ENGINEERING @
Northeastern
Spring 2017


# BOUNDLESS INNOVATION

## Shaping the future of a connected, autonomous world



Northeastern University
College of Engineering

## Dean's Message

**"Our professors and students are working side by side to spur the next generation of capabilities for a connected world."**

Dear Friends,

Advances in robotics and enabling technologies for the Internet of Things have the potential to change our daily lives for the better—beyond our imagination. With a combination of highly qualified faculty and federally funded support, our team of experts are leading transformative research in these areas to help improve safety and security, advance healthcare, and build sustainable communities; all of which will ultimately impact every one of us in our daily life, as well as the rest of the world.

Throughout this edition of *Engineering@ Northeastern*, we give an inside look at our research in action. Our professors and students are working side by side to spur the next generation of capabilities for a connected world.

We also show how our global, experiential, and personalized learning approach is offering depth and breadth of education beyond traditional competency models—globally. The official opening of our state-of-the-art Interdisciplinary Science and Engineering Complex exemplifies our leadership in providing an interdisciplinary education with boundless collaboration, use-inspired and innovative research, and rich learning experiences.

With our ever-changing and complex world, we've significantly expanded our graduate degree and certificate programs, and increased flexibility in both delivery and offerings to support lifelong learning. Our College also remains fully committed to diversity and building the STEM pipeline with formal and informal programs that create a supportive and inclusive community. Read on to learn about our students' experiences and how our efforts are making a significant difference in their lives.

I'd also like to give special thanks to all of our alumni and friends who have generously supported the College of Engineering. Your philanthropy is helping us to develop the next generation of engineering leaders that will undoubtedly continue to make our world a better place through innovation.

Sincerely,

Nadine Aubry
Dean of the
College of Engineering
dean@coe.neu.edu

# inside



Photo by Adam Glanzman

## COVER IMAGE

An attendee films on their smartphone, Valkyrie, NASA's humanoid robot destined for Mars at the official opening of Northeastern's Interdisciplinary Science and Engineering Complex. The image symbolizes a new era of autonomous, intelligent, and connected devices that will undoubtedly transform society.


» Learn more about our transformative research to enable the Internet of Things on **page 9**.

» Learn more about our revolutionary robotics innovations on **page 14**.


## Questions and Comments


dean@coe.neu.edu
College of Engineering
230 Snell Engineering Center
Northeastern University
360 Huntington Avenue
Boston, MA 02115
617.373.6300



*Editorial*
Cindy Fusco
Janet LeClair

*Editorial Credits*
News@Northeastern

*Design*
Alexandra Berleus

*Photography Credits*
Brooks Canaday
Heratch Ekmekjian
Adam Glanzman
Christina McNeil
Matthew Modoono

# New-School Innovations


With increasingly complex technical challenges involved in many of society's most pressing problems, engineers are being called upon to push innovation to new heights to provide next-generation technology solutions. This rapid evolution means that engineers must refresh, even update, their knowledge base more frequently than ever before. At the same time, professionals have less and less time to attend traditional degree program offerings. In step with Northeastern's Academic Plan, the College of Engineering continues to enhance its graduate education portfolio with new degrees and experiential opportunities; an expanding portfolio of certificates for lifelong learning and degree pathways; as well as a myriad of offerings for anytime, from anywhere, with anyone learning.

**"Industry is requiring engineers to have multidisciplinary knowledge…we are preparing our students for today's job requirements, while enabling them to personalize their learning experience."**

— Tristan Johnson, assistant dean of Multidisciplinary Graduate Education and Digital Learning

## Certificate Pathways for Lifelong Learning

The College now offers 16 (and increasing) graduate certificates that give students the opportunity to develop a specialization in a specific area. To earn a certificate, students complete four courses, and the courses can also be applied toward a Master of Science degree in the College. Certificates are offered within the following four categories:

- Data and communications technology
- Energy
- Engineering management, business, and leadership
- Supply chain and process management engineering

"These four areas have been identified as important to organizations and attractive to existing and prospective students," says Sara Wadia-Fascetti, associate dean of Graduate Education. "Our flexible certificates address the needs of full-time students, who can add them to their degrees to personalize their learning experience, as well as part-time students who want to build their knowledge in a specific area like lean manufacturing, data mining, or renewable energy."

## Specialized and Personalized Interdisciplinary Programs

The College offers interdisciplinary engineering master's degrees in several areas, such as information systems and engineering management. Additionally, the College's ALIGN program enables students without an undergraduate engineering degree to earn a master's degree or graduate certificate in specific engineering programs.

"Industry is requiring engineers to have multidisciplinary knowledge, such as engineering business and management, or energy systems. Through our innovative degree offerings, we are preparing our students for today's job requirements, while also enabling them to personalize their learning experience," commented Tristan Johnson, assistant dean of Multidisciplinary Graduate Education and Digital Learning.

# Environmental Engineering: Setting the Pace

Environmental engineering is one of the fastest-growing and most innovative fields in the engineering profession—and Northeastern's College of Engineering, starting with its Department of Civil and Environmental Engineering (CEE), is responding with new faculty, course offerings, and degree programs.

"In 2010, we had 14 standing faculty in CEE, and today we have 28," notes Jerome Hajjar, CDM Smith Professor and department chair. "With increased awareness of issues like climate change, disaster resiliency, and water quality, we have more students seeking environmental engineering degrees—and more employers looking for qualified experts. Our department will continue to grow and evolve in response."

Starting in fall 2017, CEE will offer a **bachelor's in environmental engineering, building on its new master's degrees in environmental engineering and in engineering and public policy,** both of which were launched in fall 2016. In addition, civil engineering master's students can choose to concentrate their studies in five growth areas: construction management, environmental and water systems, geotechnical/geoenvironmental engineering, structural engineering, and transportation engineering.

"With so many pressing environmental issues, our department has a responsibility to educate and prepare a new generation of experts who will solve these challenges," Hajjar points out. "We will continue to monitor and modify our curriculum to keep up with changing needs."


## Expanding Our Reach

Johnson is excited about the expanded delivery of many master's courses at Northeastern. "Today, we have more graduate students who work full-time, as well as new students who are located remotely at our campuses in the Silicon Valley, Seattle, and Charlotte," Johnson notes. "It's imperative that we offer flexible ways for these students to engage in courses at the Boston campus without being there physically."

In response, the College of Engineering has developed more than 45 online courses. Students can stream lectures on demand, anytime and anywhere. In addition, there is an increasing focus on hybrid course offerings that are available, allowing students to blend online lectures and activities with periodic class meetings.

"Northeastern has been delivering its engineering curriculum remotely for years," Johnson emphasizes. "We will continue to expand our reach using leading-edge instructional methods to offer our graduate programs globally in the most effective way possible."

## 16 Graduate Certificate Programs

### Data and Communications Technology

- Broadband Wireless Systems
- Computer Systems Engineering
- Data Mining Engineering
- IP Telephony Systems

### Energy

- Energy Systems
- Energy Systems Management
- Renewable Energy
- Sustainable Energy Systems

### Engineering Management, Business, and Leadership

- Engineering Business
- Engineering Economic Decision Making
- Engineering Leadership
- Engineering Management
- Technology Systems Management

### Supply Chain and Process Management Engineering

- Lean Six Sigma
- Process Safety Engineering
- Supply Chain Engineering Management

# MOVING

## Beyond Traffic

What do population growth, climate change, and new technology like driverless cars have in common? They are transportation challenges that the U.S. transportation system—and current planning and funding mechanisms—will not be able to meet, according to a new U.S. Department of Transportation report, "Beyond Traffic 2045."

In response, USDOT designated Northeastern University a Beyond Traffic Innovation Center; one of 18 "forward thinking and influential institutions" to lead research aimed at solving some of the challenges over the next three decades. The Northeastern team will focus specifically on the Northeast, one of 11 megaregions throughout the country, consisting of 11 states and the District of Columbia. The Northeast megaregion's public transportation systems have a high demand in the nation, while the Atlantic seaboard spans 450 miles with a host of airports, ports, rail, and urban transportation systems.

Civil and Environmental Engineering Professor Sara Wadia-Fascetti is leading the Center's efforts with

## Gut Feeling

Recent research has linked conditions inside the intestine not only to obviously related problems like inflammatory bowel disease—but, more surprisingly, to Alzheimers, depression, heart disease, and other long-term health issues.

"We're learning that having the right mix of microbes and immune components in the gut can have huge implications for long-term physical and mental health," says Rebecca Carrier, a professor of chemical engineering (ChE) at Northeastern. "The challenge is that it's very difficult to assess conditions inside the intestine and understand their implications."

