., 35

- Bowles, Roland L., 133  
Bowman, Lynn M., 101  
Boyd, D. Douglas, Jr., 186  
Boyd, Iain D., 33  
Brackney, Elisabeth S., 105  
Bradford, Bob, 166  
Bradford, Robert, 180  
Brady, John F., 77  
Brannon, Ree, 105  
Brasseur, L. H., 131  
Brat, Guillaume, 175  
Bray, M., 200  
Brebrick, R. F., 41  
Breeding, S., 26  
Breisacher, Kevin J., 36  
Brezo, Jelena, 154  
Bridges, James, 86  
Bristow, William A., 127  
Britt, Robert Roy, 128  
Brodsky, S. J., 195  
Bromwich, David H., 132  
Brooks, Thomas F., 186  
Browell, E. V., 131  
Brown, Ben, 70  
Brown, D., 141  
Brown, Gerald G., 183  
Brown, N., 24  
Brown, N. R., 187  
Brown, Peter, 221  
Brown, Samuel, 173  
Brown, Sylvia F., 51  
Brunner, Stefan, 72  
Brunty, Joseph, 35  
Buckingham, A. C., 71  
Budyono, Afif, 187  
Bull, J. M., 189  
Buoetuen, V., 37  
Burdman, G., 196  
Burnett, William, 225  
Burroughs, E. A., 211  
Burton, Rodney, 202  
Busfield, A. Rachel, 90  
Bush, J. David, 225  
Butch, G. K., 107  
Butler, Jeffrey T., 11  
Butler, Theresa, 63  
Byrd, D., 102  
Byrd, J. M., 190  
Byrne, M., 107
- C**
- Cabral, Patrick, 79  
Cadogan, D. P., 95
- Cahalan, Robert, 111  
Cai, Z., 200  
Caldwell, J. A., 155  
Caldwell, J. Lynn, 158, 159  
Caldwell, John A., 159  
Cameron, K., 214  
Campbell, Bryan A., 14  
Campbell, Dick, 10  
Campbell, Jonathan W., 91  
Cancio, Leopoldo, 143  
Cannell, David, 76  
Canning, John M., 8  
Cardullo, Frank M., 165  
Carey, Alice F., 10  
Carnasciali, M. I., 57  
Carpen, Ileana C., 77  
Carrington, Connie K., 33  
Carroll, B., 133  
Carswell, W. E., 26  
Carter, Amani, 50  
Casagrande, Maria, 157  
Casiano, Matthew J., 94  
Cassibry, J. T., 34, 202  
Cassibry, Jason T., 203  
Castillo, N. K., 106  
Caubet, Jordi, 177  
Caughey, David A., 182  
Cederwall, R. T., 132  
Cederwall, Richard T., 130  
Celata, S. M., 196  
Centeno, Martha A., 23  
Chaban, Galina M., 42  
Chaderjian, Neal M., 12  
Chaikin, P. M., 55  
Chait, Richard, 136  
Chakrabarti, Suman, 196  
Chamberlain, Jim, 166  
Champion, R., 23  
Chan, Cho Lik, 85  
Chandler, Frank, 23  
Chang, A., 204  
Chang, Hongrok, 193  
Chanteloup, J. C., 203  
Chao, A. W., 190  
Chauffard, Françoise, 155  
Chen, C. F., 85  
Chen, J.-C., 57  
Chen, L., 37  
Chen, Qiu-shi, 132  
Chen, Wen-Yau, 85  
Chen, Xia, 74  
Chen, Z., 51  
Cheng, Z.-D., 55  
Chernick, C. M., 178  
Cherns, D., 207
- Chiaramonte, Fran, 73  
Chiba, Natsuko, 135  
Chin, Mian, 124  
Choi, B. W., 45  
Chopra, O. K., 45  
Choudhari, Meelan, 185  
Christensen, Eric R., 35  
Christiansen, J. H., 174  
Christianson, R., 54  
Christmas, John, 114  
Chu, Hui-Tung, 164  
Chuck, Steven L., 143  
Cieplak, Marek, 55  
Cifelli, R., 124  
Cincotta, Daniel, 114  
Cipelletti, L., 54  
Civelek, M., 151  
Claflin, Scott, 34  
Clancey, William J., 224  
Clark, James, 226  
Clark, Kevin, 161  
Clarke, J. R., 44  
Claus, H., 37  
Clayton, J. Louie, 47  
Clemena, G. G., 44  
Clendenin, J. E., 195  
Cliff, Eugene M., 92  
Cloudsley, M. S., 22  
Cockrell, Charles E., Jr., 17  
Cohen, Sholom, 167, 169  
Colgate, E., 59  
Collins, Michael, 226  
Colozza, Anthony, 224  
Colwell, Joshua, 222  
Comella-Dorda, Santiago, 167  
Connell, J. W., 68  
Conner, David A., 188  
Conway, G., 140  
Cooke, William J., 221  
Cooney, T. W., 108  
Cooper, George, 58  
Cooper, M. A., 52  
Coppens, C., 26  
Corbett, Cynthia L., 5  
Corey, Kenneth A., 145  
Cranchaw, J., 190  
Crary, F., 217  
Crespo, Luis G., 180  
Crisman, Everett E., 61  
Croccolo, Fabrizio, 76  
Crocker, John C., 206  
Crockett, Heather C., 40  
Cross, Steve, 169  
Crowley, J., 24  
Cruikshank, D. P., 219

Cruse, T., 109  
Cucinotta, F. A., 22  
Curry, Donald M., 96  
Curtin, M. M., 3  
Cutler, A. D., 16, 40

