

**NU**

Engineer

NORTHEASTERN UNIVERSITY COLLEGE OF ENGINEERING 2008

**ENGINEERING a safer  
AMERICA**

With a major Department of Homeland Security grant, Northeastern assembles the technological talent to combat terrorist attacks

**FROM THE DEAN**



Dear Friend,

I hope you enjoy this issue of *NU Engineer* describing the latest happenings in the Northeastern University College of Engineering (COE). As we race toward our Centennial Celebration in 2009, you will find that our legacy of innovation in teaching and research continues and our faculty and students are achieving remarkably. We aim to convey who we are through this magazine.

In these pages we celebrate our five assistant professors who were honored with the prestigious NSF CAREER Award in 2008. This brings to 17 the number of current COE faculty members who are CAREER awardees (nearly 20 percent of the total COE faculty).

We also celebrate our new national Center of Excellence in Homeland Security, one of just five nationwide. The Center for Awareness and Localization of Explosive-Related Threats (ALERT) joins our NSF Nanoscale Science and Engineering Center, the Center for High-rate Nanomanufacturing, our NSF Engineering Research Center, the Gordon Center for Subsurface Sensing and Imaging Systems, and our Department of Defense-funded Center for Microwave Magnetic Materials and Integrated Circuits as our fourth major national research, education, and technology development center.

The magazine also covers some milestones. I joined the college in September 2007. At that time, the college welcomed the academically strongest freshman class in its history, which has been supplanted in that standing by the class about to begin. In October, the COE passed its ABET accreditation with all six undergraduate programs receiving a clean bill of health for the next six years.

Throughout the year, we made strong progress toward our goal of growing the faculty by 20 percent through the hiring of outstanding scholar-teachers. We will introduce you to our eight new faculty members, who bring research expertise in devices, fabrication, materials, biotechnology, and sensors; these faculty members seek to apply their research programs to twenty-first century challenges in human health maintenance and disease detection, efficient energy utilization, smart infrastructure design, and national and international security. We will also introduce a notable engineer who assumed a position of prominence at Northeastern: Stephen Director, NAE, appointed Northeastern's fourteenth provost.

Other articles briefly describe the outstanding research of our three recently tenured faculty members and celebrate the honors and awards of our faculty and students. The reasons for the growing success of our Center for High-rate Nanomanufacturing in attracting joint projects with industrial partners that build on its funding as a National Science Foundation Nanoscale Science and Engineering Center are also chronicled.

In summary, I believe you will see that the momentum that has been present for several years at the Northeastern University College of Engineering has increased substantially. Hopefully, you will also gain an understanding of why we are truly excited about our work here at Northeastern University and look to the year ahead with great anticipation.

With kind regards,

A handwritten signature in black ink, appearing to read "D. Luzzi". The signature is fluid and cursive, written over a light background.

David E. Luzzi

Dean, College of Engineering

# inside

## COLLEGE OF ENGINEERING

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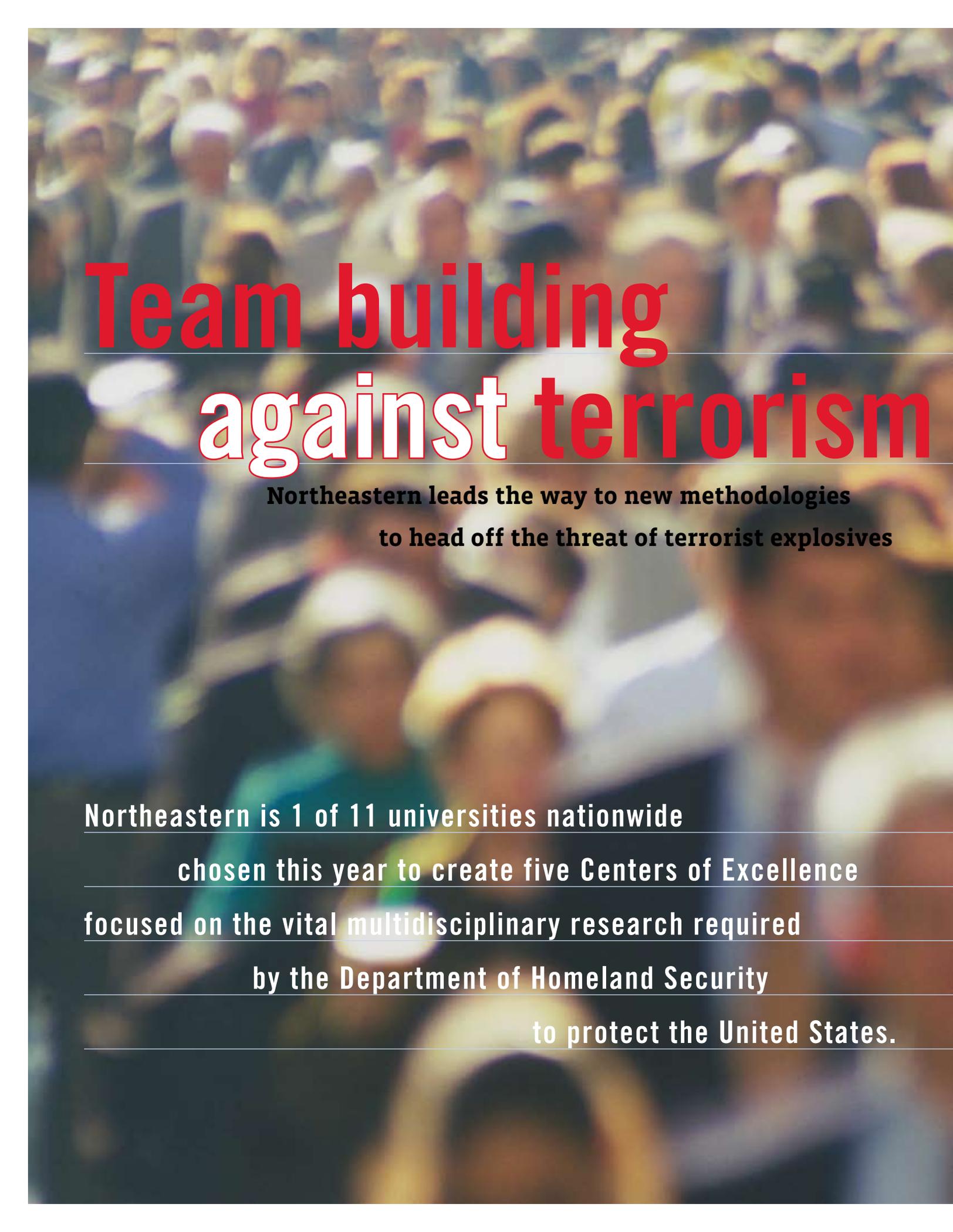
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# **Team building against terrorism**

**Northeastern leads the way to new methodologies  
to head off the threat of terrorist explosives**

**Northeastern is 1 of 11 universities nationwide**

**chosen this year to create five Centers of Excellence**

**focused on the vital multidisciplinary research required**

**by the Department of Homeland Security**

**to protect the United States.**



A car packed with explosives kills 41 people in Kabul. A man blows himself up in Islamabad, killing 15. A woman in Baghdad detonates the explosives strapped to her body and injures 29 soccer fans. Injuries and deaths in Iraq from improvised explosive devices (IEDs) have been a serious national challenge.