Carrier and Abigail Koppes, also a ChE professor, are sharing in a $5 million research grant from the National Institutes of Health to develop an in vitro model of the human gut that can be utilized for laboratory study. This project represents a collaboration between Northeastern University, MIT, and Boston Children's Hospital.

"Today, studies of the intestinal tract are done using animal subjects—but there are too many differences between these animals and humans," notes Koppes. "By creating a model that includes human tissue, immune cells, and microbes, we can get a more accurate view. These components have never before been brought together outside the human body."

YouTube Rebecca Carrier

Abigail Koppes

The implications of the team's work are far-reaching. "If food manufacturers and pharmaceutical companies can understand exactly what is happening in the gut, they can create new food and drug products that optimize that environment," Carrier explains. "Not only could these products increase people's general health and sense of well-being, but they could potentially prevent the onset of serious diseases and medical conditions. It's exciting to be part of this effort."

Professors Haris N. Koutsopoulos and Matthias Ruth. The Center will leverage the expertise of a host of faculty across disciplines in areas such as network science, public policy, resilience, and sensors and monitoring systems, as well as work closely with partners in industry, government, and academia. Additionally, the Center will build upon Northeastern's Versatile Onboard Traffic Embedded Roaming Sensors (VOTERS) center, led by Ming Wang, distinguished professor of CEE.

Through research and outreach, Northeastern's innovation center will harness Big Data to improve decision-making as it particularly relates to traffic, transit, and related infrastructure systems. The project specifically builds upon and combines Northeastern's research expertise in physical infrastructure and sensing, streamlined services using data analytics, and governance and policy.

"You can have the best systems, the best technology, the best algorithms, but unless you have incentives in governance, you're not going to see the changes that Beyond Traffic calls for," said Wadia-Fascetti. "It's really about bringing these three areas together, and using Big Data for better decision-making."

### BEYOND TRAFFIC INNOVATION CENTER LEADS

**Haris N. Koutsopoulos**, professor of civil and environmental engineering (CEE)

**Matthias Ruth**, professor of CEE and director and professor of the School of Public Policy and Urban Affairs

**Sara Wadia-Fascetti**, professor of CEE and associate dean of Graduate Education, College of Engineering

# **Applying** NEW ENERGY

Experts from across the country joined together to discuss the world's pressing energy problems at the 2nd annual Northeastern Energy Conference last fall. More than 250 students, faculty, and representatives from government and industry attended.

"The goal of the event was to look at the bigger perspective of things by integrating the pillars of technology, business, environment, and policy-making," explains Rishabh Sardana, E'17, president of the Northeastern Energy Systems Society, who organized the conference. NU-ESS is a graduate academic student group associated with the Master of Science in Energy Systems program.

Northeastern faculty across disciplines participated in panel discussions with a variety of representatives from industry and government. Topics included next-generation utility markets, energy industry entrepreneurship, integrating renewable energy into the grid, and increasing the energy efficiency of transportation. National Grid President Marcy L. Reed delivered a keynote address. "The goal for the interdisciplinary conference," Sardana says, "was not only for experts to share their knowledge with each other, but also to foster thought-provoking, dynamic discussions on energy problems and how to solve them."

According to Sardana, "Electricity or energy professionals constitute less than 1 percent of the world's population—and they alone can't save the environment," he notes. "Our job is also to engage the remaining 99 percent of the population in sustainability discussions and make them more aware. In the end, we all breathe the same air and will be equally affected by issues like climate change, pollution, transportation, and drought."

# A Presidential Honor

The Presidential Early Career Award for Scientists and Engineers, or PECASE, is the highest honor bestowed by the U.S. government on science and engineering professionals in the early stages of their independent research careers. This year, Kaushik Chowdhury, associate professor in the Department of Electrical and Computer Engineering, was one of only 102 scientists and researchers across the nation to be recognized with this award.

Chowdhury was nominated for the honor by the Department of Defense, whose Office for Naval Research is funding his research on the use of intelligent, autonomous radios in wireless communications with a $1 million Director of Research Early Career Grant over five years. The technology could significantly advance communications in military operations, natural disasters, and next-generation consumer networks.

“I was excited to receive this recognition and at the same time humbled to be counted among some very accomplished colleagues,” says Chowdhury. “Receiving the PECASE for my research serves as a reminder that the Department of Defense and the nation rely on wireless communications and networking in advancing our country’s technological edge and underscores the responsibility inherent in pursuing this work.”

# **BOOSTING** U.S. Manufacturing Competitiveness

***As a sector, manufacturing is a critical driver of innovation, productivity, and global competitiveness. As manufacturing experiences a new dynamic phase, collaborative robotics technologies can play an important role to transform factory floors and enhance productivity while lowering costs.***

Northeastern University researchers, led by robotics expert Taskin Padir, associate professor of electrical and computer engineering, have been selected to partner with a consortium of universities, nonprofit institutions, local governments, and industry to launch a new independent robotics institute as part of the U.S. Department of Defense’s Manufacturing USA, a national network for bringing innovation to manufacturing.

**“I am confident the team will develop innovative robotics systems with humanlike dexterity and adaptability, as well as safe and intuitive human-robot interaction capability for the next generation of U.S. manufacturing operations.”**

— Nadine Aubry, Dean, College of Engineering

Called the Advanced Robotics Manufacturing Institute, or ARM, the project will bring together manufacturing companies and researchers to expand the companies’ robotics capabilities, including the development of next-generation robots, educational opportunities, and workforce training. Northeastern is one of just 40 academic institutions selected to be founding members of the institute.

“Our goal is to expand the applicability of robots in manufacturing in companies of all sizes,” says Padir. “A primary question we want to answer is: How can we provide robotics and automation in a novel way so that these businesses can thrive?”

Nadine Aubry, dean of the College of Engineering, commented, “I am confident the team will develop innovative robotics systems with humanlike dexterity and adaptability, as well as safe and intuitive human-robot interaction capability for the next generation of U.S. manufacturing operations.”

ARM will be based in Pittsburgh and led by an independent nonprofit founded by Carnegie Mellon University called American Robotics. In addition to the academic partners, the consortium includes 123 industrial and 64 government entities. The funding, which comes from the various parties as well as the DOD, totals more than $250 million.

# GLOBAL IMPACT

**Brittany Foley**, Chemical Engineering

Brittany Foley recently completed a capstone project where her team, including Joe Laviano, Katy Wardzala, and Andrew Horowitz, created GroUp, which is an aquaponic system that consumes the $CO_2$ from fermentation processes at breweries via growth beds in a vertical aquaponics system.

*"Our team was wonderful in that we were all able to offer something different. Joe's co-op experiences made him comparable to an engineer with a good few years of experience in the field. Katy was our programmer and quickly became our controls expert. Andrew liked to be involved, in every sense of the word, so he was our people person and, most importantly of all, our prototype host."*

**Cassandra Johnson**

Chemical Engineering

*"As engineers, sometimes we can get caught up in all the math and science and forget the people that we're creating the products and technologies for. When I saw the advertisement for the engineering service trip to Belize, I was excited at the opportunity to experience another culture and to see how engineering might fit into an agricultural community."*

**Michael Tormey**

Civil Engineering

*"I am so grateful to Northeastern for the chance to see this amazing island nation, as it was, truly, a perfect experience. About the Northeastern students with me, about the relationship between these two nations, about what it's like to live in Cuba, about the Spanish language, about the pride of the Cuban people, I learned so much, and will cherish for a lifetime the week of memories in Havana."*

## Snapchat Takeover


Engineering students take over Northeastern's Snapchat (northeasternu) as they travel globally on experiential learning opportunities.

