University Research Contributing to a Safer America

Scientific research conducted at universities across the country is helping to make our nation safer and more secure. From nano-materials research to mine engineering, and plasma physics to differential reflectometry, and behavioral science to biosystems, science is at the core of the tools, technologies and policies that aim to keep us safe.

This TSC Update highlights some recent examples of research in areas including explosives detection and blast mitigation, screening and surveillance, infrastructure security, cyber security, food safety and bioterrorism and the psychology of terrorism. It includes a look at how researchers are using byproducts from coal-burning power plants to take the blast out of ammonium nitrate fertilizer; have developed a new technique for zapping dangerous pathogens like anthrax that also holds potential as a tool for destroying cancer cells; and have taken a device developed to assist in the decommissioning of nuclear reactors and adapted it for use in scanning vehicles, luggage and cargo vessels for nuclear materials. It also highlights many of the research centers located at universities around the country that are conducting a wide range of security-related work.

Explosives detection & screening

- A team of engineers at the **Princeton** Plasma Physics Laboratory has developed a device that can be used to scan moving vehicles, luggage, cargo vessels and the like for nuclear materials used in radiological weapons. The Miniature Integrated Nuclear Detection System (MINDS), originally developed to assist in the decommissioning of nuclear reactors, is today in use at military installations, ports and a major rail and bus commuter center in the Northeast United States. The device, which operates within one second, is capable of differentiating among naturally occurring radioactive elements, authorized medical and acceptable industrial nuclear substances, and threat materials.

- **Northeastern University**'s Awareness and Localization of Explosives-Related Threats (ALERT), a Department of Homeland Security Center of Excellence, focuses on detecting, mitigating and responding to explosives-related threats. ALERT researchers are developing video analytics tools to quickly assess surveillance video to identify abnormal activity; designing advanced radar scanners that can probe bomb threats from a distance and perform personal scanning at airport checkpoints; and creating improved and more automated technologies to scan luggage at airports.

- Researchers in the **University of Florida**'s Department of Materials Science and Engineering have developed what they believe is the [world's first explosives-detection system that utilizes ultraviolet light](#) to identify specks of dangerous explosives that could be found within luggage at airport security screening centers. The fully-automated scanning system is designed to shine UV light on luggage moving through conveyor belts commonly used at airport security checkpoints and to identify explosives materials by the varying wavelengths at which they absorb the light. The device beeps to alert security officers if an explosive is found.

Blast mitigation

- At the **University of Kentucky**'s Center for Applied Energy Research, scientist Darrell Taulbee is leading a project to create a fertilizer that, if used by terrorists, has a much smaller blast potential than ammonium nitrate, which is commonly used in agriculture as a high-nitrogen fertilizer. Taulbee has demonstrated that the [explosive potential of ammonium nitrate can be diminished](#) by coating it with coal combustion by-products. Funded by the Department of Homeland Security through the National Institute of Hometown Security, his research continues to focus on testing various concentrations of coating before the treated ammonium nitrate can be introduced for commercial agricultural use.

- Also at the **University of Kentucky**, mining engineer Braden Lusk is conducting a U.S. Navy-funded project to [design materials to lessen the effect of a blast](#) – including the development of an aluminum mesh product for blast mitigation. Aluminum mesh could be attached to the windows of buildings or as protective layers on mine-resistant, ambush protected trucks (MRAPs), a large number of which have been shipped to Iraq.

Surveillance

- **University of Southern California** researchers have developed several software programs that thwart adversaries by [randomizing schedules and activities for the nation's security agencies](#) to make them more unpredictable. The research and software, developed with funding from the Department of Homeland Security, allows security officials to focus on protecting critical assets without allowing observers to exploit patterns in patrolling or monitoring. The technology is being used by the Federal Air Marshal Service, Transportation Security Administration and U.S. Coast Guard, and is in use at Los Angeles International Airport.

- At the **University of Kentucky**'s Center for Visualization and Virtual Environments, researchers are developing a structured-light video camera that extracts 3-D depth information from a scene in real time. Combining depth information – which provides additional measurements for feature extraction and the ability to compensate for differences in pose and lighting – from this new technology with existing 2-D image-based facial recognition technology could [greatly improve the accuracy of visual surveillance systems](#). Real-time depth information will also allow faces to be identified by shape and color. The goal is to create a transparent, non-invasive surveillance system based on this technology that requires no more user cooperation than

entering a public building, boarding a plane or driving through a police checkpoint. The research is funded by the Department of Homeland Security.

Infrastructure security

- The **University of Maryland**'s Center for Advanced Transportation Technology Laboratory is conducting research as part of the Department of Homeland Security's Urban Area Security Initiative with the ultimate goal of increasing public mobility during both normal and emergency or evacuation operating conditions. It aims to do this by [strengthening information-sharing and collaboration capabilities among emergency officials within the national capital region](). Building on the existing Regional Integrated Transportation Information System, which incorporates data from select computer-aided dispatch systems, the initiative integrates real-time signal system data, transit data and incident data, which will help facilitate greater situational awareness, coordination, and improve response time. Non-sensitive data will eventually be made available to 511 systems and the media.