Homeland security experts agree that suicide bombers and IEDs are also a real threat to the United States. Quoted in a *Washington Post* article on the increasing threat, David Heyman, director of the federal Center for Strategic and International Studies, pointed out that “U.S. leaders have been concerned about IEDs for a number of years. . . . If terrorists initiated an IED campaign in America today, it could paralyze us.” The threat came frighteningly close to reality with the discovery in 2006 of attacks planned on flights between the United Kingdom and the United States.

The Department of Homeland Security (DHS) takes the threat of explosives being deployed on our shores very seriously, providing \$1.7 billion in grants to fund work on dealing with the IED threat.

### **Government-academic partnerships tackle security**

This February, DHS established five university-based Centers of Excellence (COE) to conduct research critical to homeland security, devoting one center exclusively to work on explosives. Following a highly competitive grant process, DHS named Northeastern University and the University of Rhode Island as co-leaders of a center of excellence addressing DHS research needs in explosives detection, mitigation and response. Northeastern is one of eleven universities nationwide chosen this year to create COEs focused on the vital multidisciplinary research required by DHS to protect the United States.

Operating at Northeastern as the ALERT Center, for Awareness and Localization of Explosive-Related Threats, the new center is funded by a DHS grant of \$10 million over the next four years. The major researchers and the administration of ALERT will leverage existing resources at Northeastern’s Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS).

# What impressed DHS is Gordon-CenSSIS's reputation and track record in building outstanding teams that combine varied disciplines, academic and research institutions, and industries.

ALERT holds great promise on many levels. "This represents a tremendous opportunity," explains Juliette Kayyem, undersecretary of homeland security for Massachusetts, "not only for Northeastern, but for the state. We look forward to working with Northeastern University and all its partners as they advance a project that will focus the commonwealth's academic excellence on important public safety needs."

Senators Edward M. Kennedy and John F. Kerry sent congratulations to the University, commending Northeastern for stepping up to develop innovative ways to protect the nation.

"This is a major opportunity for the University," says Michael Silevitch, Robert D. Black Professor of Electrical and Computer Engineering, whose team of researchers put together the proposal that won the grant. "We need to be in the research forefront to help the world grapple with security problems. We are extremely proud to be chosen to lead the charge."

## Academic research + industry expertise = success

At first glance, a college of engineering may seem an odd choice to lead a Center of Excellence on explosives, which is typically a chemistry related threat.

"ALERT is a chemistry-oriented initiative," explains John S. Beaty, director of technology development at Gordon-CenSSIS, who helped write the proposal to DHS. "To have an electrical and computer engineering group in the field is unusual."

"We're not chemists," says Carey M. Rappaport, Professor of Electrical and Computer Engineering and head of ALERT's research thrust in explosive detection sensors, adding with a smile, "None of us have actually blown anything up."

What impressed DHS, both agree, is Gordon-CenSSIS's reputation and track record in building outstanding teams that combine varied disciplines, academic and research institutions, and industries. "Northeastern can assemble a team of our academic and corporate partners that complements our own competencies, establishing a group that's dedicated and extremely loyal to Michael [Silevitch]," Rappaport says. "The result is a whole that's greater than its parts."

"Our work has profound impact when people with disparate areas of expertise team up to solve problems of societal relevance. That's the Northeastern way. Professor Silevitch and the ALERT group embody this approach perfectly," said Joseph E. Aoun, president of Northeastern University. "This grant demonstrates the Department of Homeland Security's confidence in Northeastern's leadership and its ability to turn fundamental research into solutions that protect our nation, and educate the next generation of security experts. These are vital responsibilities that this university is uniquely prepared to fulfill."

Northeastern's team-building expertise is exemplified in two earlier Gordon-CenSSIS projects funded by DHS. In the Advanced Spectroscopic High Energy Radiation Detector (ASHERD) program, one industrial partner, Bubble Technology Industries, Inc.,

developed a prototype using its detectors and the University's signal processing expertise to address the problem of detecting and intercepting nuclear materials smuggled across our borders. This prototype then led to a \$400 million production contract from DHS to another industrial partner, Raytheon Company. Under usual market conditions, according to Beaty, it would be unlikely that Bubble Technology and Raytheon would come together on such a project.

Another Gordon-CenSSIS effort, BomDetec Phase I, a suicide bomber-detection program relevant to ALERT's mission, received a DHS grant to verify the effectiveness of a multisensor tracking system. For this project, Northeastern coordinated research with Rensselaer Polytechnic Institute, and production with American Science and Engineering, Raytheon, and Siemens Corporate Research. BomDetec is planned to become the basis for one of ALERT's test beds.

"It's Gordon-CenSSIS's reputation as an honest broker that allows us to coordinate competing industries that are not normally in harmony," says Beaty. "Northeastern is unique in its ability to build cohesive teams from disparate components."

## Top-down approach ties research to reality

While Silevitch is credited by his colleagues with Northeastern's team-building talents, he points to ALERT's top-down organization and Gordon-CenSSIS's research track record for finding hidden objects as the University's grant-winning advantages.



At Washington State University, an ALERT partner, Senior Project Engineer Kurt Zimmerman and an intern, Eryn Cook, work on the Institute for Shock Physics' Multipoint VISAR, which is used to make velocity measurements during experiments.

“Northeastern’s strategy is what DHS needed,” Silevitch asserts. “Gordon-CenSSIS has the structure and underpinnings in place, ready to be focused on the mission to find hidden explosives. ALERT’s administration will take advantage of our existing structure. Why reinvent the wheel?”

ALERT will be built on a three-level, top-down, interrelated strategic approach already proven successful by Gordon-CenSSIS. The real-world Grand Challenges will drive the basic science, which in turn will include projects designed to overcome research barriers to meeting the challenges. Test beds will validate the research and lead to viable products. “We know how to do the research and tie it into a demonstration of the technology and the real world,” explains Silevitch. “We know how to solve the real problem.”