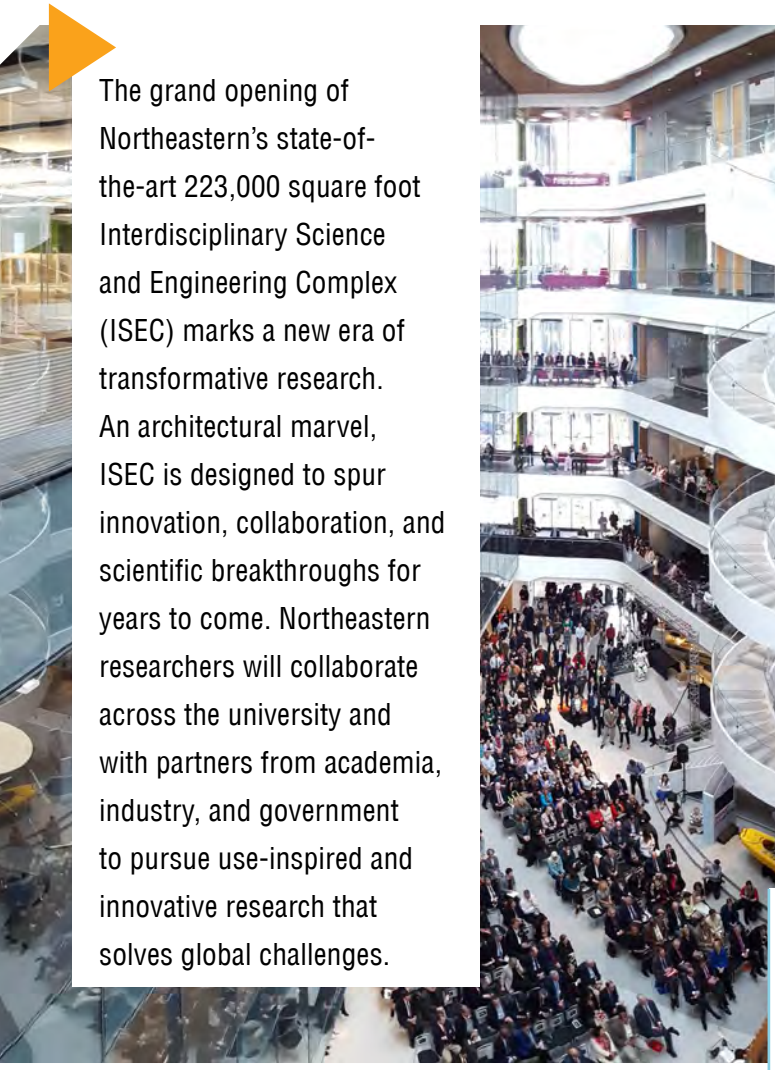
## Biomaterials Day

The second annual Boston Biomaterials Day, hosted by the Departments of Bioengineering and Chemical Engineering with the help of the College, and funded by the Society for Biomaterials, drew over 100 attendees.

empower

Explore the ISEC naming opportunity to associate your name and legacy with innovative research and education coe.neu.edu/empower-isec

The grand opening of Northeastern's state-of-the-art 223,000 square foot Interdisciplinary Science and Engineering Complex (ISEC) marks a new era of transformative research. An architectural marvel, ISEC is designed to spur innovation, collaboration, and scientific breakthroughs for years to come. Northeastern researchers will collaborate across the university and with partners from academia, industry, and government to pursue use-inspired and innovative research that solves global challenges.




# National Engineers Week 2017

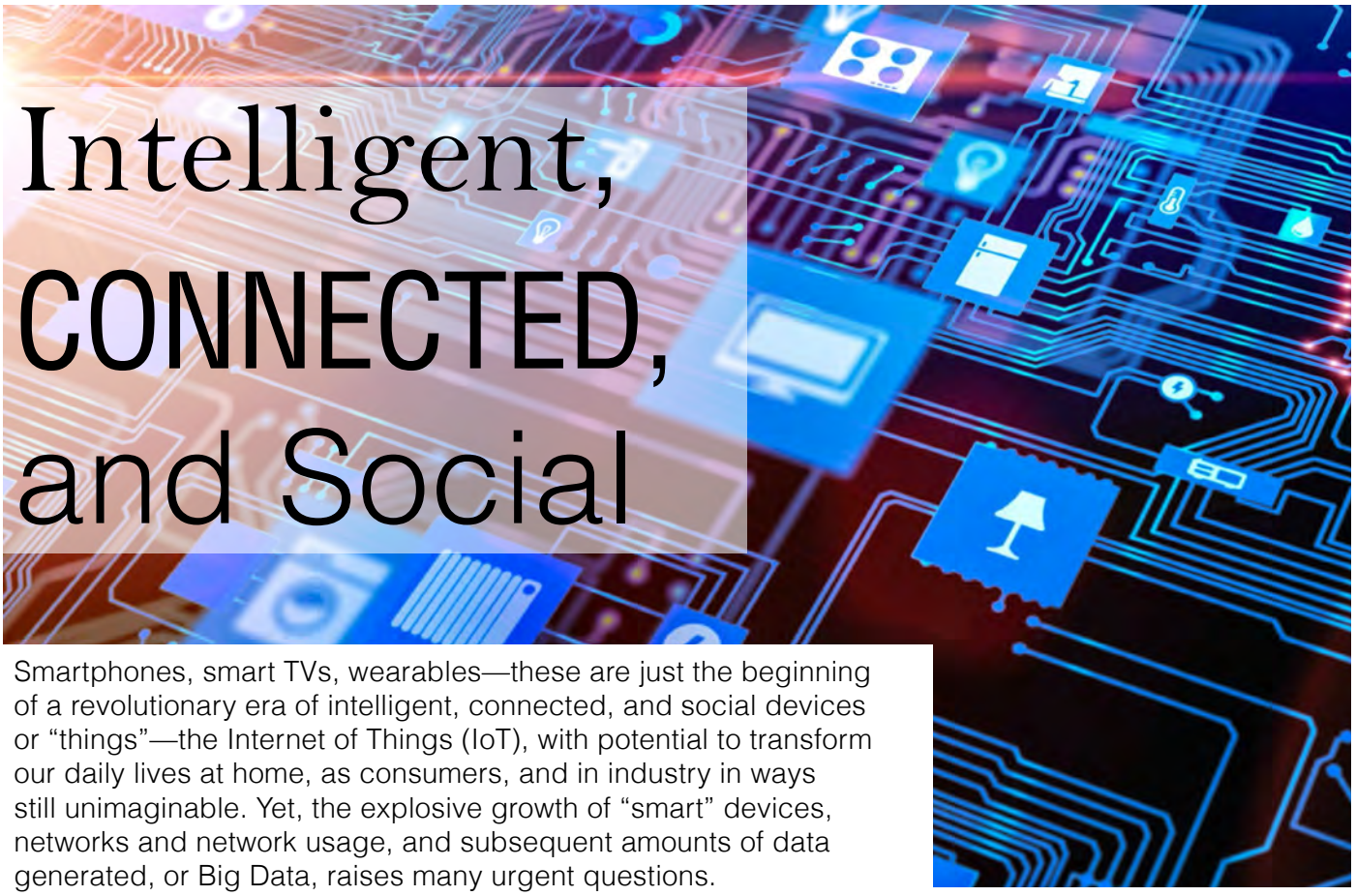
The College of Engineering celebrated the importance of the engineering profession by hosting a weeklong series of events, which brought together students, faculty, industry, academia, and the public.

Relive the event:
View recap video: bit.ly/2oYLVHN
Connect: **#NUeweek2017**

A wide array of informative and engaging events:

- Women in Engineering Day
- Robotics Open House
- Five Distinguished Lectures from Visiting Scholars
- Chemical Engineering Games
- Interactive Engineering Open House
- STEM Engineering Expo

# Intelligent, CONNECTED, and Social



Smartphones, smart TVs, wearables—these are just the beginning of a revolutionary era of intelligent, connected, and social devices or "things"—the Internet of Things (IoT), with potential to transform our daily lives at home, as consumers, and in industry in ways still unimaginable. Yet, the explosive growth of "smart" devices, networks and network usage, and subsequent amounts of data generated, or Big Data, raises many urgent questions.

How can we ensure the security of not only our personal information, but also critical government and defense data, and also use collected data for meaningful insights and decisions? How can energy efficiency be maximized to maintain the stability of the worldwide grid? And, how can IoT technology—from sensors to bandwidth—be optimized, used, and protected for new and emerging applications to benefit society?

A team of researchers in the College of Engineering are at the forefront of answering these questions, as they pave the way for IoT by making intelligent devices and the networks that connect them safer, smarter, faster, and more energy-efficient.

## Building the Backbone for Speed and Reliability

We all know the frustration of a dropped Wi-Fi connection, but network instability can have serious security implications. Inconsistent connections or intentional jamming can affect the ability of the military or emergency responders to detect and manage threats in real time, while bandwidth limitations can stall the growth and adoption of IoT applications.

Wireless networking expert Tommaso Melodia, an associate professor in Northeastern's Department of Electrical and Computer Engineering (ECE) and research director of the National Science Foundation's (NSF) Platforms for Advanced Wireless Research (PAWR) Project Office (see article on page 12), is developing alternatives to currently used 4G LTE and Wi-Fi networks, as they are proving insufficient to support network and communications stability as IoT expands.

Melodia's research focuses on solving the challenges that stand in the way of enabling future-generation wireless networks, including millimeter wave technology, which may be able to significantly speed up data transmission rates. "Millimeter wave technology uses frequencies much higher than those used in current wireless networks—28 gigahertz and above, compared to the frequencies below 6 gigahertz used in today's cellular networks," says Melodia.