## D

Dailey, J. R., 1  
DalleOre, C. M., 219  
Daly, M. E., 140  
Danehy, P. M., 16, 32, 40  
Danzmann, Roy G., 120  
Darcy, Phil, 45  
Darden, C., 133  
Darr, Lonnie J., 119  
Davidson, R. C., 197  
Davis, Phil, 36  
Davis, Stephen H., 45  
Dawson, Deanna K., 119  
DeAngelis, G., 22  
DebRoy, T., 47  
DeCarlo, F., 66  
Dee, Kay C., 154  
Deere, Karen A., 31  
Degroot, W., 193  
Delgado, Irebert R., 18  
Dell, Robert F., 183  
DellAversana, P., 57  
DeLoach, R., 16  
DeMange, Jeffrey J., 96  
DeSantis, S., 190  
DeSpirito, James, 70  
Detwiler, Cristy A., 8  
Dever, Joyce, 50  
Dexter, Richard M., 54  
Dhir, V. K., 80  
Dibble, Serena, 60  
Dickens, P. M., 62  
Diebler, Corey, 4  
DiLeo, Jonathan M., 172  
Dimopoulos, S., 192  
Dinerstein, E., 114  
Dingemans, Theo J., 86  
Disimile, P. J., 19  
Diskin, G. S., 40  
Diskin, Glenn S., 17  
Divan, R., 66  
Dix, J. K., 189  
Djongolov, M., 185  
Dolesh, R., 42  
Doll, Amy, 116  
Dolph, J. E., 174  
Domack, Marcia, 46

Doman, Dave, 2  
Donner, Leo J., 130  
Dorney, D. J., 94  
Dorney, Daniel J., 19  
Dorris, S. E., 208  
Doug, S. J., 194  
Dougherty, Kevin T., 17  
Dougherty, Michael R. P., 8  
Doyle, John, 61  
Drake, Greg, 36  
Draper, Bruce, 64  
Draper, T., 194  
Drew, Guy A., 143  
Drewes, P. A., 108  
Drummond, J. P., 40  
Drummond, J. Philip, 17  
Duet, N. R., 106  
Dulligan, Michael, 32  
Dunford, R. W., 194  
Dunlap, Patrick H., Jr., 96  
Dunn, Ed, 169  
Durlin, R. R., 106  
Dutta, P., 205  
Duval, Walter, 82  
Dvorak, M., 125, 132  
Dwyer, A. M., 223  
Dwyer, Robert L., 117  
Dyson, Rodger W., 188

## E

Eades, Richard, 114  
Ealet, A., 219  
Eaton, John, 79  
Ebbers, C., 203  
Eckermann, Stephen D., 126, 127  
Eckhoff, Anthony, 88  
Ecklund, S., 195  
Edgett, Kenneth S., 226  
Edwards, David, 50  
Effros, Michelle, 61  
Ehle, Curt, 47  
Eigen, G., 196  
Eitouni, H. B., 37  
Ekaningtyas, Ir., 187  
Elam, Kristie A., 125  
Elliott, M. Dustin, 29  
Elliott, P. E., 104  
Ellison, Robert J., 176  
Ellisor, S. W., 108  
Elmer, J. W., 47  
Elmore, Ralph, 212  
Elsner, R. F., 217  
Elvira, V. D., 197

Elvis, M., 219  
Elvis, Martin, 215, 216, 217  
Engelman, Scott, 32, 202  
England, Matt, 36  
Englar, Robert J., 14  
Envia, E., 187  
Eppard, W. M., 92  
Erickson, Gary E., 224  
Erickson, Lance K., 211  
Escalera, P. E., 223  
Evans, D. W., 106  
Evans, R. K., 148  
Ewing, T. F., 59  
Exton, Reginald J., 17

## F

Fabinger, M., 209, 210  
Fadin, V. S., 195  
Fairall, C. W., 124  
Falconer, David A., 227  
Fan, X., 222  
Fant, Wallace, 196  
Farahmand, Bahram, 46  
Farhangi, Shahram, 36  
Farmer, J., 26  
Farner, Bruce, 34  
Farria, Dione M., 144  
Fedosejevs, Robert, 202  
Feingold, Harvey, 33  
Ferguson, D., 193  
Ferguson, Dale C., 24  
Ferrare, R. A., 131  
Ferrell, Suzanne, 34  
Ferson, S., 182  
Fetrow, Matthew, 28  
Fiedler, Edna R., 6  
Fikes, J. C., 109  
Finlator, K., 222  
Finn, John E., 43  
Fish, G. G., 106  
Fisher, B. L., 208  
Fisher, J. W., 162  
Fishman, G. J., 228  
Fletcher, W. L., 102, 106  
Fofonoff, Paul W., 118  
Folk, William R., 138  
Ford, P. G., 217  
Forrester, Eileen, 169  
Forsythe, Elizabeth, 204  
Fountain, Garry, 176  
Fox, J., 190  
Fraden, Seth, 151  
Frady, Gregory P., 34

Fralick, Gustave C., 90  
Frankland, S. J. V., 38  
Franklin, Dave, 45  
Frazier, Donald O., 193  
Frazier, Zach, 162  
Frederick, Robert A., 11  
Frederick, Robert A., Jr., 11  
Freudenheim, Jo L., 137  
Freund, Jonathan B., 86  
Friedman, A., 196  
Frisch, J., 195  
Fritz, C., 42  
Frumkin, Michael A., 174  
Fuller, G. G., 50, 51  
Fuller, Kirk A., 193  
Fuller, Pam, 115

## G

Gagliardi, Mike, 167  
Gai, W., 62  
Gallagher, D. L., 211  
Gally, Tom, 10  
Galofaro, J., 193  
Ganapol, Barry, 134  
Gangopadhyay, A. K., 206  
Garanich, J., 151  
Garber, Stephen J., 229  
Garcia, Suzanne, 168  
Garcia-Blanco, Mariano A., 144  
Gardner, Barbara, 24  
Gardner, J. A., 107  
Garfield, Toby, 135  
Garoff, Stephen, 74  
Garrabos, Yves, 83  
Gaskin, J. A., 221  
Gasser, U., 54  
Gast, A. P., 37, 50, 51  
Gast, Alice P., 55  
Gates, Amanda L., 193  
Gaugush, R. F., 104  
Gause, Neal J., 10  
Gaver, Donald P., 154  
Gayda, John, 46  
George, B. E., 223  
George, M., 205  
Georgievskii, Y., 43  
Gerber, R. Benny, 42  
Gergely, Kevin J., 105  
Gerstman, Bernard, 92  
Gevorgian, V., 110  
Gianvittorio, John P., 184  
Giglio, Marzio, 76  
Gilgenbach, Ronald M., 184