The four Grand Challenges constitute the top level of the strategy that Gordon-CenSSIS will employ: ultrareliable explosives detection for screening of crowds, luggage, and cargo containers; stand-off explosives detection of packages, vehicles, and suicide bombers at distances greater than 50 meters; pre- and postblast mitigation to render explosive material inactive or to protect assets from an explosion; and rapid, thorough preparedness and response to blasts, including assessing unknown explosives and both educating and learning from first responders. ALERT expects the first of the next-generation systems addressing these challenges to emerge in about four years.

On the second level are the test beds. These include a platform based on BomDetec, trace explosives detection, advanced materials for mitigation, a multisensor luggage scanner, and a portable sniffer. ALERT plans on the test beds appearing in about two years.

Within the third, or base, level is the fundamental science, which comprises four research thrusts: the physical and chemical characterization of explosives, novel sensing modalities and configurations, multisensor systems and alternative signatures for threat detection and identification, and mitigation of the effects of explosives.

## Discovering novel modalities

One of ALERT’s main goals is to conduct transformational research and develop technology to answer the threat of suicide bombers and IEDs in the United States, and then move the research from theory to prototype to fieldable systems. “The research is real,” Rappaport asserts. “It makes us feel that we’re contributing to and benefiting society.”

The ALERT proposal outlines projects that tackle the challenges described in the research thrusts. Northeastern and its core partners will conduct the research, then team with corporate partners to bring the research to fruition.

## The ALERT Team

Co-led by Northeastern and the University of Rhode Island, ALERT will draw substantially on the expertise of its partners.

[Boston University](#)

[California Institute of Technology](#)

[Missouri University of Science and Technology](#)

[New Mexico State University](#)

[Rensselaer Polytechnic Institute](#)

[Texas Tech University](#)

[Tufts University](#)

[University of Puerto Rico at Mayagüez](#)

[Washington State University at Pullman](#)

[Woods Hole Oceanographic Institution](#)

[Idaho National Laboratory](#)

[Lawrence Livermore National Laboratory](#)

[Los Alamos National Laboratory](#)

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**Robust Tracking in Real-World Environments:** ALERT researchers are developing techniques to track individuals in video sequences as they pass behind obstructions or other people, as well as to determine dominant patterns of behavior in crowded environments. This work will be used to detect anomalous behaviors and identify possible threats from suicide bombers and other terrorists.

## Grant assists technology transition

Nationally, ALERT has great potential to make the United States more secure. Locally, the center has enormous promise to create new jobs and boost the Massachusetts economy. The John Adams Innovation Institute has enough confidence in ALERT's economic promise to grant a minimum of \$1.6 million over four years to foster industry participation.

The innovation institute is the economic development division of the Massachusetts Technology Collaborative, the state's development agency for renewable energy and the innovation economy. The John Adams Innovation Institute gives matching grants to academic institutions applying for major federal grants that have substantial research opportunities. Innovation Institute support can make a grant proposal more attractive to the federal funding agency, while creating economic benefits to Massachusetts.

"When Northeastern submitted its proposal to us," says Robert Kispert, program director for federal and university programs at the institute, "we saw economic growth potential in the state's defense, aerospace, and homeland security industries."

He explains that while a company may be interested in offering its expertise to ALERT, it may feel that the research and development costs for a specific project are greater than the potential financial benefit. The institute's grant will be used to offset the cost to the company: The grant will cover part of a company's investment costs, and the company will pay the rest. "We're buying down the cost of corporate participation," Kispert says. "It gives ALERT leverage with industry."

The overall challenge facing ALERT researchers is to detect a threat at a distance, and to do it accurately. To overlook an IED or suicide bomber—or conversely, to misidentify a person, as when Jean Charles de Menezes was wrongly suspected to be a bomber and was shot by police in London—is literally a matter of life and death. The goal is to be able to identify an explosives threat before it's too close, and therefore too late, to defuse.

"It's hard to make an unequivocal detection at a distance," says Rappaport. "It's enough to raise a suspicion to activate further surveillance."

One method for stand-off detection builds on the University's video surveillance work in BomDetec. The ALERT strategic plan proposes to develop novel approaches for interpreting the overwhelming amount of data generated by video-camera networks. Such networks are available, affordable, and easy to deploy, but they generate massive data that must be sifted through by human operators for meaningful information. ALERT researchers intend to develop change detection and understanding algorithms to automate the data analysis in real time.

In addition to video-camera systems, the ALERT model envisions networks of multi-modal sensors. When one sensor detects a suspicious vehicle or pedestrian, it triggers additional sensors to home in on the suspect, collecting information and assessing the threat as the vehicle or person progresses through the network.



# The only way to ensure that the work to protect our nation

## continues to advance over the coming decades

### is to prepare the next generation of experts in the field

### through education at all levels of schooling.

Current portal systems, such as those air passengers and their luggage pass through, are very good at looking beneath clothing or into bags for suspicious objects or unnatural protrusions, what Rappaport refers to as “lumpiness.” But how can the same be done at a distance, while balancing practicality, speed, and expense? ALERT scientists will investigate ways to improve on such current technologies as microwaves, x-rays, and terahertz spectroscopy, while researching new sensing modalities.

Sensors might be designed not only to detect irregularities in objects beneath clothing, but also to monitor behavior, sweating, and even gait, which could indicate that a person is carrying a hidden load. Methods to detect even the minutest trace of explosives at a distance will be explored, as Rappaport points out that suicide bombers do not handle the explosives but are dressed by someone else, and therefore may not have substantial amounts of explosives on their hands or clothing.

Northeastern’s core partners will play a substantial role in the research, especially in the thrusts on physical and chemical characterization of explosives and the mitigation of explosives effects.

## Education for a safer future

Homeland security is a long-term concern. The only way to ensure that the work to protect our nation continues to advance over the coming decades is to prepare the next generation of experts in the field through education at all levels of schooling. ALERT will tap into existing courses, as well as generate new courses of study to prepare students for a career in homeland security.

“Ultimately, we want to produce PhDs in DHS areas of technology,” says Stephen McKnight, Professor of Electrical and Computer Engineering. “PhD students will, in fact, be doing much of the ALERT research work.”

Aligned with this goal is Northeastern’s new Gordon Engineering Leadership Program, an intensive one-year program designed to address the shortage of people in the United States trained to lead next-generation product development and foster innovation. McKnight explains that in this context, a leader is defined as an engineer who can take a project from its beginning theory through to deployment, a skill that fits squarely with ALERT’s mission and the needs of DHS. “Projects often get stuck in research and development,” says McKnight. “The

Gordon program has interdisciplinary teams of postgraduate students who identify barriers that keep a real-world project from progressing to prototype and market.”