He is also developing smarter wireless networks that respond fluidly to changing conditions. "The problem with current network design schemes is that they require manual intervention to maintain secure connectivity at all times," notes Melodia. "This obviously creates

# Airport Security: A Moving TARGET

All of us have experienced the frustrations and delays associated with airport security screenings. Two engineering professors, Carey Rappaport (ECE) and Jose Martinez-Lorenzo (MIE and ECE), are working to improve both the accuracy and speed of this process. Their work is supported by the Awareness and Localization of Explosives-Related Threats (ALERT) program, a multi-university, interdisciplinary Department of Homeland Security Center of Excellence led by ECE Professor Michael Silevitch at Northeastern's College of Engineering.

With terrorists continually developing new weapons and materials, ensuring passenger safety has become more complex than ever. "It's easy to see a knife or a gun with today's imaging equipment, but some threats are harder to detect—and that's where the current generation of scanners falls short," Rappaport explains. "For example, plastic explosives can be shaped to resemble a money belt or another common object."

"While current scanning technologies are very good at finding anomalies on the human body, they can't effectively distinguish a harmless object like a candy wrapper from a potential weapon. They also produce blurry images when a traveler moves slightly during the scanning process," notes Rappaport. These limitations mean that a large percentage of travelers are being manually patted down following an electronic body scan, resulting in additional time, costs, and inconvenience.

According to Rappaport and Martinez-Lorenzo, today's sensors are based on older technologies, and it's time for an update. "Re-examining underlying electromagnetic sensing technologies can lead to quantum changes in how we can sense and visualize human bodies and other objects," says Martinez-Lorenzo. "Just think of the difference between watching a movie on a VHS tape versus a Blu-Ray disk."

To revolutionize security screening, these Northeastern researchers are developing new sensor technologies that allow open-air screening at airports—with possible applications at shopping malls, sports events, concerts, and other venues. Instead of stopping at a checkpoint monitored by humans, people could be passively monitored as they pass through an architectural element such as archway.

This large-scale, passive screening breakthrough is enabled by new meta-materials and complex structures which enable new coding schemes, and active multiple-input, multiple-output (MIMO) transceiver arrays that capture and process a much larger amount of information. "By coding the transmitting and receiving patterns of the electromagnetic sensors, suddenly a huge new volume of information can be extracted from the imaging region in a reduced amount of time. These are high sensing capacity systems," explains Martinez-Lorenzo.

"If we can develop the technology to quickly produce accurate, high-resolution images of people while they are in motion—perhaps on a moving walkway—we can make the scanning process both faster and less obtrusive," Rappaport says. "At the same time, we would be increasing the accuracy and reliability of the screening process. Our research has the potential to not only increase the ease of security screening, but to potentially save lives through significantly improved threat detection."

vulnerabilities when conditions change and the network fails to respond."

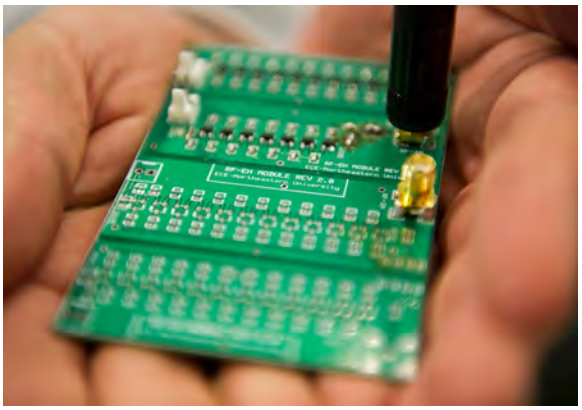
Melodia is developing new wireless networking technologies that would allow managers to "pre-set" certain behaviors—then the network would respond flexibly and autonomously in order to maintain these operating parameters.

Kaushik Chowdhury is also an ECE associate professor focusing on wireless communications and playing a leading role in the PAWR Project Office. In addition, he is leveraging a $1 million grant from the Department of Defense (DoD) Office of Naval Research to develop protections against signal jamming and other network threats. In recognition of his work, the DoD successfully nominated Chowdhury for the prestigious Presidential Early Career Award for Scientists and Engineers, or PECASE (see page 6.)

"Every device in the Internet of Things—from smartphones to satellites—communicates via radio transmitters

Carey Rappaport

Jose Martinez-Lorenzo



This circuit, developed by Northeastern engineering researchers, harvests the energy contained in ambient radio frequency waves, which will result in self-powered sensors for IoT.

and receivers," Chowdhury states. "The goal of my research is to make these radios more intelligent, so that they can detect and respond to changes such as interference and congestion."

"With the proliferation of electronic signals, the information highway is becoming very crowded," he adds. "There is available bandwidth out there—we just need to program these radios with multiple degrees of freedom, so they can responsively jump to a new channel in order to maintain connectivity 24/7."

Not only would Chowdhury's work help intelligent, connected devices work more reliably—but his research would also help networks and devices resist outside attacks such as intentional signal jamming. His technology advances could significantly improve network integrity and communications availability for military operations, disaster relief, emergency response, and next-generation consumer networks.

## Outsmarting Side-Channel Hackers

Across the globe, billions of IoT devices are collecting, sharing, and storing data. Maintaining the security of this data, and mining it for key insights, are important challenges currently being investigated by researchers in the College of Engineering.

Yunsi Fei, an associate professor of ECE, centers her research on creating data protection strategies for graphics processing units (GPUs), which leverage encryption to accelerate the management of huge amounts of information—but are currently vulnerable to hackers.

Fei and David Kaeli, COE distinguished professor of ECE, were recently awarded a $450,000 grant from the NSF and the Semiconductor Research Corporation (SRC) to investigate flaws in GPUs that allow them to be attacked through side channels.

"A side channel attack is very hard to detect because it is passive, where the adversary collects side-channel information inadvertently leaked by activities on a GPU—such as electromagnetic emanation signals and the execution timing—and then exploits that information to obtain the GPU's encryption key," explains Fei. "Once someone has that key, they can decode all the information being processed by the GPU, including credit card, banking, or government data."

Fei and Kaeli are inventing various ingenious methods hackers may use to attack GPUs, which is much more challenging than attacking other computing platforms due to the massive parallelism of GPUs. They will then make encryption codes stronger and harder to crack. Since GPUs lie at the heart of most electronic devices, including smartphones and computers, their first-of-its-kind work could have an enormous impact on data security.

## Bridging the Gap: Big Data and Privacy

Data security is also the focus of ECE Interim Department Chair and Professor Miriam Leeser's research. Her goal is to enable the enormous wealth of information created by IoT to be shared and "mined" in a secure manner.

**"With the explosion of information, there's an urgent need for new computational methods that leverage machine learning and new algorithms to make data mining faster and more efficient."**

— Miriam Leeser, interim chair of electrical and computer engineering

"Today there is so much information out there—financial data, medical records, demographic information," says Leeser. "This information has huge strategic value. For instance, we might be able to understand how diseases work if we can match specific lifestyle characteristics or regions of the world to the onset of illness. But we need to make sure we are protecting people's privacy while we are studying this kind of sensitive data."

Leeser is developing new algorithms that reveal the connections between certain data points, without a third party having to see the actual data—which can remain encrypted for security. As one example, information from millions of FitBits, a wearable health tracking device, could be collected and matched against general health trends in a geographic area—without any individuals' names being revealed. This could demonstrate a general correlation between specific heart rates, fitness levels, and locations with specific medical conditions.

According to Leeser, computational methods exist to make these correlations, but the processing times are far too long to be practical. "Our data mining and modeling methods have not kept pace with the growth of the Internet of Things," Leeser says. "With the explosion of information, there's an urgent need for new computational methods that leverage machine learning and new algorithms to make data mining faster and more efficient."


# LIVING '**SMART**' IN THE CITY

Imagine students in a rural community remotely operating an ultra-high definition microscope housed in a university lab thousands of miles away. While viewing micro-organisms under the lens, they simultaneously hold a high-definition video conference with the faculty researchers at the remote university via a low-latency, ultra-high-speed connection. With groundbreaking research in next-generation advanced wireless technology, capability such as this used for a broad range of applications has the potential to be commonplace in the not so distant future.

A Northeastern research team, led by Tommaso Melodia, associate professor of electrical and computer engineering, has been selected to direct a National Science Foundation initiative: Platforms for Advanced Wireless Research. The NSF will fund the PAWR Project Office, or PPO, responsible for $100 million in investments and a $6.1 million NSF-funded award. PAWR will foster fundamental research and development of multiple community-scale platforms supporting next-generation wireless communications networks across the U.S.

