National Institute of Standards and Technology
U. S. Fire Administration
Federal Emergency Management Agency

FIRE.GOV

Better fire fighting through research

Spring -- 2002

Robots Used in Search and Rescue

Robots are being used everywhere as: guards, disposal specialists, lawn mowers, or cleaners who vacuum rooms. They also have been in USAR (Urban Search and Rescue) and were called upon to assist in the search and rescue mission at the World Trade Center on September 12, 2001. After the Fire Department of New York (FDNY) determined it was safe enough to enter the site, roboteers from the Center for Robotic-Assisted Search and Rescue (CRASAR), the University of Southern Florida (USF), iRobot, and Foster-Miller (FM) assisted in the search and rescue mission. USF and FM located a victim shortly after their arrival at the site. Robots also were useful in locating dead end routes, thereby saving rescuers time. They also discovered several intact offices within the debris. When a tether was added, the robots could search about 30 feet ahead of the firefighters.

A firefighter went down into the intact rooms after a hole was made and located several more bodies. Robots also were used when the crawl space was too small for a dog. The experience was one of joint cooperation between the fire department and the roboteers.

Adam Jacoff is in charge of NIST's Standardized Test Course for Urban Search and Rescue Robots, tethered or radio connected. He is looking at another part of the robot phenomenon. How NIST can develop a facility dedicated toward accelerating the advancement of the capability of autonomous mobile robots. Adam and his colleagues have developed an evaluation course, with three levels of difficulty. The course is a test bed for new software and robot designs, in addition to ensuring standardization.

The course can be assembled and used each year at the American Association for Artificial Intelligence (AAAI) annual competition anywhere in North America. AAAI-2002 Mobile Robot Competition and Exhibition will be held in Edmonton, Alberta, Canada, 28 July – 1 August 2002. For more information go to the web site: www.cs.uml.edu/aaairobot/.

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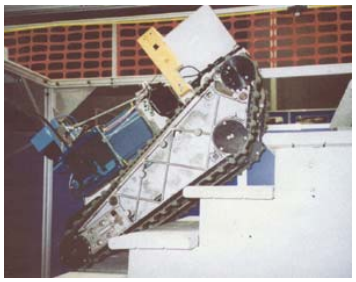
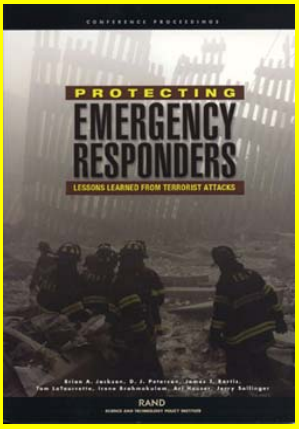


Robot ascending steps in NIST/DARPA evaluation course.

RAND Completes Emergency Responder Needs Study



In the aftermath of the September 11, 2001 attacks, the National Institute for Occupational Safety and Health (NIOSH) asked RAND to assess the equipment, training and information required to protect emergency responders as they meet the increased challenges of protecting their communities in the event of acts of terrorism.

The RAND report, *Protecting Emergency Responders: Lessons Learned from Terrorist Attacks,* summarizes the results of a conference held in New York City on Dec. 9-11, 2001, and organized by the RAND Science and Technology Policy Institute.

Participants were emergency workers from around the country who responded to the bombing of the Alfred E. Murrah Building in Oklahoma City, the September 11 attacks on the World Trade Center and the Pentagon, and the anthrax incidents that occurred during autumn 2001.

The report may be viewed and downloaded, free of charge, from the RAND web site http://www.rand.org/publications/CF/CF176/.

The report features first-person accounts from attendees. For example, according to one of the participating firefighters, "Firefighting equipment is designed well for firefighting operations that typically last 30 minutes, 40 minutes, or an hour.

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Robots Used in Search and Rescue, cont.

The course measures 20 meters (60 feet) on a side, the square test course is composed of three successively more difficult modules. The NIST work is jointly sponsored with the Defense Advanced Research Projects Agency (DARPA). In each module, a variety of overt and hidden "targets" are placed for robots to locate and identify. These include mannequins, infrared emitters (tuned to the temperature of the human body), clothing, moving body parts, hoses that emitted compressed air (to represent gas leaks) and recorded sounds of human voices. A CD-ROM, including Light Detection and Ranging (LIDAR)data, contains important information from Reference Test Arenas for Autonomous Mobile Robots. The data is important to researchers in refining their computer programs and standardizing the output. It may be downloaded from the www.isd.mel.nist.gov/

Dr. Adam Jacoff stands in the NIST/DARPA Autonomous Mobile Robot Evaluation Course.