- A systems engineering team led by **Rensselaer Polytechnic Institute** has partnered with the Department of Homeland Security and the University of North Carolina to develop software that [enables emergency response officials to physically see the interdependencies among the area's civil infrastructure systems](), including wastewater, phone lines, and power. Research has shown that damage to one critical piece of infrastructure can disrupt the entire system. The software will help emergency response officials identify these kinds of problems ahead of time, and plan accordingly. It also enables officials to input data about a particular natural disaster in order to forecast how much damage will be wrought.

Cyber security & information security

- Because security technology that is perceived as burdensome, untrustworthy, or difficult to implement is often ignored, misinterpreted or overridden by its users, researchers at the Institute for Information Infrastructure Protection at **Dartmouth College** are exploring [behavioral science techniques to improve cyber security]() and reduce risk. Researchers are conducting experiments in business settings to determine ways to improve security awareness and incentivize good security practices among employees. One experiment tested whether users who are subject to a spear-phishing email attack and immediately receive training on identifying and reporting fraudulent emails would repeat the same mistake when subject to another attack two months later.

- **Binghamton University** Engineering Professor Scott Craver is an information-security expert who specializes in information-hiding and code-breaking. His research team develops algorithms to break digital watermarks, which are used to provide proof of ownership or to send covert messages, and [expose weaknesses in security systems](). This in turns helps in the development of programs to protect against future "real" attacks. This work in breaking digital watermarks is

relevant to any security that relies on a detection algorithm, including face-recognition and thumbprint-recognition systems.

- Headquartered at the **University of Southern California**'s Information Sciences Institute, DETER (cyber-Defense Technology Experimental Research) is a Department of Homeland Security-funded collaboration among USC, UC Berkeley and Sparta Inc. It specializes in cyber security experimentation and testing – it's a place where researchers can learn to defend against the worst of the worst in viruses, Trojan horses and malware without risk to their own computer systems. This sealed off mini-Internet was created in 2004 expressly to allow safe experimentation in security issues. The test bed is used for both research and education, and is increasingly used as a place to train the large number of cyber security specialists who are urgently needed both in government and in industry. Back to the Top

Food safety & bioterrorism

- Scientists at the **University of Florida**'s Center for Food Distribution and Retailing have worked to improve radio-frequency identification (RFID) technology to ensure that military rations traveling overseas arrive safely intact, fresh and nutritious. These qualities can be compromised along the complex supply chain of food being shipped to deployed U.S. military personnel due to environmental conditions during transport and storage. The research was funded by the Department of Defense.

- Researchers at the National Center for Food Protection and Defense, a Department of Homeland Security Center of Excellence, at the **University of Minnesota** are working to reduce the vulnerability of the nation's food system to terrorist attack by contamination with biological, chemical or radiological agents at any point along the food-supply chain.

    o Scientists are currently developing methods of detecting and screening one of the most potent biological agents, clostridium botulinum neurotoxin (BoNT), which poses a major bioweapon and bioterrorism threat, especially in milk, juices, low-acid foods and water. The research team is working on the development of portable screening technology that can detect the agent in early contamination stages.

    o For use in education, training and response preparedness efforts, researchers have developed the Academic Consequence Management System (Academic CMS), software that simulates the movement of contaminated food through the food supply chain – from the farm through retail outlets to consumers. Academic CMS also models the rate at which illness occurs following consumption of contaminated food, the likelihood and timing of medical care and the timing of response from public-health officials.

- **University of Kentucky** College of Agriculture researchers have developed the Milk Transport and Traceability Security System. This prototype bulk milk transportation security system allows

users to track milk from farm to processor to ensure milk safety and security. Information is entered to record who, when, where, and why a tanker's door, valve, or dome lid was accessed. Temperature sensors monitor milk in transit, the tanker's wash cycle, and milk samples in the storage cooler. Every tanker event is captured and stored. This detailed, real-time information not only will protect the security of the nation's milk supply; it also has the potential to increase efficiencies and result in considerable cost savings. The research was funded by the Department of Homeland Security through the National Institute of Hometown Security.

- **University of Pennsylvania** microbiologist Dr. Shelley Rankin has developed an FDA-approved detection kit that tests for salmonella in poultry eggs and produces accurate results in about 27 hours. The kit allows major egg producers to meet the FDA's stringent testing standards that went into effect in July 2010 with the establishment of the national Federal Egg Safety Program. The national program drew upon the findings of Pennsylvania's Egg Quality Assurance Program (PEQAP), a risk-reduction program designed to reduce the possibility of salmonella-contaminated eggs from reaching consumers. PEQAP was founded based upon research at Penn's School of Veterinary Medicine.