Gimenez, Judit, 177  
Girgis, Morris, 100  
Giuliano, William M., 112  
Givi, Peyman, 42  
Gladstone, G. R., 217  
Gleason, Art, 134  
Glenn, L. A., 102  
Glerull, Christoph H., 59  
Gluch, David P., 167  
Gnoffo, Peter A., 2  
Gokhale, Shripad, 82  
Goldgof, Dmitry B., 150  
Goldman, Scott M., 6  
Gonzalez, L. J., 159  
Gonzalez, L. Javier, 159  
Goodman, M., 229  
Goodman, S., 133  
Gordley, Larry L., 129  
Goree, John, 184  
Gorham, James N., 118  
Gorti, Sridhar, 204  
Gostowski, Rudy, 52  
Grabowski, Wojciech W., 130  
Graettinger, Caroline P., 168  
Green, Joseph M., 224  
Green, Lawrence L., 15  
Green, P., 163  
Green, P. J., 219  
Greer, Jack, 122  
Gregory, Don A., 193  
Griffin, L. W., 94  
Griffin, Lisa W., 19  
Gritzo, L. A., 19  
Groninga, Hinrich, 91  
Gronlund, Scott D., 8  
Gropp, W., 62  
Gropper, Michael, 55  
Grotberg, James B., 153  
Grove, J. Morgan, 112  
Gschneidner, K. A., 207  
Guerdal, Zafer, 99  
Guerquin, Mike, 162  
Guichard, Francoise, 130  
Guild, Liane, 134  
Gulczinski, Frank, 32  
Gulczinski, Frank S., III, 33  
Gulczinski, Frank s., III, 31  
Guo, L. J., 49  
Gupta, Suneal, 226  
Gural, Peter S., 221  
Guruvadoo, Eranna K., 213  
Gustavsson, Jake, 36  
Guy, R. Wayne, 17

## H

Haas, Jeremy, 122  
Haber, I., 196  
Haddad, A. H., 207  
Hageman, Jacob J., 14  
Hagopian, Jeff, 21  
Hahn, H., 37  
Hall, Drew, 198  
Hall, K. K., 155  
Hall, Lawrence O., 150  
Halpern, David, 153  
Ham, Y., 200  
Hamidzadeh, Hamid R., 94  
Hamilton, David W., 133  
Hammer, Daniel A., 206  
Hamner, M. P., 51  
Hampton, Michael D., 51, 88  
Hamshire, Brian L., 54  
Hanes, D., 128  
Hanna, J. L., 223  
Hannet, L., 206  
Hanson, Robert N., 138  
Happer, William, 93  
Haralambous, Michael G., 97  
Harding, L. B., 43  
Harmon, B. A., 228  
Harper, Jeffrey, 151  
Harris, N. R., 151  
Harrison, J. S., 68  
Harrison, Joycelyn S., 68  
Hart, John, 83  
Hart, Roger C., 87  
Hartley, D. J., 185  
Harvey, J. F., 214  
Harvey, Michael C., 93  
Harwell, Kendall, 225  
Hasan, M. M., 80  
Hasan, Mohammad M., 80  
Hassanein, A., 204  
Hatch, Maureen C., 140  
Haugse, Eric, 99  
Havelund, Klaus, 172, 173, 174  
Hawkins, Tommy, 36  
Hegab, Hisham E., 27  
Hegseth, John, 83  
Heidersbach, Robert H., 44  
Heil, Michael C., 8  
Heineck, James T., 13  
Hellwarth, Robert W., 218  
Hempenius, M. A., 37  
Henley, M. W., 108, 109  
Henn, Carl R., 122  
Henry, John J., 21  
Herring, G. C., 87

Herrmann, Todd, 226  
Hershey, James, 123  
Herusulistyo, Kamidjo, 48  
Hess, Paul C., 223  
Heymsfield, A. J., 132  
Hickey, Elizabeth, 122  
Hickey, Jason, 61  
Hiddessen, Amy L., 206  
Hill, George, 114  
Hills, E. M., 140  
Hines, Anson H., 118  
Hines, James E., 118  
Hinke, Thomas H., 214  
Hissam, Scott, 169  
Hitlin, D., 196  
Hixon, Ray, 188  
Hofer, Richard R., 35  
Hoffman, M., 42  
Hoffman, W., 47, 69, 70  
Hoffman, Wesley P., 69  
Hofmann, Martin, 168  
Holland, Jeff, 16  
Holland, O. F., 214  
Hollingworth, Dennis, 170  
Homsy, G. M., 74  
Honkala, M., 66  
Hoppe, John C., 17  
Horanyi, Mihaly, 222  
Horner, Garnett C., 29  
Horowitz, G. T., 210  
Horta, L. G., 95  
Horvath, I., 194  
Horvath, Thomas J., 224  
Houck, Jacob A., 165  
Houwing, A. F. P., 32  
Howard, Ricky, 198  
Howell, J., 108, 109  
Howell, Joe T., 33  
Howell, R. R., 217  
Hsing, L. M., 45  
Hsu, Su-Yuen, 96  
Hu, Hua, 152  
Hu, Yun-Fu, 151  
Huang, Kenji, 58  
Huang, S. S., 14  
Huber, Frank W., 19  
Huber, G. M., 191  
Hudak, John, 167  
Hudgins, Douglas M., 220  
Hudy, Laura M., 86  
Huedo, Eduardo, 164  
Hughes, Thomas E., 123  
Humphreys, William M., 186  
Humphreys, William M., Jr., 86  
Hunter, Craig, 19

Hunter, David R., 6  
Hurley, P., 114  
Huston, M., 21  
Huynh, Thong, 163  
Hwang, Wontae, 79  
Hyers, R. W., 206  
Hykin, Drew, 226

## I

Ibrahim, O., 21  
Ice, G., 201  
Ikegami, Roy, 99  
Iliff, Kenneth W., 3  
Ingurgio, Victor J., 20  
Ismail, S., 131  
Israel, M. M., 214  
Ivers, James, 170  
Ivezic, Z., 222  
Iyer, Shanthi, 199

