2004 National Geospatial-Intelligence Agency University Research Initiatives – NURI

Broad Agency Announcement (BAA) HM1582-04-BAA-0002

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1. INTRODUCTION

This Broad Agency Announcement (BAA) by the National Geospatial-Intelligence Agency (NGA) announces a Fiscal Year 2004 competition for the NGA University Research Initiatives (NURI). NURI is a NGA initiative to enhance the capabilities of U.S. universities to perform research and related education in science and engineering areas critical to our mission and to national defense. The NURI Program is a component of the NGA Academic Research Program (NARP).

NGA has interest in supporting research teams whose efforts intersect more than one traditional science and engineering discipline. Such multidisciplinary team efforts can accelerate research progress in areas particularly suited to this approach and also can help to hasten the transition of research findings to practical application. By supporting team efforts, NURI complements other DoD programs that support university research principally through single-investigator awards.

The U.S. National Science Foundation (NSF) and U.S. Geologic Survey (USGS) share many of the fundamental research goals detailed in this announcement that have scientific merit beyond the specific objectives of the Department of Defense. Relevant NSF and USGS Program Officers expect to participate in the review, selection and support of some projects submitted in response to the NURI BAA.

2. GENERAL INFORMATION

Through this NURI competition, NGA expects to make awards in several specific research topics as described in Section 9. The number of grants awarded is subject to the availability of funds, but it is anticipated that as many as eight awards will be made this year. All awards will be based on merit competition. Depending on the quantity and quality of proposals received, NGA may elect not make any award(s) under individual research topics. Each grant is awarded for a base period (typically three years) and up to two one-year options (primarily intended for transitioning research to practical application). The level of the NURI grant awards is, on average, about $150,000 per year/per grant. Therefore, the base period proposal should be for three years of effort and a total of about $450,000.

Given these award sizes, NGA anticipates providing more funding for critical research infrastructure elements than traditional, single-investigator awards. Therefore, to support the proposed research, offerors can request proportionately more funding than a single-investigator proposal for training graduate students and for acquiring or refurbishing equipment needed to conduct the proposed research.

Funding note: NURI grants are funded incrementally with annual funding provided after the annual DoD budget is approved. The government anticipates that incremental funding will be provided for the full grant award, when it becomes available.

3. AREAS OF INTEREST

In Section 8, this BAA describes research topic areas comprising NGA's most important enabling technologies. These descriptions provide offerors with a frame of reference for NGA

research interests. NGA encourages innovative ideas that address these interests. Offerors are urged to consider the research issues posed and, as appropriate, to contact NGA research topic points of contact to discuss potential efforts. Inquiries are welcome. Note, however, that while technical contacts are listed for a topic, proposals must be submitted to the addressees shown in Section 5.

4. CONDITIONS

This NURI competition is specifically for the research topics described in Section 8. Offerors are advised to read this announcement carefully. It explains NGA's research needs upon which the topics are based, and the terms and conditions of this competition.

NGA encourages and accepts proposals from consortia of universities, because research in multidisciplinary topics may require forming teams with strengths in multiple science and engineering fields. Offerors who propose a teaming arrangement must name one Principal Investigator as the responsible technical point-of-contact. A U.S. university that will be the primary awardee for purposes of award execution must employ the Principal Investigator. If two or more institutions collaborate on a proposal, the proposal must describe the relationship among the institutions and their respective roles, as well as the apportionment of funds among institutions, in both the proposal text and the budget.

NGA also welcomes proposals from historically black colleges and universities, Hispanic-serving institutions, tribal colleges and universities, and other minority institutions, either individually or as members of proposed teams. This BAA does not provide a set-aside for funding proposals from minority institutions. However, an additional BAA released simultaneously with this one will provide for a specific set-aside to minority institutions.

NGA expects that NURI projects will promote application of research, primarily for defense purposes but also for commercial purposes. Therefore, one factor that will be used for evaluating proposals is the quality of planned interactions with research and development organizations that transition research findings to applications -- industrial organizations, DoD laboratories or other organizations that perform research and development for defense applications. Examples of interactions are collaboration in the performance of the proposed research, exchange of scientific and engineering personnel, and exchanges of technical information. Each proposed interaction will be evaluated in the context of the entire proposal. Evaluation will include an assessment of the likelihood that the proposed interaction positively impacts research outcomes and transition to application.