To advance the ALERT mission, the Gordon Engineering Leadership Program will reserve spaces specifically for DHS personnel. They will have the opportunity to identify a system they want to see deployed, and Northeastern will give them the tools to do so.

On the undergraduate level, the University’s unique and popular High-Tech Tools and Toys Laboratory gives students a hands-on, discovery-based learning experience as early as their freshman year. The purpose is to excite young students and develop their interest in a career in an engineering field. To capture student interest, the lab uses simple examples of complex concepts. For example, students learn about chemical “fingerprinting” of materials by using spectroscopy to identify salt versus sugar, lessons valuable for engineering, chemistry, and criminal justice students. The ALERT plan proposes creating new modules that emphasize homeland security technologies.

In addition to these existing programs, ALERT is advancing several new ones, including a proposed master’s degree in homeland security technologies, through Northeastern’s College of Professional Studies, with a focus on sensing and detection. “We are also proposing to develop techniques to train K–12 teachers in relevant but basic non-explosive applications as well as ways to give young scholars a research experience,” continues McKnight. “We would like to offer online courses that can reach across the country via our partner universities that would be made available to DHS personnel and other professionals. The University of Rhode Island has ongoing short courses and workshops for first responders as well.”

From basic science to fieldable systems to future technology experts, ALERT will build teams to support the mission of the Department of Homeland Security. As Silevitch sums it up, “We at the universities will do what we do best, and our national laboratory and industry teammates will do what they do best.” The result will be research breakthroughs that transfer to industry, and educational initiatives to help in the war against terrorism.

# Newly Tenured Faculty Bring Distinction

Three faculty members who embody the interdisciplinary breadth of research within the College of Engineering were awarded tenure by the Northeastern Board of Trustees



**Stefano Basagni**, Associate Professor of Electrical and Computer Engineering, joined the Northeastern faculty in January 2002 as Assistant Professor. His recent research interests focus on mobile networks and wireless communications systems, Bluetooth and sensor networking, definition and performance evaluation of network protocols, and theoretical and practical aspects of distributed algorithms. He is a senior member of the Association for Computing Machinery. **Basagni's publications have been cited more than 2,100 times.** Basagni holds two PhDs, one in electrical engineering from the University of Texas at Dallas and the other in computer science from Università degli Studi di Milano, Italy.

Basagni currently is working on three projects funded by National Science Foundation (NSF) grants. In “Modeling Networks with Multiple Physical Interfaces—The Case for Multi-Radio Networks,” Basagni and his colleague, Andras Farago of the University of Texas at Dallas, are developing and analyzing novel mathematical methods to quantify the network performance gain when several radio transmitters/receivers are placed in a single wireless network node, creating multiple physical layers. They will model the network topology with an edge-labeled multigraph.

“Integer Linear Programming (ILP) Models for Mobility in Wireless Networks” considers multihop wireless networks in which most nodes are immobile and only some are able to move. Using ILP, routes and schedules for the mobile nodes can be found that optimize crucial network performance metrics. “Small Antennas for Angle of Arrival Determination and Accurate Localization” focuses on finding solutions that allow small, energy-constrained wireless sensor nodes to self-localize.



**Jennifer G. Dy**, Assistant Professor of Electrical and Computer Engineering, has taught at the University since 2002. **While at Northeastern, she has won more than \$1 million in external grants.** Her research interests include machine learning, data mining, pattern recognition, medical image analysis, and computer vision.

Dy concentrates on developing algorithms for clustering high-dimensional data and applied machine learning. Her applied research focuses on biomedical imaging, specifically, tumor tracking in fluoroscopy images of the lungs for radiotherapy and image segmentation of *in vivo* confocal microscopy image stacks of the skin to detect cancer.

She won a National Science Foundation Faculty Early Career Development (CAREER) award for her current project, “A Foundation for Unsupervised Learning of High-Dimensional Data.” Dy is exploring different methods of addressing clustering in high dimensions to sort out redundant, irrelevant, or misleading features to increase interpretability and ameliorate the problem with algorithms that break down with high-dimensional data.

Working with researchers at Siemens Medical Solutions, Dy developed algorithms for extending support vector machines to multiclass problems. The team also worked on algorithms on batch-wise classification applied to computer-aided diagnosis problems. In a separate project, Dy has concentrated on tumor tracking for radiotherapy treatment of lung cancer, with the goal of performing lung tumor tracking without radio-opaque markers in order to identify the tumor location in 4DCT fluoroscopic images. The project involves developing a variety of image-tracking techniques. Yet another research project aims toward segmentation of the dermis/epidermis boundary from confocal microscopy images since cancerous lesions begin in this first layer and then spread.

Dy earned her PhD in electrical and computer engineering from Purdue University.



**Katherine S. Ziemer**, DiPietro Assistant Professor of Chemical Engineering, came to Northeastern in 2001. Her research aims to create next-generation electronic devices based on multifunctional materials to produce a single device that interacts with its environment mechanically, electronically, optically, and magnetically. Meeting the challenges of the functional integration of different materials at the atomic level opens the potential for such applications as providing crystal-clear phone communications with as few as one-tenth the number of towers currently required, or the development of pebble-sized devices that could be tossed in the ocean to record marine activity, sense undersea earthquakes, locate shipwrecks, and track ships and submarines.

Ziemer is working on engineering surfaces in order to integrate wide band-gap semiconductors with functional and multifunctional oxides, organic molecules, and/or biomaterials. Her Interface Engineering Laboratory group studies the growth and processing of thin films and nano-structures at the atomic level. Her work is based on the hypothesis that understanding the atomic-level interactions at a surface will lead to developing processes to create materials and effectively interface different materials for new functionalities.

During her Northeastern career, Ziemer has earned several academic honors, including the Marin W. Essigmann Outstanding Teaching Award from the University’s College of Engineering, **the New England Region Outstanding Teacher Award from the American Society for Engineering Education (ASEE)**, the Joseph J. Martin Award for the most outstanding Chemical Engineering Division paper at the ASEE Annual Conference, and the Northeastern University President’s Individual Aspiration Award.

Ziemer holds a PhD in chemical engineering from West Virginia University. Previously, she held professional engineering positions at the DuPont Victoria Plant in Texas.

# NEW BS/MBA PROGRAM

## Leverages the Academic and the Experiential

This fall the College of Engineering, along with the College of Business Administration, welcomes the first students to Northeastern's Galante Engineering and MBA Program, which culminates in the awarding of both a bachelor's of science in engineering and a master's of business administration.

The program addresses a growing need in the business world for leaders who possess the analytical skills derived from the study of engineering, such as quantitative analysis, process development, and product design, combined with the business acumen and perspective gained through MBA preparation.