## J

Jaberi, Farhad A., 42  
Jacob, Anne-Marie, 154  
Jacobs, J. W., 84  
Jacobson, David T., 35  
Jankovsky, Robert S., 35  
Janssens, R. V. F., 185  
Jenkins, James, 78, 128  
Jennings, John M., 34  
Jennings, Michael D., 105  
Jennings, Paul A., 41  
Jezek, Kenneth C., 134  
Ji, Q., 204  
Jiang, X., 204  
Jiang, Yangfu, 147  
Jibaja-Weiss, Maria, 136  
Jihad, Bagus H., 52  
Jin, Haoqiang, 174, 177  
Joglekar, Prafulla, 25  
Johansson, Joakim, 8  
Johnson, A., 133  
Johnson, Daniel E., 130  
Johnson, Lee, 135  
Johnson, R. E., 217  
Johnston, John D., 181  
Johnston, William E., 174, 179  
Jones, Alan, 225  
Jones, Terry Jay, 221  
Jones, Thomas W., 90  
Jorgenson, Philip C. E., 3  
Jortner, Julius, 38  
Jost, Gabriele, 177

Jothiprasad, Giridhar, 182  
Joy, Marshall K., 218  
Jumper, John P., 1

## K

Kachru, S., 209  
Kaganovich, I. D., 197  
Kaloust, Joseph, 2  
Kane, R. L., 102, 106  
Kaneta, Joyce, 225  
Kanter, E. P., 194  
Kantzios, Pete, 46  
Kaplan, D. E., 192  
Kappen, Klaus, 203  
Karghiev, V., 110  
Kauvar, Gary, 5  
Kazman, Rick, 169  
Keast, Stephen, 78  
Keating, G. M., 223  
Keel, L. H., 95  
Kegley, Jeff, 199  
Keidar, Michael, 33  
Kellas, Sotiris, 10, 15  
Kelly, Jeffrey J., 189  
Kelly, Kathryn A., 134  
Kelly, R. G., 44  
Kelton, K. F., 206  
Kent, S. A., 214  
Khairoutdinov, Marat, 130  
Khalessi, Mohammad R., 15  
Khare, B. N., 219  
Khavaran, Abbas, 86  
Khorrami, M. R., 2  
Khorrami, Mehdi R., 67, 185  
Khounsary, A., 201  
Khusid, Boris, 77  
Kim, Jungcho, 81  
Kim, M., 151  
Kim, S. H., 208  
Kim, SungWan, 178  
Kim, T., 21  
Kim, V. T., 195  
Kimball, Mark, 226  
Kimbrough, R. A., 107  
King, Raymond E., 6, 9  
Klein, M., 210  
Klem, Mark D., 36  
Klenke, Robert H., 164  
Klippenstein, S. J., 43  
Knight, Norman F., Jr., 15  
Knight, Thomas F., Jr, 65  
Knowles, S. M., 107  
Koch, D. L., 42

Koga, R., 195  
Kondev, F. G., 185  
Kondic, Lou, 78  
Kooi, S., 131  
Koplik, Joel, 55  
Koritala, R. E., 208  
Kotha, S., 98  
Kotseroglou, T., 195  
Kozaitis, Samuel P., 26  
Kramer, Philip, 134  
Krischer, Jeffrey, 150  
Krishnamurthy, Karthik, 7  
Krishnamurthy, T., 97  
Krishnan, S., 206  
Kronfeld, A. S., 195  
Krueger, Steven K., 130  
Kruger, Charles H., 93  
Krumpelt, M., 109  
Kujawa, Brian, 226  
Kumar, Arun, 18  
Kumar, D., 38  
Kundrot, Craig E., 205  
Kuo, C. W., 57  
Kuraszkiewicz, J., 215  
Kushch, V. I., 42

## L

Labarta, Jesus, 177  
Ladd, Anthony J. C., 77  
Ladner, Roy, 213  
Lagarde, Didier, 155, 156, 157  
Lai, B., 200  
LaMarre, Christopher M., 224  
Landis, Geoffrey A., 224  
Lange, K., 102  
Lanier, T. H., 108  
Larcher, Kenneth G., 5  
Larson, Ronald, 152  
Lasanen, Sari, 183  
Latief, Chunaeni, 187  
Lattime, Scott B., 95  
Lawless, Kirby, 46  
Lawrence, A., 210  
Laxdal, R. E., 208  
Le, Jeanette H., 14  
LeClair, Michael A., 152  
Lecoutre-Chabot, Carole, 83  
Lee, A. S., 37  
Lee, Benjamin, 226  
Lee, Clinton, 38  
Lee, F. X., 194, 208  
Lee, W. W., 197  
Legget, Lisa, 161

Leibowitz, Michael J., 138  
Leigh, Larry M., Jr., 49  
Leighton, T. G., 187, 189  
Leipold, Robert, 71  
Lessner, E. S., 208  
Leung, K. N., 204  
LeVan, M. Douglas, 43  
Levine, Linda, 169  
Lewis, Grace, 167  
Lewis, Raymond, 196  
Lewis, W. S., 217  
Li, F., 2  
Li, Fei, 67  
Li, Lei, 152  
Li, M., 208  
Lieu, Richard, 218  
Liliental-Weber, Z., 207  
Lillehei, Peter T., 87  
Lilley, Geoffrey M., 185  
Lin, Hong-Zong, 15  
Lin, John C., 67  
Linger, Richard C., 169  
Lipatov, L. N., 195  
Lipson, Howard F., 169  
Liu, C., 201  
Liu, W., 62  
Liu, X., 209  
Liu, Xiaming, 214  
Liu, Yiliang E., 146  
Llorente, Ignacio M., 164  
Loader, C., 12  
Lobitz, B., 141  
Lochert, Ian J., 54  
Lockard, David P., 185  
Loh, Ching Y., 3  
Lomov, I. N., 102  
Long, E. T., 40  
Lopez-Puertas, Manuel, 129  
Louge, Michel Y., 78  
Low, Steven, 61  
Lowther, S. E., 68  
Lu, Ping, 179  
Luce, Richard, 214  
Lui, Yan, 226  
Lundell, Jan, 42  
Ly, William, 198  
Lynch, A., 142  
Lytle, Bradford P., 94