Together with U.S. Ignite, Inc., a nonprofit organization, Melodia will oversee the vetting, selection, management, and construction of projects aimed at developing city-scale wireless platforms and proposed by research teams drawn from the U.S. academic and industrial wireless research community. Over the next seven years, the PPO will disburse to winning teams nearly $100 million in investments from the NSF and more than 25 companies and industry associations.

In addition, Northeastern researchers, Kaushik Chowdhury and Stefano Basagni, both associate professors in the Department of Electrical and Computer Engineering, in leading roles, will be responsible for building reference architecture for the platforms. Melodia explains, "We want to be sure the platforms cover a broad range of wireless technologies, that each one is unique, that they are designed to enable groundbreaking research, and that they can operate in conjunction with one another."

***Associate Professor Tommaso Melodia is directing the groundbreaking PAWR Project Office, responsible for $100 million in investments and a $6.1 million NSF-funded award to advance wireless communications.***

"We are very excited that our experts in wireless communications and networking, headed by Associate Professor Tommaso Melodia, have been chosen to lead the PAWR PPO together with U.S. Ignite, Inc.," says Nadine Aubry, dean of the College of Engineering at Northeastern. "By bringing together leaders in the field from academia, industry, government and communities, PAWR will significantly advance society by creating the platforms necessary to build the next-generation wireless infrastructure, which will spur the Internet of Things revolution and enable the smart cities of the future."

## Smarter, More Efficient Sensors

As IoT continues to grow exponentially, so does the overall demand for power—which creates pressure on the global energy grid. In response, Matteo Rinaldi, an ECE assistant professor, is leveraging two grants totaling $2.6 million from the U.S. Defense Advanced Research Projects Agency (DARPA) to develop a new generation of sensors and radio frequency wireless communication devices that operate on nearly zero power.

"Most security and surveillance systems are designed to provide continuous monitoring of the environment around them," Rinaldi points out. "This constant state of awareness consumes a lot of power—and it wastes a lot of energy because events of concern tend to be infrequent."

Rinaldi's goal is to develop sensors that are on "stand by"—consuming zero power—until they are activated by a suspicious event. Then these intelligent sensors, which are actually tiny micro electromechanical systems (MEMS), would begin surveillance operations to collect information and report threats as needed.

"The new smart sensor I'm developing is activated by the energy contained in an infrared signal, produced by some sort of environmental change—for example, the presence of a fuel-burning vehicle," explains Rinaldi. "The infrared signal contains very specific wavelengths that the MEMS-based sensor can recognize and differentiate the event of interest from other interferences. Once the infrared signal is recognized, its energy is used to turn on a relay switch and wake up the wireless sensor node."

Tommaso Melodia, associate professor of electrical and computer engineering

"Suddenly surveillance systems can go from being 'on' 24 hours a day to being activated for a few moments at a time, only when a potential threat is actually present," he continues. "The implications for battery life and overall energy demand are significant, because there are billions of sensors deployed around the world today."

Rinaldi is leveraging his DARPA funding to develop DoD applications for his MEMS-based sensors, but eventually his technology could be used to detect the presence of cars, planes, chemical threats, forest fires, volcanic activity, and other environmental changes relevant to consumer applications.

ECE Distinguished Professor Carey Rappaport and Associate Professor Jose Martinez-Lorenzo, jointly appointed in MIE and ECE, are also working to make systems of sensors smarter, but in a different way. They are re-examining underlying electromagnetic sensing technologies to improve the ability for the sensors to detect and visualize objects (see page 10). By doing so, systems of sensors will be able to not only collect information such as during an airport security screening, but also be able to collect the required data needed to create an image in a reduced amount of time—that is, systems with high sensing capacity.

In addition, with funding from the Massachusetts Technology Transfer Center, Martinez-Lorenzo is working to improve the sensors behind breast-cancer screenings. "X-rays and microwaves are very good at distinguishing between tumors and fatty breast tissue, and ultrasound is excellent at producing clear images of tumors in fibrous, dense tissue," he explains. "Since breasts are composed of both types of tissue, it makes sense to develop a new, hybrid sensing method that combines the strengths of these three technologies." Parts of his new system are being piloted at Massachusetts General Hospital.

## Northeastern: A Leader in IoT Research

Managing the complex challenges associated with the growth of IoT is not easy, because it involves bringing together many engineering disciplines. The College of Engineering has emerged as a global leader in IoT-related research in part because its faculty is diverse and multidisciplinary.

"Northeastern has leading expertise in every single field related to the Internet of Things," notes Matteo Rinaldi. "There are experts in micromechanical systems, wireless networks, Big Data, imaging, signal processing—and, of course, security. This combination of expertise is quite unique, and that creates the critical mass needed to solve complex problems."

Tommaso Melodia emphasizes the opportunities he's been given to lead cutting-edge projects since he arrived at Northeastern in 2014. "I was initially attracted to the university because of its growing interests and capabilities in IoT-related research," he recalls.

"What I didn't realize was how empowered I would be. As an associate professor, I've been given the opportunity to lead big, ambitious research initiatives that have the potential to change people's lives," Melodia continues. "That simply doesn't happen at other institutions—and it's evidence of Northeastern's commitment to tackling huge, complex interdisciplinary engineering challenges. Northeastern is extremely committed and supportive, which enables its faculty to obtain funding, win awards, and make rapid progress in solving today's pressing IoT challenges."

Taskin Padir, associate professor of electrical and computer engineering

# LEADING THE ROBOTICS REVOLUTION

**From space and undersea exploration to bedside medical care, there's no doubt that the field of robotics is breaking new ground. With world-renowned expertise and a portfolio of high-profile projects, Northeastern's College of Engineering is on the cutting-edge of robotics research focused on solving real-world challenges for the benefit of society.**

Taskin Padir joined the faculty at Northeastern in 2015 for a simple reason. "I saw that the College of Engineering was making investments in robotics that were positioning Northeastern as a global leader," says Padir, who was already a recognized expert in the field. "I wanted to be a part of an energetic community of robotics researchers, at an institution that would enthusiastically support my research goals. Northeastern was the perfect fit."

Two years later, this associate professor of electrical and computer engineering (ECE) has made his mark, winning a number of prestigious grants and founding the Robotics and Intelligent Vehicles Research Laboratory (RIVeR Lab), where engineering students work on advanced development projects (see page 17).

One of Padir's most visible successes has been bringing NASA's Valkyrie humanoid robot to the Northeastern campus. Destined for Mars, Valkyrie needs to be able to complete such tasks as exiting an airlock, walking, and picking up rock samples—which means bringing together interdisciplinary expertise including control, perception, locomotion, manipulation, and software engineering.

"NASA awarded two robots to university teams, and the other robot went to the Massachusetts Institute of Technology," notes Padir. "I think that speaks volumes about Northeastern's growing reputation for leading-edge, interdisciplinary robotics research."

## Advancing Humanity

Whatever the project, Padir stresses that the real purpose of all robotics innovations must be to advance humanity. "We can't just design capabilities such as climbing a ladder because it's an interesting engineering problem to solve. There always has to be a real-world application," he points out. "As scientists, all our work has to assist humans and ultimately benefit society."

In keeping with this goal, Padir and other researchers at Northeastern are partnering with a consortium of universities, nonprofit institutions, local governments, and industry to support the Department of Defense's Manufacturing USA initiative, aimed at bringing robotics innovations to the world of manufacturing to make operations both safer and more efficient (see page 6).

But perhaps closest to Padir's heart is his research on developing assistive healthcare robots. Following the tragic, widespread outbreak of Ebola in 2014, he is leveraging funding from the National Science Foundation (NSF) to help develop robotics technologies that will improve the quality of care provided to patients who are highly infectious, while protecting human medical personnel from exposure.

"Scientists have developed protective gear and medical tents that can protect healthcare workers—but this gear is hard to put on, and only allows 45 minutes of bedside care each day for patients who are extremely ill," explains Padir. "We need to do better, and robotics can help."

By developing and deploying medical robots to the bedsides of highly contagious patients, doctors can administer an appropriate level of care and also collect volumes of patient data, safely and continuously. Padir has spoken at the White House on the need to develop these capabilities quickly, in order to be prepared for another epidemic.

**"Eventually, our hydraulics-based technology could even be used for delicate tasks like surgery, where it could significantly reduce the potential of human error."**

— Peter Whitney, assistant professor of mechanical and industrial engineering

"The best part of my job is creating real benefits for society," says Padir. "Whether we're engineering autonomous healthcare robots, robotics-based manufacturing systems, or humanoid robots that will enter dangerous habitats like space, at the end of the day my team aims to make a real difference in people's lives. That's what motivates me to come to work every day."

Padir's commitment to improving the quality of life for humans is shared across his fellow researchers in the College of Engineering—who are developing robotics technologies that will benefit industry, the healthcare field, and eventually all consumers.