- Researchers at **Rensselaer Polytechnic Institute** have developed a new way to seek out specific proteins – including dangerous ones such as anthrax toxin – and render them harmless using nothing but light. By exposing protein-wrapped carbon nanotubes to invisible and near-infrared light, the targeted protein is deactivated. The technique could be used in defense, homeland security and laboratory settings to destroy harmful toxins and pathogens. The method also could offer a new method for targeted destruction of tumor cells. The research was funded by the National Institutes of Health and the National Science Foundation.

- Chemical and biological engineers at **Rensselaer Polytechnic Institute**'s Center for Biotechnology and Interdisciplinary Studies have created a nanoscale coating for surgical equipment, hospital walls and other surfaces that safely eradicates methicillin-resistant MRSA, the bacteria responsible for antibiotic-resistant infections. In tests, 100 percent of MRSA in solution were killed within 20 minutes of contact with a surface painted with coating-laced latex paint. The work was funded by the Defense Threat Reduction Agency. Researchers are exploring whether this work could be expanded to protect against other diseases or potential bioweapons.

- Researchers at **Michigan State University**'s Center for Advancing Microbial Risk Assessment (CAMRA) are developing laboratory techniques and databases to improve the means of addressing danger to U.S. communities from the intentional or accidental releases of hazardous biological agents**.** Researchers summarize threats from multiple microorganisms with diverse biologies across a variety of scenarios to provide risk estimates, which in turn help identify the greatest microbial dangers and set priorities for dealing with biological agents of concern. Such risk estimates are used by public health specialists, emergency managers, first responders,

regulators, legislators and engineers to assess and control risk. CAMRA is the Homeland Security Center of Excellence jointly established with the U.S. Environmental Protection Agency to develop scientific knowledge on the fate and risk of potential bioterrorist and other high-priority infectious agents. Back to the Top

Psychology of terrorism

- The **University of Maryland**'s National Consortium for the Study of Terrorism and Responses to Terrorism (START), a Department of Homeland Security Center of Excellence, studies the causes and consequences of terrorism in the United States and around the world. Research focuses include the radicalization process and conditions that lead individuals to terrorism; attack patterns and the evolution of terrorist behavior in predicting future terrorist activity; the effectiveness of counterterrorism efforts; and community resilience in the face of terrorism activities. START's databases on terrorist attacks and government responses to man-made and naturally occurring hazards are regularly used by officials in the federal government as well as state and local governments. START also offers both undergraduate and graduate programs in terrorism studies aimed at training a new generation of analysts and researchers.

- The mission of **Penn State University**'s International Center for the Study of Terrorism is to engage in and promote the scientific study of terrorism and political violence. ICST research focuses on the social and behavioral sciences, which have tremendous potential for advancing our knowledge and understanding of terrorism and for developing policy-relevant interventions to prevent, reduce, and control terrorism and its consequences. For example, researchers reviewed open-source literature and conducted interviews with officials associated with intervention programs to determine whether de-radicalization of terrorists is possible. Back to the Top

About The Science Coalition

The Science Coalition is a non-profit, nonpartisan organization of the nation's leading public and private research universities. It is dedicated to maintaining strong federal funding of basic scientific research as a means to stimulate the economy, drive innovation and secure America's global competitiveness. Learn more at www.sciencecoalition.org.

Other Security Research Resources

- [Center of Excellence for Awareness & Localization of Explosives-Related Threats (ALERT)](#), Northeastern University

- [Center for Advancing Microbial Risk Assessment (CAMRA)](#), Michigan State University

- [Center for Catastrophe Preparedness and Response (CCPR)](#), New York University

- [Center for International Security and Cooperation (CISAC)](#), Stanford University

- [Center for Risk and Economic Analysis of Terrorism Events (CREATE)](#), University of Southern California

- [Center for Surveillance Research (CSR)](#), Ohio State University

- [Center for Technology, Security, and Policy (CTSP)](#), Virginia Tech

- [Cyber Security Policy and Research Institute (CSPRI)](#), George Washington University

- [International Center for the Study of Terrorism (ICST)](#), Penn State University

- [Institute for Security, Technology, and Society (ISTS)](#), Dartmouth College

- [Institute for Soldier Nanotechnologies (ISN)](#), Massachusetts Institute of Technology

- [Institute for Strategic Threat Analysis and Response (ISTAR)](#), University of Pennsylvania

- [National Center for Food Protection and Defense (NCFPD)](#), University of Minnesota

- [National Center for the Study of Preparedness and Catastrophic Event Response (PACER)](#), Johns Hopkins University

- [National Consortium for the Study of Terrorism and Responses to Terrorism (START)](#), University of Maryland