Of interest to the fire service is a new competition sponsored by AAAI. It is the Rescue Robot Competition. Robots must enter a fallen structure, locate human victims, and direct human rescuers to the victims. For more information go to their web site: http://robomec.cs.kobe-u.ac.jp/robocup-rescue.

Fire departments who are interested in partnering with Adam Jacoff in developmental work or who would like to have their robots and robotic operators use the NIST test facility should contact him directly. Adam may be reached at (1) + 301-975-4235, or adam.jacoff@nist.gov.

Shinjuku Fire – Fire Test Summary

The worst Tokyo building fire in recent memory took the lives of 44 people and injured three others on September 1, 2001. It is thought that the fire started before 1:00 AM in a third floor staircase in Myoio 56, Shinjuku, which housed five entertainment facilities. The total building area was 498 m^2 from the 2nd basement floor to the 4th floor.

A 4-story mock-up of a staircase.

The fire started in the only staircase and is believed to be the primary reason for the high number of deaths. The sole evacuation route was filled with smoke and dust; it also was reported that there were a large number of combustibles placed in the staircase at the time of the fire. Therefore, it was difficult for the building occupants to evacuate and for firefighters to gain access to the fire via the stairs. Experience indicates that fires in staircases of small buildings most likely are the work of arsonists.

Although fire doors were installed in the 3rd and 4th floors between the staircase and private use area for tenants, they were not closed during the fire. This may have been because: the smoke detector was disconnected or malfunctioning, and/or objects were placed in front of the fire doors.

Another possibility is that incomplete combustion caused a large amount of carbon monoxide to be generated because fuel was burnt in such a small, confined area as a staircase.

The National Research Institute of Fire and Disaster (NRIFD) in Tokyo, Japan, had the responsibility of performing a series of fire experiments. A 4-story mockup of a staircase was used to:

investigate the fire behavior and/or combustion of fire source according to different opening conditions, size and kind of fire source, and position of fire sources;

observe to what extent carbon monoxide is generated;

investigate what is the most appropriate position for smoke detectors and sprinkler heads in a staircase, if the equipment were to be installed there.

A short report of this study will be presented at the May 2002 Annual Meeting of the Japan Association of Fire Science and Engineering in Tokyo.

For further information contact: Dr. Ai Sekizawa, Tel: (81) + 422-44-8439; fax: (81) + 422-42-7719, e-mail: sekizawa@fri.go.jp.

A flame extended from the third floor level was ejected from the open door on the 4th floor.

RAND Completes Emergency Responder Needs Study, cont.

But when you have fires burning for six, eight, nine weeks, bunker gear gets to be pretty cumbersome." The conference participants offered concrete recommendations to address the challenges and improve response capabilities.

The apparent tradeoff between the level of protection provided by equipment and the discomfort and physical burden the equipment placed upon those using it was looked upon as an area in need of R&D. Directing R&D toward advanced respirators, clothing, sensors, and other safety gear may be able to reduce that tradeoff. Other areas suggested by the conference discussions include applications of information technology and communications systems for better management of worker safety at disaster sites and continued emphasis on technologies for locating responders buried or trapped under rubble.

The study points out that technology transfer can help reduce personal protective equipment costs by spreading R&D outlays across a larger user community. It can also speed the introduction of new technologies to the emergency-response community. But the emergency-response community also has special safety needs that may not be adequately met through technology transfer alone.

Many at the meeting suggested that publicly supported R&D would be appropriate for addressing the safety needs of emergency responders.

For additional information contact: Dr. Brian Jackson at RAND Science and Technology Policy Institute, (1) + 703-413-1100, ext. 5950, E-mail: Brian_Jackson@rand.org.

Fire Fighters Receive Wireless Alarm Panel Information

NIST's Building and Fire Research Laboratory (BFRL) staff and the NIST Fire Department held a series of full-scale fire tests in the Large Fire Facility (Building 205) on April 3, 2002. The purpose was to demonstrate a new standard fire service interface and incident management information system. BFRL has been working with the NFPA Technical Correlating Committee for the National Fire Alarm Code (NFPA 72) to include the fire service interface specification in the 2002 edition of NFPA 72.

A multi-room structure was built inside Building 205. Furnishings were placed within the structure, ignited and allowed to burn to flashover.

NIST researcher Dr. Walter Jones performs final check of laptop computer installed in NIST fire truck.