Founding support for Northeastern's new BS/MBA track comes from Edward Galante, '73, and his wife, Cathie. The Galantes recently pledged \$5 million to establish the new program and to provide scholarships for engineering students selected for their high level of academic achievement and future promise.

Galante credits the success of his 34-year career at ExxonMobil to his start as a Northeastern civil engineering co-op student at Mobil Oil. According to Galante, the experience made him a "true believer" in Northeastern and its importance in his career. He hopes the new program will provide students with a grasp of the leadership skills and business know-how necessary to navigate an ever-changing environment.

**The Northeastern BS/MBA is designed to prepare students to follow both traditional and nontraditional career paths.** The rigorous background fundamental to the study of engineering has customarily led to positions in technical or engineering companies, preparation which will now be complemented by a breadth of business experience and sound understanding of how businesses work. Nontraditional



From left, Edward Galante, Cathie Galante, and President Joseph E. Aoun

paths now available to trained engineers with MBAs can lead to opportunities in financial services, retail, and supply-chain organizations, among others.

The Galante Engineering and MBA Program encompasses six years of classroom and co-op experiences. The majority of business courses, taken in the final year of the combined-degree program, will be scheduled in the evening to enable engineering students to study alongside working professionals from a variety of backgrounds. Engineering co-ops will be complemented with a business co-op assignment as well as a corporate residency at the graduate level, balancing the academic and experiential components of the program.

# DISCOVERY IN ULTRA-STRONG MAGNET PRODUCTION

## Can Be Game-changer in Electric Vehicle Manufacture



Cabot Professor and Chair of Chemical Engineering Laura Lewis, with William Lincoln Smith Professor and director of the Center for Microwave Magnetic Materials and Integrated Circuits Vince Harris (right), and scientist, C. N. Chinnasamy.

Researchers in the College of Engineering have discovered a process that could revolutionize the production of

jets, hybrid automobiles, and other technology that depends on super-strong magnets.

Through a research effort led by Dr. C. N. Chinnasamy of Northeastern's Center for Microwave Magnetic Materials and Integrated Circuits (CM3IC), a method to significantly lower the cost of ultra-strong magnet production was discovered recently, and word is spreading among industry leaders and media officials.

"The potential for what was discovered in Chinnasamy's wet chemistry experiment is enormous," said Vince Harris, William Lincoln Smith Professor of Electrical and Computer Engineering, and CM3IC director.

Harris said that Chinnasamy discovered a way to produce a rare-earth material, Samarium cobalt, a key ingredient in expensive, ultra-strong magnets used in a wide array of technologies. With the discovery, researchers predict that the resulting drop in production costs will open up a new path in everything from jet engine development to the manufacture of hybrid cars.

**"This holds great promise for the automobile industry, where these magnets are commonly found in motors used in hybrid and electric vehicles."** —Professor Vince Harris

Northeastern's National Science Foundation

# NANOMANUFACTURING CENTER ANNUAL INDUSTRY PARTNERSHIPS REACH \$1 MILLION

The growing success in translational research of the College of Engineering's National Science Foundation (NSF) Nanoscale Science and Engineering Center for High-rate Nanomanufacturing (CHN) is evidenced by the growing engagement of corporate partners. In 2008, industrial projects with CHN grew to more than \$1 million, continuing the trend of rapid growth through the first four years of the center's existence. This industrial support is in addition to government-funded projects yielding total funding that exceeds \$6 million per year.

CHN is one of four NSF centers in the nation that focus on nanoscale manufacturing. Established in 2004, CHN develops novel science to enable high-rate/high-volume nanomanufacturing. Commercial scale-up for the creation of highly anticipated commercial products will not be realized unless one can perform high-rate/high-volume nanomanufacturing economically and using environmentally benign processes. **CHN's processes and tools continue to bridge the gap between nanoscale science and development of commercial products** in application areas such as bio/med, energy, electronics, and materials. CHN is developing a fundamental understanding of the interfacial behavior and forces required to assemble, detach, and transfer nanoelements, which are needed for guided self-assembly at high rates and over large areas. CHN is a synergistic team of three universities led by Northeastern University and joined by the University of Massachusetts Lowell and the University of New Hampshire. The work of CHN is made possible by the state-of-the-art nanofabrication clean-room facilities of the George J. Kostas Nanoscale Technology and Manufacturing Research Center at Northeastern University.

An example of CHN's cutting-edge work was featured in June at the Nano Science & Technology Institute's Nanotech 2008 Conference in Boston. Researchers at CHN, under the direction of Professor Ahmed Busnaina, with partners University of Massachusetts Lowell and the University of New Hampshire, developed a technique to scale up the directed assembly of single-walled carbon nanotube (SWNT) networks, from microns to inches, creating a viable circuit template that can be transferred

from one substrate to another for optimum productivity. The revolutionary process has the potential to change the way electronics and other applications are developed for consumers.

"This technology is a platform for many applications, and the fact that it is scalable makes it easier to bring to market," says Busnaina, William Lincoln Smith Professor and director of CHN. "The cost of current nanomanufacturing techniques is sky-high, and our product has the potential to increase productivity tremendously without sacrificing reliability."

The revolutionary assembly process developed by Busnaina and his team scales up the nanoscale structures on a wafer level on a variety of hard and soft substrates, such as silicon and polymers. In addition, the assembled structures can be transferred to other substrates in continuous or batch processes. Concurrently, researchers at CHN are investigating the environmental and biological implications to ensure that these devices and techniques are safe for people and for the environment.

Because of the unique capabilities of nanoelements, researchers at CHN and industry leaders have the opportunity to create scores of innovative new products that are impossible to make today, and that have the potential to transform industrial sectors as well as society as a whole. While many of these applications are years away, some may come more quickly. "The role of our research is pivotal in bringing nanoscale inventions to market," adds Busnaina. "Some of what we are working on, like biosensors and batteries, could be available as soon as the next three to five years. There is a world of possibilities for additional ways that nanodevices can improve the way we live our lives today."

The developed technology will lead to many novel applications in the future, such as laptops the size of business cards; sturdy, lightweight materials to replace metal in aircraft or automobiles; nano-biochips that can detect cancer and other diseases years before existing technology; thin, flexible, lightweight batteries that offer longer life and more power than today's models; and super-tiny memory devices resistant to heat, cold, magnetic fields, and vibrations that can be used to create small machines.

# ENGINEER TAKES LEADERSHIP ROLE at Northeastern University

In May, Stephen Director, a member of the National Academy of Engineering and a fellow of the Institute of Electrical and Electronics Engineers, was named the University's provost and senior vice president for academic affairs, validating in a highly visible way the value and flexibility of an engineering education.

Like the College of Engineering students who are exploring ways of maximizing their classroom and experiential education opportunities, the new provost is an example of how engineering graduates are able to choose from a variety of careers, following paths both traditional and unconventional.