To facilitate such interactions, offerors can propose sub-awards to industrial organizations. However, consistent with the principal goals of a university-based research initiative, at least half of the award funds are to remain vested with the university. Cost sharing by industrial and university participants is encouraged.

NGA intends to acquire unlimited rights to the technical data resulting from research work specified as an element of performance under the resulting contract(s)/grant.

Awardees must be a domestic college, university or other institution providing post-secondary school courses of study.

5. REQUIREMENTS FOR PROPOSALS

5.1. General

NGA intends to award all available FY04 funds. To be considered and evaluated, the full proposal must be received by the Government by the due time and date as identified in Section 9. Proposals received after the closing date will be treated according to Federal Acquisition Regulation part 15.208.

The Government will evaluate all proposals submitted under the terms and conditions of this BAA. Proposals will be evaluated against criteria in Section 6. The estimated grant start date identified in Section 9 should be used for budget and proposal purposes. You may, however, request a later start date and could therefore develop your budget in accordance with your proposed start date.

5.2. Submission

Proposals shall be formatted ONLY as editable (not scanned) .pdf files and must be less than 2MB in file size. The proposal shall reference BAA Number **HM1582-04-BAA-0002**. Proposals shall be submitted by e-mail electronically to narp@nga.mil.

NGA will send an acknowledgment of receipt of the proposal to the originator of the e-mail that submitted the proposal. After evaluation by the Evaluation Team, NGA will notify originators whether or not a proposal is being recommended for an award. Acknowledgment and notification will be sent via e-mail according to the schedule in Section 9, with a copy to the appropriate university administrative office.

5.3. Content

Proposals must be complete and self-contained to qualify for review. Proposals shall be prepared single-spaced in 12 point Times New Roman font, with at least one inch margins on top, bottom and sides, for printing on 8½" by 11" paper.

NGA is concerned with research in specific areas of science and engineering, with science and engineering education, and with the availability of equipment required to meet its research objectives. For this reason, all proposals must adequately describe the technical objectives and approaches, support of students, and expenditures for equipment, all of which will be evaluated by qualified reviewers per Section 6. Separate attachments, such as institutional brochures or reprints that are not germane to the proposal, are discouraged.

The proposal shall include all of the following items:

5.3.1. Cover Page

The cover page shall include the BAA number **HM1582-04-BAA-0002**, proposal title, and NGA topic or research area of interest as described in Section 9. A single proposal may span several topic areas; please ensure the topics are clearly identified. The cover page must also indicate the name, phone number, fax number, postal address, and

e-mail address of both the Principal Investigator AND an appropriate official in the university's administration.

5.3.2. Executive Summary

Provide a project summary no longer than three (3) pages. This shall summarize the significant and important characteristics, approaches and benefits to NGA of the proposed research, abstracted from the Project Description.

5.3.3. Project Description

The project description portion of the proposal shall be limited to ten (10) pages (not including references) and should:

A. Describe in detail the research to be undertaken. State the objectives and approach and the relationship to state-of-knowledge in the field and to similar work in progress. Include appropriate literature citations and prior work. Discuss the nature of expected results.

B. Describe the facilities available for accomplishing the research objectives. Describe any equipment proposed for acquisition under this program and its application to the research objectives. Government Furnished Information (GFI) may be provided upon request. Describe plans for the research training of students in science and/or engineering.

C. Describe in detail proposed sub-awards or relevant collaborations (planned or in place) with industry, government organizations, or other appropriate institutions. Particularly describe how collaborations are expected to facilitate the transition of research results to application. If sub-awards are proposed, make clear the division of research activities and provide detailed budgets for the proposed sub-awards. If industrial collaborations are proposed, describe how the proposed research will impact the industrial partner's research and/or product development activities.

D. Identify other parties to whom the proposal has been/will be sent.

5.3.4. Personnel

Describe the qualifications of the Principal Investigator and the qualifications of other key researchers involved in the project. Include curriculum vitae. For teaming or collaborations, one individual must be the designated Principal Investigator for purposes of technical responsibility and contact. The page limit shall be two (2) pages per person.