## M

Ma, B., 208  
Maatsch, J., 24  
Mack, D. J., 191

Macrander, A., 201  
Madsen, Louis A., 86  
Magori, Erhard, 92  
Mahmassani, H. S., 62  
Maida, James C., 29, 159, 163  
Majeed, T., 217  
Malik, Mujeeb R., 67  
Malina, R., 219  
Mallery, E., 142  
Maly, Joe, 99  
Maly, Kurt, 214  
Mancini, D. C., 66  
Mankins, J. C., 108, 109  
Mankins, John C., 33  
Manley, S., 54  
Mantovani, James G., 89  
Manzella, David H., 35  
Marciano, W., 196  
Marcischak, Jacob, 54  
Marechaux, Toni, 136  
Markarian, Nikolai, 77  
Markusic, T. E., 202  
Markusic, Tom E., 203  
Marmorstein, Ronen, 150  
Maroni, V. A., 46  
Marsh, P. E., 53  
Marshal, Hillary, 162  
Marston, Philip L., 75  
Martin, James, 196  
Marz, Theodore, 167  
Maser, J., 200  
Mashayekhi, A., 201  
Mathur, N., 194  
Mathur, S., 215  
Mathur, Smita, 215, 216, 217, 219  
Matt, G., 219  
Matzner, Rolf, 60  
Mauch, K., 110  
Mavriplis, Dimitri J., 182  
Maxwell, Daniel, 204  
Mazurkivich, P., 23  
McAlister, K. W., 14  
McAlister, Kenneth W., 13  
McAllister, L., 209  
McCann, Linda, 118  
McCarthy, Daniel, 117  
McCaughan, Lean, 89  
McClure, J. C., 96  
McCorkle, Richard C., 118  
McCormack, H. F., 106  
McCormick-Ray, Jerry, 120  
McCrone, E. J., 123  
McDonnell, V. G., 71  
McDown, Jerry R., 5  
McFadden, Mara, 58

McGuire, Steve, 161  
McHugh, John, 169  
McIntire, Harold, 28  
McKee, P. W., 103  
McKegg, Janet S., 115  
McLean, Garnet A., 5  
McMahan, M. A., 195  
McMahon, P. J., 200  
McMakin, Lenore, 28  
McQuillen, John, 81  
McWreath, H. C., 103  
Mead, Nancy R., 169  
Megaridis, C. M., 56  
Mehrotra, P., 175  
Melendez, F., 108  
Melendez, Orlando, 51  
Meling, John E., 10  
Melnikov, K., 184  
Mendoza, Jeff M., 186  
Mercurio, Arthur M., 148  
Merenkov, N. P., 194  
Mertens, Christopher J., 129  
Mesfin, Fassil B., 144  
Messer, Russell, 50  
Meyer, W. V., 55  
Meyer, William, 76  
Michael, J. V., 43  
Michalopoulos, Panayiotis, 64  
Mickelson, S., 125, 132  
Miles, Erica H., 159  
Miller, Jason, 46  
Miller, Roy, 115  
Mills, N., 142  
Mills, Scott H., 8  
Mills, T., 12  
Mims, Katherine, 35  
Mitchell, Olivia S., 59  
Mlynczak, Martin G., 129  
Moertl, Peter M., 8  
Mohammed, Ali, 63  
Mohan, N., 110  
Mokler, P. H., 194  
Moldovan, N., 66  
Monier, Eric M., 216  
Montero, Ruben S., 164  
Montgomery, Edward, 198  
Mooney, Robert A., 147  
Moore, Andrew P., 176  
Moore, K. C., 52  
Moore, Ronald L., 227  
Moran, M. J., 162  
Morgan, J., 131  
Morgan, Raymond P., II, 120  
Morozov, V., 204  
Morris, Geof F., 11

Morris, Marilyn E., 142  
Moshtagh, Nima, 161  
Mudawar, Issam, 80  
Murman, Scott A., 12  
Murman, Scott M., 20  
Murphy, Kelly J., 224  
Murphy, M. M., 148  
Murr, L. E., 96  
Murray, Michael R., 170  
Murray, P. M., 107  
Murray, Richard, 61  
Musielak, Z. E., 218  
Muslim, Buldan, 128  
Myers, Gerry, 30

## N

Naguib, Ahmed M., 86  
Nagy, P., 57  
Nahra, H., 42  
Nair, Sunita, 217  
Nallasamy, M., 187  
Narayanan, R., 84  
Nassiri, A., 207  
Natesan, K., 46  
Nawaz, Zafar, 146  
Nayagam, V., 56  
Nealy, J. E., 22  
Neitzel, G. Paul, 57  
Nelson, Gordon L., 51  
Nelson, Michael, 214  
Neugebauer, Adam, 58  
Ng, K. Y., 194  
Nguyen, Clark T., 62  
Nichols, Bruce E., 123  
Nichols, James D., 118  
Nichols, Kelvin, 166  
Niederhaus, C. E., 84  
Nieh, T. G., 45  
Nikolaenko, Gennady, 76  
Nikolayev, Vadim, 83  
Nindl, B. C., 148  
Noble, M., 218  
Nolton, Darrell, 116  
Noor Ahmed K., 87  
Noor, Ahmed K., 39  
Norbury, John W., 228  
Norman, Ryan, 228  
Novak, J., 29  
Nowak, B., 96  
Noy, Peter M., 123  
Nugent, K. A., 200  
Nunes, A. C., 96  
Nwosisi, Genne, 52

## O

O, 101, 170, 171  
OByrne, S., 32  
Offermann, Dirk, 127  
Ohlsen, Dan, 83  
Ohmi, K., 190  
OKeefe, Sean O., 1  
Okumura, Yasushi, 148  
Olds, J. R., 24  
Oliker, Leonid, 177  
Olson, D. M., 114  
Olson, John V., 127  
Om, D., 3  
Oprisan, Ana, 83  
Osenton, Peter C., 121  
Ostroumov, P. N., 208  
Otto, Antonius, 127  
Ounaies, Z., 68  
Ounaies, Zoubeida, 68  
Overton, K., 107  
Owens, L. R., 51