Director previously served as provost at Drexel University and was dean of engineering at both the University of Michigan and Carnegie Mellon University.

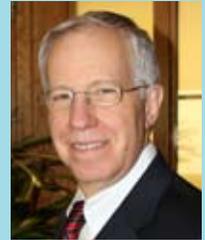
Director earned his bachelor's degree from the State University of New York at Stony Brook, and his master's and doctoral degrees at the University of California, Berkeley. He began his teaching career at the University of Florida and in 2002 was named honorary professor of Shanghai Jiao Tong University by the Chinese Ministry of Education.

Director is a pioneer in the field of electronic design automation and has a long record of commitment to and innovation in

engineering education. He has published more than 150 papers and authored or coauthored six texts.

As the University's chief academic officer, the provost serves as chair of the Faculty Senate. In fulfilling this role, Director will provide leadership for the University's education and research programs and work closely with the deans of the colleges to articulate a vision for the entire academic enterprise.

Northeastern's new provost appreciates the variety and breadth of opportunities that an engineering education can provide. "Engineers turn fantasy into reality and therefore have played a pivotal role in developing the technologies that maintain our nation's economic, environmental, and national security," notes Director. "But engineering education is evolving. In addition to its traditional emphasis on problem solving, quantitative and critical thinking, creativity, and innovation, engineering curricula are also teaching teamwork and leadership skills. I truly believe that engineering programs prepare individuals incredibly well to pursue any one of a number of careers in addition to engineering and that my engineering education has served me well in the academic administrative posts I have had the privilege to hold."



## DAVID LUZZI Named Engineering Dean



Last September, David Luzzi, a materials science and engineering professor from the University of Pennsylvania, was named dean of the Northeastern University College of Engineering

Luzzi is internationally recognized for his expertise in nanotechnology and the development of innovative interdisciplinary programs in academia. At the University of Pennsylvania, he cofounded the Nanotechnology Institute, a partnership among a dozen local universities, colleges, and research institutions. Author of 120 scientific and engineering articles, he has advised leaders in the United States and around the world on nanotechnology. His discovery of the so-called peapod class of nanomaterials landed him on the cover of *Science* magazine and garnered worldwide press coverage.

In addition to his scholarly pursuits, Luzzi is the Chief Scientific Advisor of NanoSelect-Sensors, a five-year-old high-technology venture that develops and manufactures nanotube devices for high-end, high-volume applications. The company was created based on discoveries from the Luzzi laboratory. Luzzi has served as the Science and Technology Chair of the U.S. Air Force Scientific Advisory Board, where he led the review of the \$3.6 billion Air Force Research program. He was also a Science and Technology Advisor to the Chief of Naval Operations' Strategic Studies Group.

Luzzi holds a bachelor's degree in engineering physics from the Stevens Institute of Technology, a doctorate in materials science and engineering from Northwestern University; and an MBA from the University of Pennsylvania's Wharton School of Business.

## IGERT Program in Intelligent Diagnostics

# LINKS NORTHEASTERN WITH INDUSTRIAL PARTNERS

Under a grant from the National Science Foundation, Northeastern University and the University of Puerto Rico are embarking on an exciting new program in which science and engineering doctoral students will develop new tools for restoring and improving urban infrastructure through intelligent diagnostics. Interdisciplinary in nature, the Integrative Graduate Education and Research Traineeship (IGERT) program in Intelligent Diagnostics will expose PhD-bound students to the rigors of the engineering curriculum complemented by the acquisition of communications skills, familiarity with public policy, and the toolkit for research they will be conducting. Students from diverse backgrounds—structural engineering, mechanical engineering, computer engineering, and physics, among others—will learn how to ask the right technological questions, find fitting answers, and work on state-of-the-art research projects.

**Students from diverse backgrounds ... will learn how to ask the right technological questions, find fitting answers, and work on state-of-the-art research projects.**

Addressing infrastructure issues is one of the fourteen Grand Challenges determined by the National Academy of Engineering as opportunities for engineering to make transformative impacts in the new millennium. The National Science Foundation-supported IGERT program has been developed to meet the task of educating U.S. PhD students and engineers who will pursue interdisciplinary careers in research and education. During the program, students will gain the required

knowledge in specific disciplines, and acquire the technical, professional, and personal skills to become leaders and creative agents for change, including the Grand Challenges articulated by the National Academy.

In addition to the academic foundation provided by Northeastern University and the University of Puerto Rico, industrial partners will play an important role in the IGERT Intelligent Diagnostics program by providing research opportunities for the students. Among the program's industrial partners are Camp Dresser and McKee, TransTech Systems, and Weidlinger Associates. Vice president of research and development at Witten Technologies, Ralf Birken, recognizes the value of an interdisciplinary focus: "I believe that public policy is important not only for the IGERT program; it may be the only way to make sure that new technologies geared toward improving the aging civil infrastructure will actually be used to their utmost and to the benefit of the taxpayers."

Northeastern University president Joseph E. Aoun adds, "The solution to problems associated with aging civil infrastructures is a complex one that crosses several disciplines and relies on academic and industrial collaborations on the national and global levels. We are proud to be on the cutting edge of science and translational research that is closely linked to industry needs and will help solve pressing societal and economic issues."

Drawing on the rigorous training provided by the College of Engineering, enhanced by strong social programs, such as public policy, urban planning, and communications, among others, Northeastern is well positioned to prepare engineering and science professionals to grapple with the formidable challenges of the century ahead.

## AMERICAN SOCIETY OF CIVIL

## ENGINEERS

**Honors Northeastern's  
Richard J. Scranton**



As a singular honor, the American Society of Civil Engineers (ASCE) established the **Richard J. Scranton Outstanding Community Service Award** in recognition of Scranton's pioneering work in service learning. This national award honors Scranton's work in promoting ASCE student chapter involvement in community service activities. The annual award will be presented to the ASCE student chapter that best demonstrates excellence in community service. This is a well-deserved perpetual recognition of Rick's dedication to the comprehensive education of students, to enabling their success, and to his field of civil engineering.



## Ming Wang

Professor of Civil and Environmental Engineering, has extensive research experience in experimental mechanics and sensor technology for infrastructures, including work on the micro-mechanics of failure in quasi-brittle materials, constitutive law and damage mechanics of quasi-brittle materials, monitoring and damage assessment of large structural systems, sensor technologies and experimental techniques for infrastructure application, and probabilistic structural dynamics and vibration testing. He has established and maintained a number of structural mechanics laboratories, and has published more than 200 papers in various journals, conference proceedings, and edited books. Wang was awarded a patent on the “Fast Scanning Electron Microscope” in 1993, and filed several disclosures and patents on EM sensor technologies currently under use worldwide.