5.4. Cost

The financial portion of the proposal, beginning on a new page, should contain cost estimates in sufficient detail for meaningful evaluation, including cost details for proposed sub-awards. For proposal purposes, use the later of the estimated award start date per Section 9 or the proposed start date. The cost proposal must include the total cost of the

project, as well as a breakdown of the amount(s) by source(s) of funding (e.g., funds requested from NGA, non-federal funds and/or institutional funds to be provided as cost sharing, etc.). The costs should be broken down for each year of the program and shown by three distinct totals: a total for the basic three-year grant period and a total for each of two optional follow-on years. Costs of entertainment, amusement, diversion and social activities and any costs directly associated with such activities are unallowable. There is no page limit for the cost section of the proposal. This section shall include statements as to the basis of estimate for all proposed costs. Cost elements should include, but are not limited to:

A. Time being charged to the project: for whom (principal investigator, colleagues, graduate students, etc.), and the commensurate salaries and benefits. Allowable charges for graduate students include salary, appropriate research costs, and tuition. Allowable charges for undergraduate students include salary and research training costs, but not tuition.

B. Fringe benefits.

C. Costs of equipment: based on recent quotations and broken down in sufficient detail for evaluation (equipment costs should be budgeted primarily during the first year). Allowable equipment will ordinarily be limited to research equipment and apparatus not already available for the conduct of the work. General-purpose equipment, such as a personal computer, is not eligible for support unless primarily or exclusively used in the actual conduct of the proposed scientific research.

D. Travel costs and time, and the relevance to stated objectives. This shall include a breakdown of the number of travelers, location, and duration; and estimated costs for transportation, rental car and per-diem. This shall also include travel for the required attendance at the annual NARP Symposium after the award of the grant and at the end of each subsequent year of the grant (i.e., four trips for the basic three-year grant award). The symposium is held in the Washington D.C. area.

E. Other direct costs: materials and supplies; publication, documentation and dissemination; consultant services; computer services; communication costs not included in overhead; other (identify).

F. Sub-award costs and type (the portion of work to be sub-awarded and rationale); note that the sub-award of funds among all university and industry performers responding as one consortium must be described carefully in both the text and the cost section. Also, while collaborations with industry are encouraged, award funds must be vested substantially (at least half) with the academic institution(s).

G. Indirect costs.

5.4.1. Certifications

By signing and submitting any proposal under this BAA, the offeror is providing the:

A. Certification at Appendix A to 32 CFR Part 25 regarding debarment, suspension, and other responsibility matters;

B. Certification at Appendix C to 32 CFR Part 25 regarding drug-free workplace requirements; and

C. Certification at Appendix A to 32 CFR Part 28 regarding lobbying.

These certifications are located in Parts 25 and 28 of the DoD Grant and Agreement Regulation (DoDGARs), D0D 3210.6-R. This document is available electronically, under the heading "publications", at the following Internet site: http://www.dtic.mil/whs/directives.

The person who is authorized to provide these certifications should sign proposals. Proposals submitted without signatures shall require a separate execution of the certifications.

6. EVALUATION CRITERIA AND SELECTION PROCESS

6.1. Evaluation Criteria

Proposals in each of the research areas will be evaluated in accordance with the following criteria. The percentage in parentheses indicates the relative importance of each criterion.

The primary evaluation criteria are:

A. Relevance and potential contributions of the research to the NGA science and technology needs as described in this BAA (25%)—note that this is a key criteria and proposals that are not relevant to the stated needs, no matter how technically meritorious, will not be funded, and

B. Scientific and Technical Merit (50%) [proposal must address research questions, not merely “integration”]

Other evaluation criteria, of lesser importance than (1) and (2) but equal to each other (25% total), are:

C. The qualifications of the Principal Investigator and other key research personnel (5%);

D. The adequacy of current or planned facilities and equipment to accomplish the research objectives (5%);

E. The impact of the research to enhance the US technical base by training students in science and engineering as well as strengthening the institution’s infrastructure, if necessary to meet NGA research objectives, by acquiring or refurbishing equipment key (5%);

F. The impact of interactions with other organizations engaged in related research

and development, in particular industrial organizations, DOD laboratories and other organizations that perform research and development for defense applications (5%), and;

G. The realism and reasonableness of cost, including proposed cost sharing; cost realism as it relates to the Government's degree of confidence in the offeror's ability to perform the proposed work at the proposed cost. (5%).