## Venturing where Humans Cannot

Professor Hanumant Singh, jointly appointed in ECE and mechanical and industrial engineering (MIE), joined the Northeastern faculty in 2016 after spending 26 years at the prestigious Woods Hole Oceanographic Institution. He believes robotics can make a meaningful impact by gathering data and interpreting it to answer critical scientific questions related to a sustainable society.

These efforts include understanding the role and effects of global warming on sea ice in the Arctic and Antarctic, as well as on glaciers in Greenland; assessing fish populations for fisheries management; studying underwater habitats; and the role of autonomous aerial drones in mapping remote areas.

"Much of the evidence about climate change lies in our oceans—including rising sea levels, changes in marine life, and the thickness of polar ice floes and glaciers," Singh notes. "However, it's dangerous and expensive to send humans into the ocean to investigate these questions. That's where robots come in. Divers can't go below 100 meters, but the capabilities of robots are unlimited."

Singh has developed marine robots that observe and count fish populations, as well as a self-driving kayak that travels far closer to glaciers than human beings could safely venture. His forward-


JetYak is an unmanned autonomous kayak used to study glaciers from a proximity unachievable by humans.

looking research targets the development of robots that can swim under Arctic and Antarctic ice floes to measure changes in their thickness, as well as designing autonomous drones that can fly over these regions to count and assess the health of penguin populations.

In addition to being gratified that his work is benefitting society, Singh enjoys the opportunity to work with students in the College of Engineering and expose them to the growing field of green robotics. "I can't imagine anything more rewarding than solving some of today's most pressing problems, such as assessing the environment or developing technologies that create environmental benefits," Singh says.

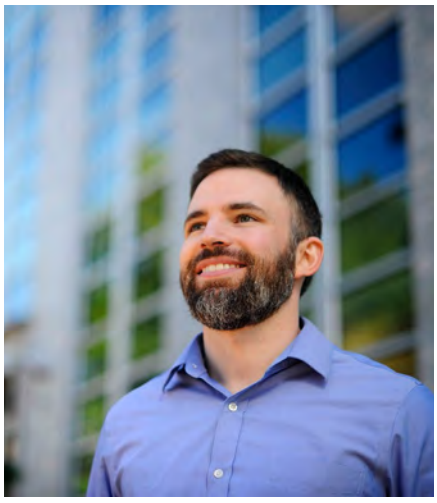
This professor clearly enjoys giving his students hands-on opportunities, as evidenced by his "Robotics Sensing and Navigation" course, where every student has the chance to use a self-driving car on the Northeastern campus (see page 19). Says Singh, "One of the things that brought me to Northeastern was not only the opportunity to join a leading robotics think tank, but also to support the next generation of robotics engineers."

## Innovating Foldable Robots

When most of us hear the word robot, we probably picture a humanoid machine like Valkyrie or C3PO from "Star Wars." But Sam Felton, an assistant professor in MIE, who joined the College of Engineering in 2016, is turning that vision on its head with his novel foldable robots. He calls his creations "origami robots," because his assembly technique is based on the Japanese art of paper folding.

"As engineers, we now have access to many great new materials that combine strength with flexibility," Felton explains. "That's changing the way we can design and build robotic systems, as well as making them much faster and less expensive to construct."

Felton is focused on designing folded robots that assemble themselves and then perform pre-programmed tasks. These robots could eventually assemble themselves inside the human body to biopsy cells and carry out other critical healthcare assignments.



Sam Felton, assistant professor of mechanical and industrial engineering

In addition to materials improvements, Felton has benefitted from advanced software tools that quickly and automatically generate folding patterns. "If you've ever tried to fold a paper crane, then you know that origami is not intuitive," he notes. "But new computer tools enable engineers to specify any shape, then quickly generate a pattern for constructing a self-folding robot in that exact shape."

Felton is currently designing his flexible origami bots at the centimeter scale and smaller, but he envisions constructing robots large enough to serve as a human habitat or to lead space expeditions. "It's difficult to move materials to remote areas like space, or regions that have been affected by a natural disaster," Felton points out. "By moving a folded robot, then having it assemble itself, we could save a lot in costs, time, and manpower."

## Creating Human-Robot Collaboration

Also joining the College of Engineering in 2016, John "Peter" Whitney, an assistant professor in MIE, focuses his research on robotics technologies that create opportunities for collaboration between humans and machines. While many robots are designed to work autonomously in extreme environments, a growing trend in robotics is the development of robots that can perform complex tasks, safely, in the presence of humans.

**"Northeastern is already a robotics leader, but we're on an upward trajectory… Northeastern has become the go-to place for the diversity of expertise and the interdisciplinary engineering environment needed to solve complex robotics problems."**

— Taskin Padir, associate professor of electrical and computer engineering

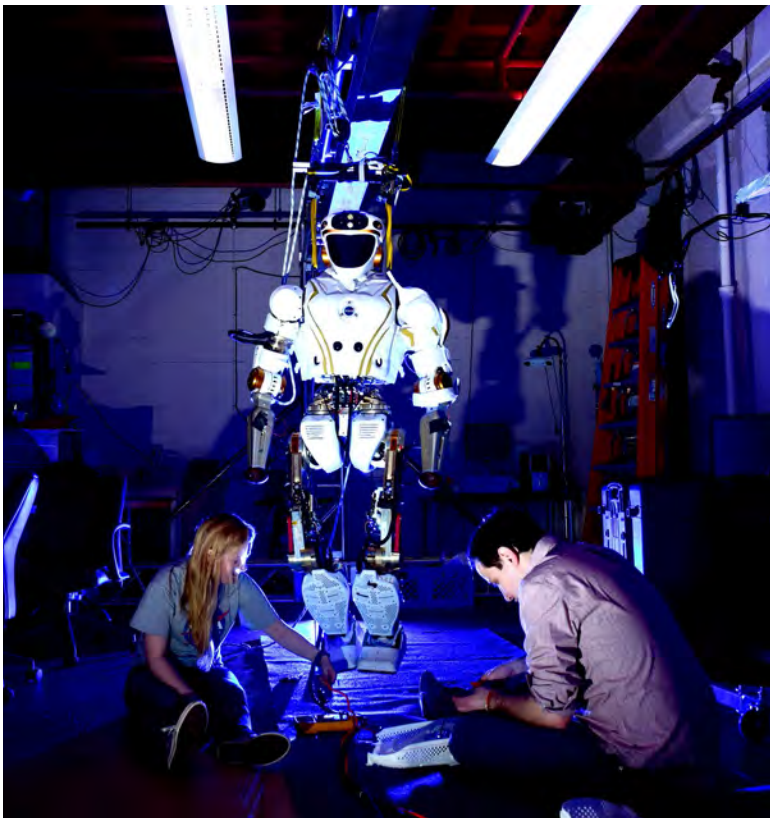
"By partnering people with robots, we can leverage the innate intelligence and responsiveness of humans to ensure that robotics technologies are working at peak efficiency," states Whitney. "The problem is that current robots have difficulty sensing the physical environment around them. By moving too fast or applying too much pressure, it's relatively easy for them to injure people who are working nearby."

Whitney is addressing this challenge by applying hydraulic science to make "gentler" robots that are imbued with touch sensitivity. He has already developed a prototype humanoid robot that combines speed with a very precise touch. This remarkably lifelike robot can pick up an egg or catch a balloon without breaking it.

While the robot is controlled by a human operator today, Whitney is partnering with Northeastern's Robert Platt, an assistant professor in the College of Computer and Information Science, on developing the artificial intelligence required for the robot to perform autonomous tasks.

According to Whitney, the target for his technology is any application that requires a robot to be precise and fast in one moment, and compliant and gentle in the next. "If we can program a robot to precisely grasp and manipulate objects with the right degree of pressure, the applications are wide-ranging—from working in a factory to helping patients with mobility issues complete common tasks like eating and shaving," notes Whitney.

"Eventually, our hydraulics-based technology could even be used for delicate tasks like surgery, where it could significantly reduce the potential of human error," he adds.



Engineering PhD candidates, Murphy Wonsick and Velin Dimitrov, work on Valkyrie, NASA's humanoid robot prototype.

# RIVeR: Overflowing with Innovation

From freshmen to PhD students, the Robotics and Intelligent Vehicles Research Laboratory, or RIVeR Lab, provides a unique opportunity for students at all levels to work on the world's leading robotics projects. RIVeR brings government and industry funding, and enthusiastic students together to advance the capabilities of autonomous robots and intelligent vehicles to solve real-world problems.