## Deniz Erdogmus,

Assistant Professor of Electrical and Computer Engineering, received his PhD in electrical and computer engineering from the University of Florida, where he continued on as a postdoctoral research associate. Prior to joining the Northeastern faculty, he was an assistant professor at the Oregon Health & Science University. His exper-

## College Of Engineering

# WELCOMES NEW FACULTY

tise is in information theoretic and nonparametric machine learning and adaptive signal processing, specifically focusing on cognitive signal processing, including brain interfaces and assistive technologies. Erdogmus has been serving as an associate editor of *IEEE Transactions on Signal Processing*, *Transactions on Neural Networks*, *Signal Processing Letters*, and *Neurocomputing*. He is a member of the IEEE-SPS Machine Learning for Signal Processing Technical Committee.



## Andrew Gouldstone,

Assistant Professor of Mechanical and Industrial Engineering, received his PhD in materials science and engineering from MIT. He was an NIH postdoctoral fellow in the Harvard School of Public Health physiology program, where he worked on respiratory mechanics and mesothelial lubrication between soft tissues. At Stony Brook University, he worked on experiments and modeling of mechanically heterogeneous systems, such as nanoporous metals, thermally sprayed (TS) coatings, lungs, and hydrogels. Gouldstone is expanding his biomechanical work to include *in situ* observation of alveolar mechanics in the lung, mechano-chemistry of lung surfactant, and biomechanical aspects of TS-coating fatigue for functional and implant applications.



## Mark Niedre,

Assistant Professor of Electrical and Computer Engineering, joins Northeastern from Harvard Medical School and Massachusetts General Hospital, where he worked as a research fellow specializing in *in vivo* fluorescence molecular imaging and treatment monitoring of photodynamic therapy of cancer. He was also a postdoctoral fellow in medical biophysics at the University of Toronto’s Cancer Institute. His research interests encompass fluorescence molecular imaging at multiple

scales using a number of techniques, including optical tomography, microscopy, and epi-fluorescence imaging, as well as dosimetry and monitoring of anticancer therapies such as photodynamic therapy using optical techniques. He received his PhD in medical biophysics from the University of Toronto.



## Milica Stojanovic,

Associate Professor of Electrical and Computer Engineering, received her PhD in electrical engineering from Northeastern University. She was a postdoctoral fellow at the Woods Hole Oceanographic Institution, where she remains active as a guest investigator. Prior to joining the Northeastern faculty, she was a principal scientist at MIT. Her research interests include digital communications theory and statistical signal processing, and her expertise is in the area of underwater wireless communications. Stojanovic has served as an associate editor for communications with the *IEEE Transactions on Vehicular Technology*, and she is a member of the IEEE Ocean Engineering Society’s Administrative Committee.



## Juraj Topolancik,

Assistant Professor of Electrical and Computer Engineering, focuses his research on the fabrication of photonic micro- and nano-structures and their applications in sensing and optical signal processing. He received his PhD in applied physics from the University of Michigan; his doctoral dissertation was on photonic crystal light emitters and microsensors. In 2005 he joined the Rowland Institute at Harvard, where he worked as a postdoctoral research fellow in the biofunctional photonics group until the summer of 2008. He is a member of the Institute of Electrical and Electronics Engineers and the Optical Society of America.



**Ashkan Vaziri**, Assistant Professor of Mechanical and Industrial Engineering, is also a senior research scientist for FM Global Research, an associate of

Harvard University's School of Engineering and Applied Sciences, a visiting scholar in bioengineering at the University of California, Berkeley, and a research affiliate in MIT's Biological Engineering Division. He received his PhD from Northeastern, and conducted his postdoctoral work at Harvard University's then-Division of Engineering and Applied Sciences. He has twice received the U.S. Association of Computational Mechanics Young Investigator Fellowship and has published extensively in a variety of publications. His work will focus on studying the mechanical behavior and performance of materials and structures, including biomaterials at various scales, from nanowires and living cells to ships and buildings.



**Kai-tak Wan**, Associate Professor of Mechanical and Industrial Engineering, comes to Northeastern from the Missouri University of Science and

Technology (formerly University of Missouri-Rolla), where he received two Faculty Excellence Awards. His research interests encompass areas in cellular biomechanics, tissue engineering, ophthalmology, micro-electromechanical systems, and micro- and nano-structures. He earned his PhD in chemical physics from the University of Maryland at College Park, and worked as a postdoctoral fellow in mechanical and mechatronics engineering at the University of Sydney, Australia, and at the Hong Kong University of Science and Technology.

Of 94 current College of Engineering faculty,  
17 have received NSF CAREER grants

## FIVE COE Faculty WIN CAREER AWARDS

### Two Chosen for ONR Young Investigator Awards

The prestigious Faculty Early Career Development (CAREER) Program is the National Science Foundation's award for "junior faculty who exemplify the role of teacher-scholars through outstanding research, excellent education and the integration of education and research."

**Rebecca Carrier**, Assistant Professor of Chemical Engineering, will study the influence of micro- and nano-emulsions on the absorption of drugs and other compounds into the bloodstream. **Edwin Marengo**, Assistant Professor of Electrical and Computer Engineering, will research an interdisciplinary approach to the study of wave-based signal processing. **Shashi Murthy**, Assistant Professor of Chemical Engineering, will research microfluidic devices that can separate and manipulate very small numbers of cells for applications in regenerative medicine and clinical diagnostics. **Nian Sun**, Assistant Professor of Electrical and Computer Engineering, will investigate novel spin-spray synthesis methods for magnetoelectric films at a low temperature. Sun is also the recipient of a Young Investigator Award from the Office of Naval Research (ONR). Fellow Assistant Professor of Electrical and Computer Engineering Purnima Ratilal, was also a winner (see the 2007 issue of *NU Engineer* for more on her research). **Mehdi Tahoori**, Assistant Professor of Electrical and Computer Engineering, will develop tools to provide defect and fault tolerance in the presence of high-defect densities.

## PRESTIGIOUS AWARDS

### Go to College of Engineering Faculty

**John Proakis**, former chair and Emeritus Professor in Electrical Engineering, has been awarded the Athanasios Papoulis Award at the European Signal Processing Conference. He also was named to the board of Lumera, a photonic communications firm.

**James C. Benneyan**, Associate Professor of Mechanical and Industrial Engineering, has been named a fellow of the Healthcare Information and Management Systems Society and of the Society for Health Systems.

**Vincent Harris**, William Lincoln Smith Professor of Electrical and Computer Engineering, has been named a fellow of the Institute of Electrical and Electronics Engineers (IEEE) for his contributions to the science and engineering of microwave magnetic materials.