6.2. Selection Process

Proposals will be grouped together by specific research topic area. An expert technical team evaluates all proposals in the same group. The evaluation process consists of the following steps:

A. Proposals will be evaluated and scored against all seven criteria above and ranked in terms of preference for grant award by Government technical experts on the NURI Evaluation Team. Proposals not sufficiently meritorious for grant award will be noted as "Non-Selectable". Proposals deemed "Selectable" will be considered for funding as described below. However, it is anticipated that the number of "Selectable" proposals will exceed the available funding.

B. The entire NURI Evaluation Team will convene to consider the overall contribution of each proposal as reflected by the evaluation scores, the potential contribution to the advancement of the targeted technical topic(s), the amount of similar or related research currently underway on a given topic, and the amount of available funding. This step brings a cross-discipline balance to the selection process, reconciles recommendations about proposals spanning more than one technical area, and allows for strategic consideration of the diversity of proposals across the topic areas. While it is NGA's intent to distribute awards across the topic areas, the final outcome may not reflect this intent.

C. The NURI Evaluation Team will forward a list of proposals recommended for award ranked in order of preference, along with a description and results of the evaluation process, to the Chief of the NGA InnoVision Basic and Applied Research Office for approval.

D. Once approved, this final award list will be forwarded to the Contracting Officer for negotiation and award action.

In summary, the NURI Evaluation Team will recommend the proposals that most effectively advance NGA's Academic Research Program and related thematic research programs for award in order of preference. The number of awards made is dependent upon the amount of available funding. If additional funding becomes available from within NGA, or from other U.S. Government agencies, NGA may choose to make additional awards under the terms of this BAA from the remaining most preferred proposals. The sponsoring organization will be free to support any 'selectable' proposal(s) that addresses the research interests of that organization.

7. AWARDS

Awards will be made at funding levels commensurate with the research and in response to Agency missions, but on average about $150,000 per year per award. Further, awards will generally be made for three years (through incremental funding) with options for two additional years (1 year per each option period). Negotiations may result in funding levels or periods of performance more or less than originally proposed. Awards are expected to be in place by the start date identified in Section 9 or identified in the proposal, whichever is later.

8. SPECIFIC RESEARCH TOPICS FOR FY04 NURI

In a change from the structure for previous NURI solicitations, this year there is an overarching focus for the research topics that NGA has identified for the NURI grants. Sub-topics identify specific subjects that directly support the overarching objective.

The overarching focus for the FY04 NURI solicitation is Automated Geospatial-Intelligence Analysis (AGA) and its constituent technologies. This involves both research, to help improve analyst abilities, as well as providing better automated capabilities in the analyst environment. One of the major hard problems facing NGA and the geospatial-intelligence community is challenge of converting the vast quantities of geospatial, geophysics and geodetic data acquired by advanced sensor systems into useful and actionable information and intelligence. At the same time that the volume of raw data is expanding by orders of magnitude, the capacity of traditional human analysis and data extraction, while improving through the use of better tools, remains relatively constant. Therefore, it is critical that robust semi- and fully-automated approaches to Geospatial-Intelligence Analysis be developed. True Automated Geospatial-Intelligence Analysis requires many supporting technologies including automated registration, change detection, feature extraction, automated target recognition and novelty detection among others.

Registration encompasses both sensor-to-sensor registration and sensor-to-earth reference system registration. Fusion of disparate geospatial data into common reference systems is critical to creating true multi-sensor, multi-int geospatial-intelligence capabilities.

Change detection encompasses the automated detection of both feature and broad area changes. The goal is to automate upstream processing of vast amounts of sensor data to detect changes to features of interest and notify human analysts. Broad area change detection is focused on determining when sufficient changes have occurred over a region of interest to justify methodical updates to the underlying geospatial-intelligence databases for the region.