## P

Pace, J., 29  
Paciesas, W., 228  
Padshah, Mohammad Imran, 214  
Page, Juliet A., 188  
Pai, D., 38  
Pakvasa, S., 192  
Paley, Mark S., 193  
Palmerton, David A., 5  
Panda, Jayanta, 125  
Pandya, A. K., 159  
Pandya, Mohagna J., 31  
Pandya, Shishir A., 12  
Pankow, Steve, 36  
Panzarella, Charles, 82  
Pappa, Richard S., 90  
Parchure, Trimbak M., 70  
Pardridge, William M., 137  
Park, C., 68  
Park, Cheol, 68, 87  
Park, Michael A., 179  
Park, Y. S., 59  
Parker, Timothy W., 27  
Parkhurst, Stephen N., 96  
Parkinson, Randall W., 127  
Parvin, Jeffrey D., 135  
Pasyanos, M. E., 101  
Paterson, D., 200  
Paterson, J., 93  
Pati, J. C., 192  
Patty, Sandra K., 119

Paulikas, A. P., 37  
Pawlowski, K., 68  
Pawlowski, R. P., 211  
Paxson, Daniel E., 17, 18  
Pearson, Boise, 196  
Pecharsky, A. O., 207  
Pecharsky, V. K., 207  
Peele, A. G., 200  
Peifer, Mark, 150  
Pellett, Gerald L., 17  
Pendergraft, O. C., Jr., 3  
Peng, X. D., 53  
Penner, Joyce, 125  
Perchonok, Michele, 160  
Perchonok, Michele H., 160, 161, 163  
Perina, D., 88  
Perotti, Jose P., 88  
Perry, Matthew C., 121  
Pesce-Rodriguez, R. A., 53  
Peshkin, M., 59  
Petch, Jon C., 130  
Peters, Jeanne M., 39  
Peters, Wanda, 50  
Peterson, B. M., 215  
Peterson, Peter Y., 35  
Peterson, Walter A., 124  
Petry, Frederick, 213  
Phan, S.-E., 55  
Picard, Richard H., 129  
Pierce, Jennifer C., 11  
Pierzchala, T., 191  
Pigeau, Ross A., 155  
Pimentel, David, 114  
Pinero, Luis R., 35  
Pipes, R. B., 38  
Pisharody, S., 162  
Pivovarov, G. B., 195  
Plawsky, Joel, 82  
Plotz, Gary, 60  
Pogge, R. W., 215  
Pohorille, Andrew, 139  
Pollock, Kenneth H., 118  
Pollock, Neal, 213  
Pompi, Thomas, 64  
Popernack, T. G., Jr., 51  
Pople, J. A., 37, 50, 51  
Porter, J. G., 218  
Potter, Seth D., 108  
Poulikakos, D., 56  
Povinelli, Louis A., 18  
Prasad, V., 54  
Prazinko, Brian F., 159  
Presz, Walter M., Jr., 19  
Preusse, Peter, 126, 127  
Pridmore, Lori, 168

Prieto, E., 219  
Prinos, S., 107  
Prisk, Kim, 153  
Proctor, Fred H., 133  
Proctor, Margaret P., 18  
Puckett, David, 50  
Pusey, Marc L., 204  
Pusey, P., 54  
Puster, Richard L., 17  
Putnam, David, 112  
Putterman, Seth, 82

## Q

Qian, J., 200  
Qin, H., 197  
Qin, Y. C., 110  
Qiu, Zhiyong, 77  
Quayle, Michael, 58  
Quick, Dana M., 11  
Quintana, Rolando, 160

## R

Radhakrishnan, R., 98  
Raftogianis, Rebecca B., 143  
Rahmat-Samii, Yahya, 184  
Rajkumar, T., 111  
Rajulu, S., 159  
Rajulu, S. L., 159  
Rakoczy, John, 198  
Ralph, J., 109  
Ramachandran, N., 205  
Ramanathan, V., 132  
Rame, Enrique, 74  
Ramsey, B. D., 221  
Randall, David A., 130  
Rasberry, D. Ann, 118  
Ratanabanangkoon, Pasut, 55  
Rathz, T. J., 206  
Ratner, Mark A., 64  
Raubenheimer, T. O., 209  
Ray, G. Carleton, 121  
Redmond, Timothy, 170  
Reed, Wanda, 123  
Reeves, Anthony, 78  
Reiss, Michael, 149  
Resau, Robert, 123  
ReVelle, Penny, 123  
Reynolds, A. B., 61  
Reynolds, Gary, 19  
Rice, Robert, 170  
Richard, R. L., 130  
Richards, S. D., 187

Richter, Joel, 161  
Rickleby, E. J., 189  
Riedinger, L. L., 185  
Rink, D. L., 46  
Rioual, F., 128  
Ristenpart, W. D., 73  
Rivers, H. Kevin, 96  
Rivers, S. M. B., 3  
Roach, Allana Nicole, 154  
Robb, G. B. N., 189  
Robbins, Chandler S., 119  
Robertson, Scott, 222  
Robideau, J. A., 107  
Robinson, J. L., 103  
Robson, Stuart, 90  
Rocker, JoAnne, 214  
Roerber, D., 205  
Roerber, Dana, 148  
Rogers, J. R., 206  
Rogers, Lynn, 99  
Rogers, R. Clayton, 17  
Rohrschneider, R. R., 24  
Romagnolo, Donato F., 147  
Romano, P., 215  
Romero, V. J., 97  
Romeu, Jordi, 184  
Ronca, A., 142  
Ronca, A. E., 140  
Roncaglia, George, 214  
Rose, F., 26  
Rosita, Geni, 38, 48  
Rosman, Elly, 48  
Rostker, Bernard, 5  
Rosu, Grigore, 173  
Roth, Nancy E., 119  
Rottman, Gary, 111  
Rouse, Jason H., 87  
Roush, T. L., 219  
Rowe, Anton, 183  
Roy, Arun, 83  
Roy, Kathleen M., 12  
Ruiz, Gregory M., 118  
Ruppert, G. P., 107  
Russel, W. B., 55  
Russell, Carolyn, 46  
Russell, James M., III, 129  
Russell, John M., 24  
Russo, Jose, 140, 151  
Rutledge, S. A., 124