**George Adams**, Professor of Mechanical and Industrial Engineering, has been named a fellow of the Society of Tribologists and Lubrication Engineers.

**Thomas Sheahan**, Professor of Civil and Environmental Engineering, is the 2007 winner of the Tau Beta Pi Capers and Marion McDonald Mentoring Award for his outstanding work with engineering students.

**Robert Tillman**, Associate Professor of Civil and Environmental Engineering, received the 2007 Alvah K. Borman Award from the Cooperative Education Division of the American Society for Engineering Education (ASEE).

**Yiannis Levendis**, Distinguished Professor of Engineering, won a 2007 John J. McCambridge Research Grant from the Institute of Hazardous Materials Management to work on emergency fire extinction by direct application of liquid nitrogen. He also was named the 2007 Outstanding Teacher of the Year by the New England section of ASEE.

**Susan Freeman**, Senior Academic Specialist of Mechanical and Industrial Engineering, and **Beverly Jaeger** and **Richard Whalen**, Associate Academic Specialists of Mechanical and Industrial Engineering, received Best Paper Award at the annual ASEE conference.

**Ronald Willey**, Professor of Chemical Engineering, received the 2007 William H. Doyle Award from the American Institute of Chemical Engineers (AIChE) for Best Paper presentation at the institute's 2006 Prevention Symposium.

## WIN MULTIPLE NATIONAL AWARDS



COE students at ASCE Bridge Competition

### CIVIL STUDENTS WIN ASCE NE BRIDGE COMPETITION

The Northeastern student chapter of the American Society of Civil Engineers (ASCE) took first place in the annual New England regional Steel Bridge Competition, topping 10 other teams and winning their second regional championship and fourth trip to the U.S. finals since 2000. The key to victory: "It's really light, it's really strong, and they put it together really fast," said Associate Professor Robert Tillman, coadvisor—with Professor Tom Sheahan—of the student group.

### CHEMICAL STUDENTS WIN AICHE NATIONAL DESIGN COMPETITION, OUTSTANDING STUDENT CHAPTER, AND CHEM-E-CAR COMPETITION

Three chemical engineering students from the Class of 2007 received the American Institute of Chemical Engineers' (AIChE) William A. Cunningham Award for winning first place in the National Student Design Team Competition. Jeiran Jahani, Brian McMahon, and Melissa Semple also won the Ephraim Scheier Team Award, the AIChE National Student Design Competition Award for Safety. Kyle Stephens, Class of 2009, was the regional 2008 Northeast Region AIChE Student Paper Competition winner.

The AIChE student group won the award for Outstanding Student Chapter, presented annually to those chapters that show an exceptional level of participation, enthusiasm, program quality, professionalism, and involvement in the university and community. Faculty advisors were Dr. Katherine Ziemer and Dr. Daniel Burkey, with student presidents Matthew Marino and Katie Megley.

The AIChE Chem-E-Car team won first place at the regional conference held at Northeastern, and came in sixth at the San Francisco national meeting. The main goal of the competition is to build a car that is powered by a chemical reaction and stops at a given distance. The team may not use any mechanical or electrical braking, so the stopping mechanism must be controlled through chemical kinetics.

### REACHING OUT TO HELP OTHERS

Northeastern's Engineers without Borders (EWB) won the Sustainable Legacy Award presented at the 2008 EWB-USA International Conference. The group has been working in the Yoro district of Honduras since August 2005 to help bring a clean, reliable source of water to villagers. They also have built a strong relationship with Americans Caring Teaching and Sharing (ACTS), as well as with the Honduran communities of El Tecuan, Los Planes, and El Rosario.

### AICHE NATIONAL SCHOLARSHIP

Each year, only 15 student members from across the country are chosen by AIChE to receive a \$1,000 Donald F. and Mildred Topp Othmer National Scholarship Award. Students are nominated by their chapter advisor and awards are given to students who demonstrate academic achievement and involvement in chapter activities. One of the recipients of the 2007 award was Katie Megley, a 2008 graduate of chemical engineering.

### INDUSTRIAL ENGINEERING STUDENT WINS MULTIPLE NATIONAL SCHOLARSHIPS

Lauren Hale, a 2009 industrial engineering student, is involved in a number of engineering student groups, including the Institute of Industrial Engineers (IIE), Society of Women Engineers (SWE), and American Railway Engineering and Maintenance-of-Way Association (AREMA). Over the past year, she has received the following scholarships:

**\$1,000 IIE Presidents Scholarship (2008):** The scholarship is given to students pursuing studies in industrial engineering and recognizes excellence in scholarly activities and leadership in the IIE student group, as well as promoting IIE involvement on campus.

**AREMA Scholarship (2007, 2008):** The AREMA Educational Foundation provides scholarships to engineering students specializing in the railway industry. Lauren received the 2007 AREMA President's Scholarship for \$1,500 and another AREMA scholarship in 2008 for \$1,000.

**\$2,000 AACE Scholarship (2008):** The Association for the Advancement of Cost Engineering (AACE) awards scholarships based on academic performance, extracurricular activities, and an essay on the value of study of cost engineering or total cost management.

**\$1,000 Susan Miskowicz Memorial Scholarship (2007):** The scholarship is sponsored by SWE to honor Susan Miskowicz, who died in the World Trade Center on September 11, 2001, and supports women in the transportation field.

# NU Engineer

## Advancement Report

### > INAUGURAL ISSUE OF NEW ALUMNI PUBLICATION COMING THIS WINTER

The College of Engineering will mark an important milestone when we commemorate our centennial year in 2009. We invite you to join in the celebration as we salute our past and look toward our future with a variety of activities and special events for our alumni, students, faculty, staff, and friends.

From Northeastern's early days as a small college to its current standing as a leader in engineering education and research, our solid tradition of cooperative education, inspired teaching, and innovation has never wavered.

As we move into our second century, the College of Engineering is more committed than ever to offering greater opportunities for alumni engagement. Over the next hundred years, some 50,000 students will earn degrees from the College of Engineering. With you as our partners, we will provide these bright, ambitious students with the academic programs, faculty, facilities, and opportunities they will need to be the most inspired and talented generation of Northeastern engineers.



For questions, or to make your gift to engineering, contact Mark O'Donnell, Director of Development, College of Engineering, at 617.373.4845 or via e-mail at [m.odonnell@neu.edu](mailto:m.odonnell@neu.edu).

Be on the lookout this winter for the inaugural issue of *NU Engineer: Advancement Report*, a new publication that is being created to reflect the leadership and private support from our alumni, parents, and friends whose generous investment in the college makes all that we achieve possible.



# Northeastern

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