Automated feature extraction encompasses the delineation and attribution of geospatial features and conversion of those features into standardized geospatial data representations. Features of interest include natural land cover, topography, hydrography, bathymetry as well as cultural (man-made) features such as urbanization, transportation networks and infrastructure both as area-delineated features and as individual features (e.g., buildings). A particular challenge is extracting data across the land-water interface and dealing with the issues of tidal state and multi-modal sensors. Again, the goal is to place this automated capability as far upstream in the process as possible.

Automated feature recognition encompasses the detection, categorization and identification of features of interest. Expert geospatial-intelligence analysts are amazingly quick and accurate at identifying salient features on imagery. The goals of this portion of the research program are to understand the innate abilities and limitations of analysts, offer better computer-assisted tools, and identify effective training approaches for feature detection and identification. Fully automated, upstream, robust processes to screen vast amounts of imagery to queue human analysts to images that have a high probability of containing features of interest are an area of extreme interest. Human-assisted automated feature recognition research in the neurosciences has matured enough to develop sophisticated functional models gleaned from physiological studies. The goals of this portion of the research program are to identify new approaches to automated feature recognition from the knowledge of biologically employed features, identify new automated feature recognition computational architectures, and demonstrate computational models for single or multiple sensor modalities.

Novelty detection encompasses the identification of anomalies that are likely to be significant though previously unrecognized or categorized. These anomalies may be detected by imaging or non-literal sensors. Non-literal sensors may use gravity gradiometry, magnetic, seismic, and other similar information above and below the earth's surface to detect and identify underground structures or improve positioning for airborne sensors.

The sub-topics described in the following sections describe in detail the research requirements that will support the overall objective.

While the intent of this solicitation is to select proposals that support all of the sub-topics described below, awards in any sub-topic area will be made only if sufficiently meritorious proposals are received. NGA reserves the right to allocate available funds among the sub-topics based on the quality of the responses and NGA priorities. An individual sub-topic area may have no awards, a single award or multiple awards.

8.1. Sub-topic Area 1: Geospatial Science

POC: Mr. Dennis Motsko, (703) 735-3125, MotskoD@nga.mil

NGA is interested in standardizing the representation of geospatial data to improve exchange of data and interoperability across the geospatial community. Data structures must adequately meet the needs of multidimensional (spatial, temporal, spectral, etc.) geospatial data. The representations must be highly descriptive, computationally efficient and support distributed production/development/maintenance and validation as well as complex modeling and analysis. Research is needed to look at fundamentally new ways to represent geospatial data (and metadata) occurring on, above, and below the earth’s surface. Seamless integration of geospatial data from water to land to air is needed to form the foundation for the national security community information infrastructure.

Existing structured geospatial databases and overhead imagery represent the bulk of traditional geospatial data sources. These sources will remain important for the foreseeable future, but the potential to exploit other sources, along with the demand to create/model/depict geospatial phenomena in a more timely, accurate and multidimensional

(space, time and spectral) manner necessitates the need to consider the use of other sources. Research is needed in identifying and synergistically exploiting traditional and non-traditional sources of geospatial data from imaging and non-imaging mobile and in-situ sensors, spatial and non-spatial databases and other means to span the National System for Geospatial Intelligence (NSGI) common data model information content gap that will continue to exist even as traditional sources grow in number and provide increasingly large volumes of data.

Secondly, specific to this sub-topic area, the capability to perform automatic attribution and editing of data as it pertains to automated feature extraction, automated feature recognition and change detection is of particular interest to NGA. Automatic attribution and automatic or "smart" editing can be described as follows:

Automated Attribution:

Feature extraction for geospatial production includes detecting the relevant feature in imagery, delineating the feature, and assigning appropriate attributes. These attributes include geometric characteristics (length, width, height, area), material properties (asphalt road, cement road, gravel road, etc.), and "use" categories (civil airstrip vs. military airstrip). Automated attribution is the process whereby a software algorithm or tool analyzes the imagery data (and possibly other data) to automatically assign attributes to a delineated feature.