RIVeR's most visible project is developing functionality for Valkyrie—a 6'2", 285-pound humanoid robot developed by NASA to prepare Mars for human habitation. In 2015, Northeastern was one of only two university teams nationwide awarded this robot and tasked with developing capabilities such as walking and picking up objects.

Murphy Wonsick, a doctoral student in electrical and computer engineering (ECE), is thrilled to lead this

Anas Allaban, E'21, and Lindsay Wright, ME'17, work on the Toyota HSR robot.

high-visibility, cutting-edge project. "We're working on advanced robotics challenges, answering critical questions such as, 'How can we make Valkyrie behave in a manner intuitive to humans—so it can work effectively alongside people?'" she says. "That involves more than just mechanics, it also requires expertise in psychology, algorithms, vision, and other areas."

"The idea of human-robot collaboration on shared tasks—like building a habitat—is a relatively new field, and I feel that we are breaking new ground," Wonsick adds.

"Northeastern's growing reputation in robotics has allowed us to attract large amounts of funding and prestigious projects," says Taskin Padir, ECE associate professor, and founder and director of RIVeR. "By accomplishing the everyday work associated with these grants, our students are gaining real-world experience that's preparing them to be robotics leaders." He notes that former RIVeR student researchers are now employed by Amazon Robotics, Apple, Google, iRobot, and Toyota.

ECE master's student Tarik Kelestemur came to Northeastern from Turkey specifically to tackle real-world robotics challenges at RIVeR. He is currently working on a mobile in-home robot developed by Toyota called Human Support Robot (HSR) that will compete in the RoboCup@Home competition. In this collegiate competition, student teams develop control, navigation, perception, and manipulation systems that enable the robot to help humans with daily activities.

"The HSR needs to navigate in cluttered home environments, interact with humans using speech recognition, and help them with domestic activities," explains Kelestemur. "This is challenging because it brings together so many disciplines, including computer vision, control, and machine learning."

Even the youngest Northeastern students have the opportunity to engage in hands-on research at RIVeR. James Tukpah, E'20, began working at RIVeR when he was a freshman. He says, "My work has involved supporting the foot step planner that enables Valkyrie to walk forward. I don't know of another engineering school where a freshman would be working on a NASA robot and making meaningful contributions. I'm extremely grateful for this opportunity."

## Pioneering the Future

With all the diverse robotics research happening today in the College of Engineering, Padir reports that the energy is almost palpable.

"Northeastern is already a robotics leader, but we're on an upward trajectory," he emphasizes. "We've already won some prestigious projects and made amazing progress, but we're ready to take on even tougher challenges. Northeastern has become the go-to place for the diversity of expertise and the interdisciplinary engineering environment needed to solve complex robotics problems."

Singh, who has co-founded two successful companies based on his underwater robots and autonomous surface vehicles, believes Northeastern provides the right climate for quickly bringing a robotics innovation from the drawing board to real-world application. "With all the support the College of Engineering provides us, we can actually make that quantum leap from the university lab to the consumer marketplace," he says.

Speaking on his research experience, Felton adds, "If it were possible right now, in the short term, someone would already be doing it. It is exciting that my position in the College of Engineering enables me to be a pioneer."

**"With all the support the College of Engineering provides us, we can actually make that quantum leap from the university lab to the consumer marketplace."**

— Hanumant Singh, professor of electrical and computer engineering, interdisciplinary with mechanical and industrial engineering

# DRIVING FORCE


Professor Hanumant Singh believes in putting his students in the driver's seat—literally. With a joint appointment in electrical and computer engineering (ECE) and mechanical and industrial engineering (MIE), Singh teaches a graduate class called "Robotics: Navigation and Sensing." Students enrolled in this course have the unique opportunity to work on robotics systems for an autonomous car owned by Northeastern.

"The car, a Lincoln MKZ, is an electric hybrid vehicle that has been customized with inputs for standard robotic software," explains Singh. "With this car as a starting point, the grad students in my class are working on solving some key autonomous driving challenges to make the experience safer and more reliable."

Master's student, Nicholas Stangas, ME'17, is part of a team that's investigating technologies to help self-driving cars detect and stay in their own lanes. Stangas and his fellow students have mounted a camera on the Lincoln MKZ to develop computer-vision capabilities that can differentiate among lanes on the highway.

"I took this class because I was looking for a true hands-on learning experience—and I haven't been disappointed," Stangas says. "It's pretty thrilling to go down to the Gainsborough Garage and see this cutting-edge vehicle parked next to the university's maintenance vehicles and snowplows. I don't know many schools where students would be able to install equipment on a semi-autonomous vehicle and conduct real-time highway testing."

Another master's student, Pritpal Bains, ME'17, registered for the class as an elective because he believes exposure to robotics is essential for today's engineers, whatever their focus. "Robotics is bringing about a change similar to the Industrial Revolution," he notes. "It's important for every engineer to have knowledge of, and an appreciation for, robotics systems."

Bains and his fellow team members are developing dynamic computer vision algorithms to help autonomous cars navigate more effectively in rain, snow, and fog—which confuse most computer vision systems. Mounting high speed CMOS (complementary metal-oxide semiconductor) cameras on the vehicle, the team is exploring whether light-generated measurements can work as a navigational aid in extreme weather and traffic conditions. The team plans to improve the algorithms by incorporating LIDAR (light detection and ranging) technology to enhance the capability of Northeastern's autonomous car.

"I've learned so much by taking the car out on the highway, gathering data, and working on improvements," Bains says. "Professor Singh has stressed throughout the course that we need to be fully engaged, working on real-world challenges with our hands. I can't imagine a better way to appreciate the complexities and potential of robotics than taking this course."

Students develop computer vision capabilities that can differentiate among lanes on the highway.

Students explore whether light-generated measurements can work as a navigational aid in extreme weather and traffic conditions.

Courtney Johnson, E'17

# ENGINEERING GREATER DIVERSITY

*A multicultural community, the College of Engineering takes great pride in fostering diversity and inclusion, and making historically underrepresented students feel at home in and outside of its classrooms and labs.*

When Courtney Johnson, E'17, decided in eighth grade that he wanted to be a chemical engineer, his mother and other family members were concerned. "I come from a family of nurses, so they always imagined me being a doctor because I was good at math and science," recalls Johnson. "That's the career path they were familiar with. They weren't sure what an engineer did, and whether it was a good job that would pay well." Johnson relied on his math teacher to talk to his family, explain what the job of an engineer involved, and convince them that it was a wise career choice.

According to Richard Harris, assistant dean and director of the Northeastern University Program in Multicultural Engineering (NUPRIME), Johnson's story is typical among many first-generation engineering students. But it's especially true for students from historically underrepresented groups, including African-Americans, women, and Hispanics looking to enter science, technology, engineering, and math (STEM) programs.

"In the past, these underrepresented students and their parents might not have been made aware of career options in STEM-related fields like engineering," Harris explains. "Those students who have chosen to pursue degrees in STEM subjects have traditionally found themselves a very small minority, and have often been challenged to find other students who look like them and share their experiences."

## Northeastern: A Pioneer in Multiculturalism

Forty years ago, Northeastern's College of Engineering recognized this issue and created Harris' position to help minority students acclimate to the College and leverage the many resources available to support them.

"Northeastern was way ahead of the curve by recognizing that, if you really want to encourage diversity, you need to provide formal and informal mentoring, networking opportunities, organizations, and clubs that make underrepresented students feel they're part of a larger community," Harris says. Today, the College of Engineering continues to further its commitment through innovative programs like the recently-funded NSF $5 million S-POWER, which helps underrepresented students transfer from colleges that lack their own STEM/engineering degree-granting focus (see page 22).

For students like Courtney Johnson, the College of Engineering's investment in creating a diverse community has paid off. With a prestigious Gates Millennial Scholarship, and the highest GPA in his high school's history,

Johnson could have attended any university—and he chose Northeastern. He's never regretted this choice, even though Boston is worlds away from his native Miami.

"Honestly, I've always felt at home at Northeastern," says Johnson. "I've been blessed to meet wonderful friends not only in my day-to-day classes, but also in the Black Engineering Student Society, Northeastern's chapter of the National Society of Black Engineers."

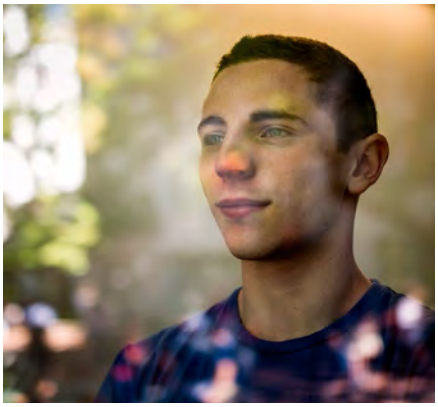
"Through this group," he continues, "I made friends when I was a freshman who are still my closest friends today. We've gone from overwhelmed first-year students, surviving the rigors of homework and finals, to now working on the same teams to finish our Capstone projects. We've been like family to each other."

