School of Engineering and Applied Sciences
University at Buffalo *The State University of New York*

December 2003

Dear Friends and Colleagues,

I am pleased to share with you our faculty's research efforts in Homeland Security. While this topic is relatively new, our faculty have been involved in related research for quite some time.

The majority of this publication is a reprint of our article and ad in the September 2003 issue of Borders and Transportation Security. Also included are a listing of associated research groups and a sample of current Homeland Security grants and contracts which have been awarded to our faculty.

We would be pleased to discuss collaborating with you in this critical area of national concern.

Sincerely,

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School or Related Groups involved with Homeland Security

Center for Aviation Inspection and Maintenance, conducts research projects concerning human factors issues in aviation inspection and maintenance.

Center for Computational Research, a leading academic supercomputing and visualization center that supports research including Homeland Security projects.

Center of Excellence in Information Systems Assurance Research and Education, a NSA center of excellence that coordinates research in computer security and information assurance.

Center for Multi-source Information Fusion, develops basic and applied research in multiple source information processing environments including those for advanced surveillance and reconnaissance systems.

Center for Unified Biometrics and Sensors and Center for Excellence for Document Analysis and Recognition, researches physiological and behavioral characteristics to automatically identify individuals and conducts an advanced automated character recognition program, respectively.

Multidisciplinary Center for Earthquake Engineering Research - a National Science Foundation center of excellence that develops and applies knowledge and advanced technologies to reduce hazard losses.

A Sample of Current Homeland Security Grants and Contracts

Information Fusion Support for Natural and Man-Made Disasters, Air Force Office of Scientific Research

Event Correlation for Cyber Attack Recognition System, Department of Defense – Advanced Research and Development Activity

User Intent Encapsulation and Reasoning about Intrusion: Implementation and Performance Assessment, Defense Advanced Research Projects Agency

Language-Related Errors in Aviation Maintenance and Inspection, Federal Aviation Administration

Unintended Information Retrieval, Federal Aviation Administration

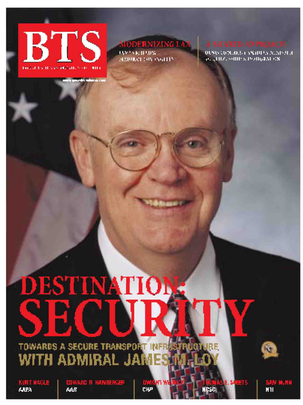
Blast Load Effects on Suspended Ceiling Systems, National Institute of Standards and Technology

Securing Documents from Insider Threat – A Multi-Phase Approach, National Security Agency/Advanced Research and Development Activity

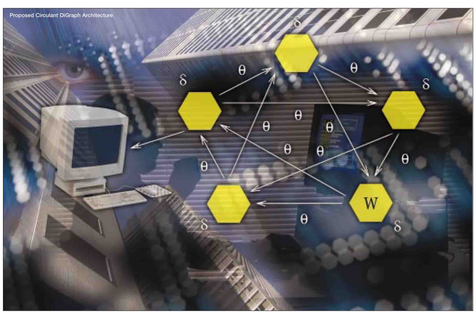
Medical Biometrics, National Science Foundation

PROMISE (PROtection with Multiple SEgments): A Novel Survivability Framework for High-Speed Networks, National Science Foundation

Solid-State Imprinted Xerogel Arrays Integrated with Smart CMOS Detectors for Biological Research, National Research Foundation



BORDER AND TRANSPORTATION SECURITY



AN ARRAY OF HOMELAND SECURITY APPLICATIONS

Research crossovers into homeland security at the University at Buffalo are numerous, ranging from disaster communication issues to biometrics and aviation security-related human factors, from cyber security and critical transportation modeling to blast-resistant building technologies and sensor technology.

From the first moments after American Airlines flight 11 struck the north tower of the World Trade Center, emergency communications poured from the site in a rapidly increasing flood. It was a classic example of a modern problem in tragically modern dimensions: how to organize and interpret massive flows of uncoordinated information from thousands of sources in real-time.

This is the province of the relatively new subject called information fusion. It has its origins in military communications research, and the Center for Multisource Information Fusion (CMIF) at the University at Buffalo School of Engineering and Applied Sciences is a national leader in the field. CMIF is currently working to develop software that can make emergency response more effective by 'fusing' the many channels that flow after a disaster. The project is funded by a US$2.5 million US Air Force Office of Scientific Research grant.

One of CMIF's partners in the work is another large University at Buffalo engineering school research group – the Multidisciplinary Center for Earthquake Engineering Research (MCEER). One of the world's leading centers for advanced technology applications to reduce earthquake damage and losses, the center has specialized expertise in the consequences of disaster – from the behavior of buildings subjected to catastrophic forces to the effect of lifeline losses on delivery of vital services and resources.

Both centers show the ready adaptability of several Buffalo engineering school research efforts to homeland security applications; indeed, researchers and faculty from the school were among the first to gather data from Ground Zero, only days after the towers fell.

Automated character recognition

Buffalo's Center of Excellence in Document Analysis and Recognition (CEDAR), which developed the systems and software that postal services around the world use to read handwritten addresses at high speed, is currently pursuing two areas of research in automated character recognition that have direct application to homeland security.

In one, with potential intelligence applications, the center is developing the first technologies for machine reading of texts in Hindi and several South Asian languages based on the intricate symbols of Devanagari script. It is expected that this work, now supported by the National Science Foundation, can lead to optical character recognition systems for rapid machine reading of other scripts of this general type.

CEDAR is also developing a new architecture for state-of-the-art automated fingerprint identification and a data surveillance system that flags suspicious patterns of emergency medical reports. Of forensic interest, the center has already developed software that can identify the author of individual samples of handwriting.

Transport security

In another aspect of the human element in homeland security work, Buffalo's long-established FAA-funded Center for Aviation Inspection and Maintenance (which has expertise in the human factors of critical inspection work) has expanded its field of interest into error reduction in airport security inspections.

Meanwhile, dynamic traffic flow modeling research at Buffalo's Center for Global Enterprise Management is developing emergency decision support for routing the 250,000 shipments of hazardous materials in the US transportation system on any day.

Information assurance

Cyber security, a national concern for many years, is an established area of interest at Buffalo's engineering school. In 2002, the school was named by the National Security Agency as a Center of Excellence in Information Systems and Assurance Research and Education, and researchers associated with the center have recently developed new user monitoring software that may offer additional protection to military, government and commercial networks.

The University's Center for Computational Research – one of the top 10 academic supercomputing and visualization centers in the US – is assisting the National Technology Alliance, which seeks to promote commercial and dual-use technology development in the national security and defense technology arenas.

Physical security

In the realm of physical security, Buffalo's faculty has developed structural shock absorbers and isolation technologies that reduce damaging vibrations by earthquake or blast. These devices and designs, some of which were originally produced for the US Department of Defense and on which the center continues to work with defense contractor partners, may offer protection to critical infrastructure elements.

Another Buffalo research program is looking at the role of turbulence-chemistry-radiation interactions on soot formation during combustion in order to better understand heat damage to steel structures. Meanwhile, at the opposite end of the size spectrum from whole buildings, Buffalo engineering school researchers are developing tiny biochemical sensors (100um x 100um) based on CMOS optical detectors. The work has already resulted in the successful combination of detectors and xerogels printed on an LED that can detect the presence or absence or oxygen, as well as indicating concentration. Sensor technology will always be a key homeland security tool.