Smart Editing:

Automated feature extraction tools invariably produce features that are less than perfect and require editing to satisfy certain product specifications. Smart editing refers to automated editing processes that are designed to operate to provide efficient methods for "cleaning up" the automated feature extraction results. Smart editing capabilities can include context-sensitive processing that performs specific editing operations depending on the feature type, an optimized user interface to minimize editing time, and templates or geometric constraints for certain classes of features.

Wherever possible, the implementation of fully automated, upstream AGIA requiring little downstream intervention by human analysts is the goal. Emphasis can be on (1) extending or modifying existing algorithms and which results in significantly improved speed and reliability of the algorithm or (2) on novel approaches.

Finally, a major area of research interest is developing innovative methodologies for geospatial data conflation to combine and deconflict data sets. Equally important is the need to characterize the quality of conflated data sets in terms of both statistical and other measures of confidence of the correctness of the result. The types of data combinations that may occur include but are not limited to: the integration of small patches of higher resolution elevation data into lower resolution digital terrain elevation data, the combining/deconflicting of dynamic/temporal data with existing static data, and conflating 3D/4D data (e.g., urban site models) with other data, for example high-resolution terrain information and digital terrain elevation data. Also of interest is a mathematical statement of a minimal set of integrity requirements for automatic integration of data of multiple accuracies and from

multiple sources, as in a database where users may be making changes to some data without viewing other, potentially affected data. Robustness of the approach should be demonstrated by identifying a complete set of topological conditions that should not be inadvertently violated when data are added, deleted or modified; a set of conditions to verify that topology remains consistent when multiple geolocations are maintained for the same feature; and the definition of requirements/conditions for lockout to prevent concurrent update of complex features.

8.2. Sub-topic Area 2: Sensor Data, Image Understanding and Exploitation

POC: Dr. Paul Salamonowicz, (703) 735-3065, SalamonP@nga.mil

Imagery collection, exploitation and data analysis are technologies critical to NGA. Imagery systems cannot simply be treated as another form of digital data since they interact with the visual system of the human analyst. The Sensor Data, Image Understanding and Exploitation (SDIUE) topic area is concerned with all aspects of the phenomenology of sensor systems and the imaging chain as they pertain to the interpretation and extraction of information from remotely sensed image data. The goal is to fund research in either of the following categories: (1) techniques which improve our ability to extract information by developing new processing approaches or (2) investigations of new sensors in order to characterize the information which can be extracted from these systems. In both categories, the ultimate goal is to increase the speed, reliability and/or extent of information extraction.

Example research areas of particular interest are summarized in the following paragraphs:

a. Research which provides a better understanding of analysts' capabilities compared to the general population to help in selection, training and retention of analysts. In particular, we would like to answer the question are analysts innately capable to do their tasks, or do they acquire their capabilities from training? This research can also involve applying the knowledge gained to develop innovative means for analyst training and methods of exploitation.

b. Alternative techniques for processing existing data types which will lead to faster and more reliable information extraction than what is achieved with current processing approaches. Problems with current approaches arise for several reasons. For example, digital data extraction requires human analyst perception and manipulation performed on digital imagery workstations. However, most knowledge of human and machine interaction used today in exploiting imagery was developed for hard copy film, including the resolution scales and exploitation criteria. Additionally, where feature type is based on pattern classification of the surface cover (such as determining grassland) results are generally successful, whereas if the feature type is based on function (such as a golf course), success is less likely. Robust measures of success are critical as well. An apparent success of 90% extraction may not actually be 90% from a workload standpoint if the remaining 10% requires almost as much extraction time.

c. Research which characterizes the capability of emerging systems. For example,

investigations of the utility of Polarimetric C-Band data (for example, from RadarSat 2) and/or Polarimetric L-Band data (for example, from the ALOS system) to support change detection and automated/assisted feature extraction, especially as it relates to the rapid generation of NGA feature foundation data (FFD) is of interest. Proposals should succinctly demonstrate knowledge of the existing research and then emphasize specific improvements which the proposed research will address to define what can be achieved with these new systems.