NIST firefighters in the station and in the responding vehicle were able to access real-time information about fire conditions (e.g., temperatures, visibility, fire size). For those in the responding truck, information was transmitted to a laptop computer with a wireless modem installed in the cab. The prototype fire alarm panel collected the information and transmitted it in a form that could be viewed as web pages by standard web browsers on any type of computer (handheld, laptop, desk) or text pager.

All of the sensor measurements and onsite video coverage from the fire was available and could be viewed depending on capabilities of the receiving device. In addition, information from the sensors was processed using fire models so that higher-level information such as the heat release rate of the fire could be displayed.

The wireless display in the apparatus, the terminal in the firehouse, and the panel mockup in the fire test building all had full access to the information and could query the system independently. As the suppression team entered the structure, their position in the structure was monitored and displayed continuously (the tracking system is being simulated at this point because practical tracking technologies are still under development). Conditions in the structure were monitored in real time and special warnings could have been issued if the system running fire models in parallel determined that the limits of the firefighters' protective clothing was reached or flashover would occur before suppression could begin.

It is still an open question as to how the vast amount of fire information that could be placed in the hands of incident commanders (IC) would be used. We expect that the more information that is available to the IC, the safer and more effective the fire fighting operation will be. More discussions with the fire service and demonstrations are planned. Your ideas would be appreciated.

For additional information, contact Walter W. Jones, (1) + 301 975 6887, wwj@nist.gov .

Firefighters enter NIST multi-room fire structure during fire test.

Goats Can Reduce Wildland Fire Danger in WUI Areas

Researchers with the Bureau of Land Management (BLM) and Utah State University (USU) are developing guidance for fire managers on the effectiveness of controlled browsing of goats to reduce fire fuels and fire hazards in the Wildland-Urban Interface (WUI). Although goats have been used before for reducing fuels, Kathy Voth (BLM) points out that goats have not achieved widespread acceptance by fire managers as a tool for control of shrub dominated fuels, but initial results from the study have shown that goat treatment is effective in stopping fire spread.

The study is part of the Joint Fire Science Program, [http://www.nifc.gov/joint_fire_sci/jointfiresci.html]. The researchers want to determine the degree to which goats can modify fuel types and then model the fire behavior fire managers might expect, given the modification. Information from the study will be used to determine where the treatments will be most effective and also will provide practical guidance to those who want to control livestock for fuels reduction.

As a demonstration, a herd of 40 goats was taken to an area that had been mechanically thinned two years ago and was due to be thinned again. The herd was managed as it would be in ordinary WUI situations to discover problems and work out management solutions. All of this information contributes to the guidance that eventually will be given to fire managers.

An unexpected fire in the study area prevented the completion of the planned study, but it was helpful in answering questions about fire resistance that the fire modeling software could not. In the plots where the goats had worked, the fire ran to the boundaries of the fences erected to control goat movement and stopped! Even in areas where the regrowth had begun, the goat treatment held the fire back. The unexpected fire also gave an opportunity to compare the results of mechanical thinning and goat treatment. The week before the fire, wildland firefighters had mechanically thinned oakbrush, by cutting immediately adjacent to one of the goat study areas. The area that was thinned by firefighters burned over while the goat treated area stopped the fire.

Results of this research have been used to produce a web based calculation tool for fire managers. The calculator estimates the cost of fire prevention employing the goat foraging strategy with user input need for local conditions. It is found at URL: www.math.usu.edu/~slm4h/goats/.

An informative and entertaining CD-ROM summarizes recent project results and it is available from Kathy Voth who can be contacted at (1) + 435-797-1279 or by e-mail: kvoth@cc.usu.edu.

*A short video (26MB) showing mechanical thinning by Forest Service Hotshot Crews and alternate treatment by goats is available **HERE**.*

One Year Together

This issue marks the beginning of the second year of ***FIRE.GOV***. The best part of putting together information on research of interest to the fire service, specifically, and for the fire community in general, was how much I learned about activities world wide to enable better fire fighting and fire prevention. I hope that the readers have benefited equally. The initial goal of 1000 subscribers has been met. Many have provided favorable comments about the content and also ideas about topics that needed to be addressed. Fire service activities are very broad in scope. The staff strives to report research activities that address as many as possible. Unfortunately, as we have come to find, research aimed specifically at the needs of the fire services is uncommon. There are a few "hot spots" around the world where engineers and scientists are engaged in planning and performing research that will move the safety and effectiveness of fire service activities to new levels. We have heard that a few of our readers have taken the time to contact researchers featured in ***FIRE.GOV***. More communication and new alliances are needed between a progressive fire service and researchers providing the underpinning to advance fire service practice. During the next year let me hear about a dozen new research efforts that have started to address the needs of the fire service!

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