## S

Saeri, 52  
Saether, E., 38

Saito, Yuichi, 162  
 Sakurai, Takashi, 227  
 Salinger, A. G., 211  
 Salles, Ernesto J., 165  
 Salmeron, Javier, 183  
 Saltzman, Edwin J., 3  
 Sampaio, Chere, 36  
 Samulski, Edward T., 86  
 Sandstead, Harold H., 141  
 Sangani, A., 42  
 Sankar, J., 38  
 Santoso, Anwar, 128  
 Saphir, William C., 171  
 Sapna, G. H., 95  
 Sarruff, Soraya, 70  
 Satibi, Loekman, 48  
 Sauer, John R., 118  
 Sausville, Lisa P., 113  
 Savage-Moure, Janet, 123  
 Savella, Phil, 36  
 Saville, D. A., 73  
 Scarborough, S. E., 95  
 Schaffstall, W. P., 106  
 Scheehan, K. M., 148  
 Scheiern, M., 23  
 Schenk, Robert J., 168  
 Schilling, John H., 32  
 Schmahl, Karen E., 97  
 Schmidt, C., 141  
 Schneider, G. A., 148  
 Schnell, Andrew R., 49  
 Schoefield, A., 54  
 Schoeman, B., 205  
 Schriver, D., 130  
 Schultz, Matthew, 174  
 Schulz, M., 209  
 Schwab, David, 46  
 Schwartz, C., 207  
 Schweighofer, Karl, 139  
 Scott, David L., 148  
 Seasholtz, Richard G., 125  
 Segre, P., 54  
 Semmel, Charles, 50  
 Sentman, Davis D., 127  
 Sentz, K., 182  
 Sever, Tom, 105  
 Sgouros, George, 147  
 Shabbir, A., 187  
 Shah, Sandeep, 46  
 Shan, Hongzhang, 177  
 Sharma, D. P., 221  
 Sharp, John R., 28  
 Sharp, P. K., 12  
 Sharp, S. R., 44  
 Shastri, S. D., 200, 201  
 Shaver, Russell, 5  
 Shen, Zuojun, 179  
 Sheng, William, 164  
 Shepard, K. W., 208  
 Shepherd, J. E., 52  
 Shi, Y., 162  
 Shiels, Andrew, 114  
 Shorter, Andrew G., 9  
 Shortis, Mark R., 90  
 Shriver, Duward F., 64  
 Shu, Chi-Wang, 181  
 Shu, D., 200  
 Shy, Karla S., 14  
 Sicard, Bruno, 155  
 Sickafoose, Amanda, 222  
 Siemien, Jon, 115  
 Silverstein, E., 210  
 Sims, W. Herbert, 196  
 Singer, B. A., 2  
 Singh, Bhim, 72  
 Singh, Jaswinder P., 177  
 Singh, K. P., 215, 219  
 Singleterry, Robert C., Jr., 173  
 Sinha, Nishant, 170  
 Sinnott, Tim, 115  
 Siochi, E. J., 68  
 Siochi, Emilie J., 87  
 Sista, S., 47  
 Siviyy, Jeannine, 168  
 Sjoegreen, B., 172  
 Sjoegreen, Bjoern, 71  
 Skipper, Mike, 65  
 Slade, K. N., 29  
 Sledd, Annette M., 30  
 Sledge, Carol A., 169  
 Sloan, Anne, 114  
 Sloan, Kevin, 161  
 Slocombe, D. Scott, 117  
 Smeed, Eric, 143  
 Smeltzer, Stanley S., III, 101  
 Smidansky, Paul, 161  
 Smith, David D., 193  
 Smith, Dennis, 171  
 Smith, Mark, 4  
 Smith, R. R., 107  
 Smith, Richard H., Jr., 121  
 Smith, Timothy D., 36  
 Smither, R., 201  
 Snider, Jack D., 10  
 Sobieszczanski-Sobieski, Jaroslaw, 173  
 Sobota, T. H., 52  
 Socolovsky, Eduardo A., 182  
 Solomon, Paul, 167  
 Sommers, J. C., 202  
 Sondak, D. L., 94  
 Sondak, Douglas L., 19  
 Soppet, W. K., 46  
 Soule, Albert, 169  
 Southerland, Mark T., 119  
 Spanjers, Greg, 32, 202  
 Spanjers, Gregory G., 31, 32, 33  
 Sparkman, Clint, 28  
 Spataro, M. A., 214  
 Spaur, Christopher C., 123  
 Spelt, P. D. M., 42  
 Spores, R. A., 34  
 Spores, Ronald A., 32  
 Sridhar, K. R., 43  
 St.Clair, T. L., 68  
 St.Germain, B., 24  
 Staines, C. L., 120  
 Staines, S. L., 120  
 Stanton, William, 46  
 Starnes, James H., 100  
 Starnes, James H., Jr., 39, 99  
 Startsev, E. A., 197  
 Stein, Stanley, 138  
 Steinetz, Bruce M., 95, 96  
 Sterling, Alphonse C., 227  
 Steury, Brent W., 124  
 Stevens, D. E., 132  
 Stevens, Irene, 160  
 Stiles, Bangyan, 135  
 Stoermer, Christoph, 170  
 Stoker, Y. E., 102, 106  
 Stoll, Cindy S., 121  
 Stone, Barbara M., 156, 158  
 Stoner, G. E., 44  
 Stover, G., 190  
 Su, Ching-Hua, 41  
 Su, M. C., 43  
 Sue-Antilla, J. M., 19  
 Suess, Steven T., 227  
 Suggs, Robert, 221  
 Sumida, John, 204  
 Suri, Suresh C., 54  
 Sussman, Gerald J., 65  
 Sutton, Robert, 36  
 Swango, Beverly, 161  
 Swango, Beverly E., 160  
 Swanhard, Lisa, 150  
 Sweetkind, D. S., 104  
 Swift, Wesley, 221  
 Syarkawi, Atwirman, 53  
 Sydelko, P. J., 174  
 Sylvester, K., 98