The SDIUE topic will entertain proposals related to the mathematics, physics and related mathematical models or algorithms pertaining to sensor system investigations, with emphasis on research supporting automated or computer assisted data extraction, including biologically/neuroscience inspired approaches, to Image Understanding and Exploitation.

8.3. Sub-topic Area 3: Geodesy and Geophysics

POC: Dr. Randy W. Smith, (301) 227-7510, SmithR@nga.mil

The NGA mission includes development of a coherent set of Earth models including a detailed representation of the Earth's gravitational and magnetic fields. While significant advancements have occurred in the last decade, measurement and representation of the high frequency (short wavelength) components and the gradients of these fields require further research. Other areas of geodetic and geophysical interest include prediction of Earth Orientation Parameters (polar motion and Earth rotation rate), plate tectonic motion and solar radiation pressure models. Improvements to geodetic positioning and orbit determination algorithms are also of interest as well as new concepts for high-accuracy (<3m) 3-dimentional positioning technologies that can be used indoors and underground. Improvements in these areas facilitate more rapid registration of remotely sensed data, improved levels of absolute geopositioning and more rapid delineation, conflation and attribution of natural and man-made features.

NGA is also interested in research that applies Automated Geospatial-Intelligence Analysis (AGIA) techniques to extract and integrate geophysical and geospatial measurements from various sensors. AGIA relies heavily on various kinds of "signatures" in data sets to identify and characterize features. These methods often fail to emulate the intuition and experience of a human analyst. Extracted geophysical data must adequately meet standardized data structures of multidimensional (spatial, temporal, spectral, etc.) geospatial data. The representations must be highly descriptive, computationally efficient and support distributed production, development, maintenance, and validation as well as complex modeling and analysis. Focus should be placed on automated location and detection of geophysical signatures aided by improved positioning and attitude determination for airborne sensors (GPS/INS). Seamless automated integration of these geophysical data with geospatial data to better position and characterize features is of primary interest.

Existing extraction methods will remain important for the foreseeable future. The potential to exploit current and future technology, along with the demand to create, model, depict, and integrate geophysical phenomena with geospatial phenomena in a more timely, accurate and multidimensional (space, time and spectral) manner, necessitates the need to

consider the use of highly automated techniques. Research is needed in identifying and synergistically exploiting traditional and non-traditional extraction techniques of geophysical data from imaging and non-imaging mobile and in-situ sensors, spatial and non-spatial databases and other means to span the National System for Geospatial Intelligence (NSGI) information.

An additional major area of research interest is developing innovative methodologies for geophysical and geospatial data conflation to enhance the combination of data sets. It is important to characterize the quality of conflated data sets in terms of both statistical and other measures of confidence in the correctness of the result. The types of data combinations that may occur include but are not limited to: the integration of small patches of higher resolution elevation, magnetic and/or gravity data into lower resolution data, the combining/deconflicting of dynamic/temporal data with existing static data, and conflating 3D/4D data (e.g., urban site models) with other data. Automated extraction and integration of these types of data, including a mathematical statement of a minimal set of integrity requirements for automatic integration of diverse data of multiple accuracies and from multiple sources, is of additional interest.

8.4. Sub-topic Area 4: Knowledge Discovery and Dissemination

POC: Mr. David K. White, (703) 735-3066, WhiteD@nga.mil

Information sources for analysts are becoming more diverse and more technically capable. The art of intelligence analysis has migrated from counting and reporting only observations to performing analyses and assessments. Because of fast advancing information technology, policy makers and battlefield commanders are asking much more complex and detailed questions. Instead of asking "How many...?", an analyst is now asking "When will...?". To answer these questions, analysts need to be multidisciplinary experts or have access to experts in many specialized disciplines. Analysts need to query multiple experts in a particular domain to solve a problem or provide reference within a technical field unfamiliar to the analyst.

Innovative proposals that address one or some combination of the following areas are encouraged:

Knowledge Based Systems and/or Expert Systems

One way to deal with the need for access to domain experts is via knowledge based systems and/or expert systems. These systems provide a mechanism for capturing, organizing and representing domain knowledge in the absence of the experts themselves and for preserving domain knowledge when an expert moves to a new job or retires. It also allows for the synergistic use of multiple experts' knowledge so that the whole is greater than the parts.

Semantic Web Technology

The World Wide Web and similar network architectures are growing sources for knowledge and information sharing. Unfortunately, most of the current Web content is

designed for humans to read and not for computers to manipulate. Since computers have no reliable methods to process semantics, a vast amount of useful information may be missed in any given query due to the computers inability to understand language to establish information links. The advent of Semantic Web technology as an extension of the current Web paradigm will bring new functionality that will allow networked computers to better process and understand these data.

Visualization

As one might expect, the information used in intelligence analysis are better illustrated through multimedia, which are very visualization oriented. The forms of visualization include imagery, graphics, motion imagery (video), text, audio and animation (models and simulation). The user interface involved in merging these multimedia sources with expert domain knowledge and visually presenting them to a wide audience as well as an analyst remains an important issue. Visualization incorporates all aspects of human cognitive interface with large data sets, their ordering, analysis and interpretation. Current visualization environments are predominantly 2D-visual and the resultant data sets are also 2D. New data environments and customer driven requirements will revolve around the capture of 3D+ data sets using visual, textual, streaming media, architectural and other sources adjusted to end user interface capability. Research proposals should develop the data structures and interfaces required, and advance the understanding of how visualization can be properly assessed and integrated into NGA's core mission areas. Proposals should demonstrate an understanding of how disparate data types can be stored, utilized, exploited and disseminated using multi-modal 3D+ interfaces in NGA's mission areas. These mission areas include: planning and staging of mobile sensor platforms of heterogeneous data types, integration and analysis of incoming data types in autonomous or semi-autonomous/direct capability, integration of new and derived data into existing data stores, and command and control decision support capability based on information derived from past and present data. Augmented reality, virtual reality and novel display types offer unique capabilities for the dissemination and use of NGA data sets. NGA is very interested in how such displays change the way data is used, stored, formatted and disseminated to end users. Research in this area should reflect current and expected state-of-the-art off-the-shelf capability over the next 5 years and offer insights into how NGA data sets and processes would change to meet these new display types.

This topic area encourages proposals pertaining to capturing, processing and disseminating knowledge elements useful in the process of intelligence analysis. Traditional "knowledge management" efforts require a high degree of organization knowledge and involvement, such as familiarization with policy, processes and culture. Since most Offerors will not possess this "internal" knowledge, emphasis is placed on more tangible and practical technical proposals that show promise of transitioning into an analyst's environment relatively quickly. Also, recognizing that submitters will not have vast knowledge of current intelligence analysis workflows, innovative approaches that exploit current technologies are encouraged. Areas like semantic processing capabilities, intelligent agents, approaches to handling large volumes of data, capturing tacit knowledge of analysts, and anything else that facilitates the process of analysis will be considered. Proposals that address transitioning the

capabilities developed into an operational prototype are highly encouraged. Although basic research is normally the research and development level for NURI projects, for this topic area we invite innovative ideas using "applied" approaches that can eventually be delivered for test-bed investigations, especially those that can be tied to the issues addressed in the other sub-topic areas.

9. SIGNIFICANT DATES

The following table provides the significant dates referred to in the body of this announcement.

Action	Responsibility	Due Date
Issue announcement in Commerce Business Daily	Government	06 February 2004
Proposal due	Principal Investigator	19 March 2004
Acknowledge receipt of proposals	Government	22 March 2004
Grant Award	Government	21 May 2004
Estimated Start date	Principal Investigator	21 June 2004

9.1. Late Submissions

Proposals will be considered for award if submitted in a timely manner. If a proposal is submitted in an untimely manner, after 3:00 P.M. (Eastern Daylight Savings Time) on 19 March 2004 the criteria in Federal Acquisition Regulation part 15.208 will apply.

10. POINTS of CONTACT

10.1. Grants and Contracting

Mr. Andrew Karl at 703-735-3205. Email: karla@nga.mil or G. Denise Wood at 703-735-3023. Email: woodg@nga.mil.

10.2. Technical Issues

Dr. Scott Loomer at 703-735-3062. Email: LoomerSc@nga.mil.