## T

Tagg, Randall P., 83  
Taggart, D. G., 21  
Takai, Toshiro, 148  
Talley, D. G., 71  
Tang, Rong, 214  
Taracido, Jose, 112  
Tarbell, J. M., 151  
Taylor, J., 125, 132  
Telban, Robert J., 165  
Teo, Marissa, 145  
Teytelman, D., 190  
Therres, Glenn D., 112, 113, 116  
Thiessen, David B., 75  
Thio, Y. C. F., 202  
Thio, Y. C. Francis, 34, 203  
Thomas, Aaron M., 84  
Thomas, Russell H., 189  
Thomas, Valarie D., 90  
Thompson, David E., 111  
Thompson, Emily, 162  
Thorndill, David, 123  
Thorowgood, Teri, 136  
Thorp, S. A., 187  
Tinetti, Ana F., 189  
Tinker, Michael L., 49, 94  
Tinnirello, Michael, 54  
Tischler, J., 201  
Tobin, Eric J., 48  
Toellner, T. S., 200  
Toerge, John, 137  
Toerne, Mary E., 160, 161  
Tohver, Valeria, 206  
Tolson, R. H., 223  
Toon, O. B., 132  
Torres, Juan, 134  
Toskes, Jane, 123  
Toughiry, M., 98  
Touryan, K., 110  
Tran, C. Q., 200  
Trego, Angela, 99  
Trinh, Eugene, 73  
Tripathi, R. K., 22, 228  
Trivedi, S. P., 209  
Trotter, P., 133  
Troxel, S., 131  
Tsang, Y. H., 42  
Tsimhoni, O., 163  
Tuan, S. F., 192  
Tucker, J. R., 19  
Tucker, Jerry H., 164  
Turchi, P. J., 202  
Turner, Richard, 198  
Twery, Mark J., 171

Twiggs, Robert, 28  
Tyler, Robert R., 16

## U

Ugone, Mary L., 10  
Ulmer, Don, 34  
Utter, Brian, 78

## V

Vailati, Alberto, 76  
Valance, A., 128  
Van Putte, William, 143  
Van Syckle, Peter J., 168  
VanderWijngaart, Rob F., 171  
Vargas, R., 96  
Vaughn, Milton E., Jr., 70  
Vayner, B., 193  
Veal, B. W., 37  
Venturini, M., 191, 192  
Verhoef, Chris, 170  
Vetrano, M. R., 57  
Villareal, J., 142  
Villegas, Yvonne, 52  
Virmani, Y. P., 44  
Visser, Willem, 174, 175  
Viventi, Jonathan, 225  
Volkov, Igor, 55  
Volpe, J. A., 9  
vonOfenheim, William, 214  
Vora, V. P., 62

## W

Wade, C., 142  
Wagner, Eric J., 144  
Wagner, John, 46  
Wagner, Phillip G., 69  
Wahls, R. A., 3, 51  
Waite, J. H., 217  
Wajda, Rebecca K., 113  
Walford, Alan, 90  
Walker, John, 167  
Wallnau, Kurt, 170  
Walter, W. R., 101  
Walton, Krista S., 43  
Wambold, James C., 21  
Wang, K. Charles, 3  
Wang, Ying-Xi, 82  
Wapner, P., 47, 69, 70  
Wapner, Phillip G., 69  
Ward, A., 105  
Ward, Thomas, 74

Warren, Anthony W., 7  
Warrier, G. R., 80  
Was, Z., 191  
Wasfy, Tamer M., 87  
Washington, W. D., 70  
Watson, K. A., 68  
Waymouth, R. M., 50  
Wayner, Peter C., Jr., 82  
Webster, Harry, 57  
Weh, Thomas, 89  
Wei, Wei, 75  
Weidman, Patrick D., 83  
Weir, John, 198  
Weiser, Erik S., 51  
Weitz, David, 77  
Weitz, David A., 54, 206  
Wells, Doug, 46  
Werner, M. R., 223  
Wescott, Eugene M., 127  
West, R., 110  
Wherley, Brian, 34  
White, P. R., 189  
Whitebread, Ken, 168  
Whitt, A., 211  
Wienands, U., 191  
Wiest, Florian, 65  
Wiggins, W. D., 107  
Wignarajah, K., 162  
Wilcox, D. B., 104  
Wilke, E. D., 211  
Wilkes, Belinda, 215, 216, 217  
Wilkinson, Stephen P., 4  
Willems, Ben F., 8  
Williams, Clara A., 8  
Williams, Kevin W., 16  
Williams, Martha K., 51  
Willocq, S., 190  
Wilson, J. W., 22  
Wilson, Jack, 17, 18  
Wilson, Michael, 139  
WilsonHodge, C. A., 228  
Wing, David J., 7  
Winget, D. E., 218  
Winick, Jeremy R., 129  
Wintersteiner, Peter P., 129  
Wisdom, Jack, 101  
Wise, Kristopher E., 68  
Witherow, William K., 193  
Witiw, Michael R., 131  
Wiyatno, W., 50, 51  
Wodtke, Alec M., 192  
Wolf, John, 114  
Wong, J., 47  
Woo, G. L., 206  
Wood, Richard M., 1, 4

Worek, M., 191  
Wrbanek, John D., 90  
Wright, S., 141  
Wright, William, 82  
Wu, Fen, 178  
Wu, Hong, 135  
Wu, K. Chauncey, 99  
Wu, S. T., 34

## X

Xie, S., 132  
Xu, Haitao, 78  
Xu, Kuan-Man, 130

## Y

Yaeger, J., 66  
Yager, Thomas J., 21  
Yamauchi, Yohei, 227  
Yan, Jerry, 174  
Yan, Jue, 181  
Yang, Z., 47  
Yao, Chung-Sheng, 67  
Yarmolenko, S., 38  
Yee, H. C., 71, 172  
Yio, J. J., 132  
Yoda, M., 85  
Yodh, Arjun G., 73  
Yost, Alan, 16  
Young, D., 24  
Yu Vorobiev, O., 102  
Yule, T. J., 59  
Yun, W., 200  
Yungster, Shaye, 18

## Z

Zaidi, S. H., 111  
Zancy, Kris, 58  
Zeigler, F., 133  
Zeng, Z., 46  
Zenit, R., 42  
Zetocha, Paul, 28  
Zhang, Hui, 80  
Zhang, M., 132  
Zhao, Z., 196  
Zheng, H., 37  
Zheng, Ling, 82  
Zhu, J., 55  
Zimmerman, A. H., 108  
Zobov, M., 190  
Zubair, M., 175  
Zubair, Mohammad, 214