While still in high school, Johnson set a personal goal of curing diabetes, which claimed his great grandmother at a young age. At Northeastern, he has been able to complete several co-ops focused on medical research, drug therapies, and disease mechanisms that will help him achieve this mission. "Everyone here knows me, and knows what I'm trying to achieve—and they help me reach my goals," he says. "I don't think I would have that experience at another school."

As president of the Black Engineering Student Society for the past two years, Johnson has been a visible presence on campus, and enjoys helping underclassmen set and achieve their own goals. "As a freshman, I met upperclassmen who became my mentors—and they still keep in touch with me today," he states. "I love creating connections with younger

**"Everyone here knows me, and knows what I'm trying to achieve—and they help me reach my goals. I don't think I would have that experience at another school."**

— Courtney Johnson, E'17
chemical engineering



## Climbing to the Top

Josh Levin, E'17, is not your typical Northeastern student. This mechanical engineering senior recently made it to the finale of the NBC television show *American Ninja Warrior*, which pits contestants against each other as they navigate a series of physical obstacles. Since age 9, Levin has also been the reigning U.S. national climbing champion.

"For as long as I can remember, I've enjoyed climbing," recalls Levin, "and I think it's that same element of problem-solving that made me a mechanical engineer. You need to figure out the next step. You need to work out how things are going to fit together. You have to solve a series of complex physical challenges."

Not surprisingly, Levin came to Northeastern from his home in Silicon Valley because of the College of Engineering's focus on co-op experience. "I loved the idea of learning in a hands-on way, traveling, and accomplishing something while I was still an undergraduate," he notes. "I always want to be moving and getting things done."

Levin returned to his native California to complete a co-op at the NASA Jet Propulsion Laboratory, where he worked on the Mars 2020 rover, as well as a co-op at Apple where he was on the manufacturing design team for the latest MacBook Pro. "I visited manufacturing sites in Asia where I was able to see the production processes I designed in action," Levin states. "It was rewarding to see my concepts put into practice."

Back on campus, Levin was also gratified to form the first-ever Northeastern Climbing Team. He founded the team with two fellow engineering students in their sophomore year, when 12 people joined. Today, with 30 members chosen from a pool of 120 candidates, the team has gone undefeated at regional championships and finished second at the Collegiate National Championships. Levin also founded the Northeastern Recreational Climbing Club in fall 2016 to accommodate the growing interest in climbing at the university.

"I have loved sharing my passion with the Northeastern community, and that's really helped me feel at home here on the campus over the past five years," Levin says. One of his personal goals is to build a climbing wall on the Northeastern campus, so members have easier access to training facilities.

But Levin has other dreams. The Tokyo 2020 Olympics will be the first to feature climbing as a sanctioned sport—and Levin is determined to make the U.S. team. "I'm eager to apply my knowledge and my co-op experience as a professional engineer, but this is a once-in-a-lifetime opportunity to represent my sport and my country on an international stage. Northeastern has taught me so much, including how to set goals and achieve them—and that will serve me well no matter where my journey takes me," Levin concludes.

students. You see these freshman and they're overwhelmed by the coursework and experiencing college for the first time. It's a great feeling to help them navigate the campus, their course load, and all the other challenges of freshman year."

Maddy Leger, computer engineering

James Tukpah, electrical engineering

One student who's benefitted from Johnson's mentoring is sophomore James Tukpah, E'20. "Everyone calls us brothers, because Courtney and I have become so close," notes Tukpah. "He's been an important role model and friend during my first year. Northeastern has given me so many opportunities, like the chance to work on a NASA robot, but it can be hard to juggle everything. Courtney's helped me with that." Adds Tukpah, "I've also formed a very close relationship with Dean Harris—his door is always open, whether you're dealing with a personal or academic issue. And my professor, Taskin Padir, has really taken me under his wing at the Robotics and Intelligent Vehicles Research laboratory. Starting when I was a freshman, he's enabled me to do cutting-edge research, which is going to help me achieve my goal of working at NASA someday." See related story on page 17.

"I feel like Northeastern works hard to educate you about the resources and opportunities available to you—and encourages you to use those resources to succeed," Tukpah continues. "I believe I'm part of a family here, and that people care about me. That's so important when you're leaving your real family behind for the first time."

## Women in Engineering: Growing Numbers

To help encourage women to enroll in and graduate from the College of Engineering, Northeastern has also created a Women in Engineering Program. Similar to the NUPRIME, this program focuses on creating a network of resources and support for female engineering students.


From left: S-POWER principal investigator, Professor Brad Lehman of the Department of Electrical and Computer Engineering; Marilyn Minus, associate professor of Mechanical and Industrial Engineering; Claire Dugan, director of the Center for STEM Education at Northeastern; Richard Harris, assistant dean and director of the Northeastern University Program in Multicultural Engineering (NUPRIME); and Khalil Shujaee, professor of Computer Science at Clark Atlanta University (not pictured)

## S-POWER Grant Creates New STEM Pathways

As part of a national imperative to increase workforce diversity in STEM fields and the energy sector, Northeastern was awarded a $5 million grant from the National Science Foundation to establish the Student Pathways Opening World Energy Resources, or S-POWER, program.

A five-year innovative scholarship and mentoring program, S-POWER seeks to increase the number of underrepresented minority college transfer students from two- and four-year institutions that don't offer degrees in STEM to institutions that do grant degrees in STEM. It also seeks to address the need for fundamental research and training in energy-related fields in order to prepare a new generation of energy experts.

Northeastern is partnering with two historically black colleges and universities—Clark Atlanta University and


The NU Epsilon Zeta chapter of the Alpha Delta Phi Fraternity presented a check to the College of Engineering's Center for STEM Education to support the Young Scholars Program.

"It's been gratifying to see a growing awareness of STEM opportunities among America's middle and high school students, including young women," says Assistant Dean Rachelle Reisberg, who directs the Women in Engineering initiative. "We still have a long way to go, but Northeastern's efforts to attract and retain female students have paid huge dividends." In 2016, nearly a third of the incoming freshman class was female—above the 2015 national average of 21.5 percent across all engineering schools.

Hampton University—as well as Mass Bay, Middlesex, and Northern Essex community colleges in Massachusetts. Undergraduates from these institutions will transfer into Northeastern's College of Engineering, beginning with the first cohort of about 25 students in fall 2017. They will receive mentoring, guidance on mapping out their curricula, peer support, and access to Northeastern's rich resources for underrepresented students.

The program will provide scholarships for up to 160 undergraduate and graduate students; participating students will each be eligible for up to $30,000 in direct financial aid. Northeastern will also build a collaborative education, administrative, and mentoring ecosystem that uniquely supports students throughout the transfer process, including helping partner colleges and universities implement S-POWER back at their institutions.

The program will focus on building social and mentoring ties with students in a number of ways, such as through a summer program at Northeastern where students will acclimate to the university while participating in research projects. A robust mentoring and advising network will be established as well. Students will have faculty mentors at both Northeastern and their original schools, mentors in the energy industry, and peer support from Northeastern's student organizations such as the Northeastern chapter of the National Society of Black Engineers. They will also be connected with multicultural university resources such as the John D. O'Bryant African American Institute and the Latino/a Student Cultural Center.

Richard Harris, assistant dean and director of the Northeastern University Program in Multicultural Engineering, explains, "We want to develop something that is not only programmatic, but also based in educational research. The idea is to leverage S-POWER as an educational research tool. We want to identify the key success factors, then replicate this program nationally and institutionalize it at Northeastern in a way that builds on the work we're doing today."

**"Through the Women in Engineering Program and organizations such as the Society of Women Engineers, our students receive a continuum of formal and informal support…to encourage them to seize opportunities and help them achieve their personal aspirations."**

— Rachelle Reisberg, assistant dean of Enrollment Management and Retention

"In a field typically dominated by men, it's so important that we create a culture where women feel welcome and comfortable," emphasizes Reisberg. "Through the Women in Engineering Program and organizations such as the Society for Women Engineers, our students receive a continuum of formal and informal support from staff, faculty, and peers to encourage them to seize opportunities and help them achieve their personal aspirations."

Maddy Leger, E'19, believes the College of Engineering has created a culture where women can feel empowered—as well as having ample opportunities to connect with one another. "I've formed a close relationship with Dean Reisberg and I've been able to meet other female engineering students through the Society of Women Engineers," she says.

In her three years at Northeastern, Leger has had co-ops at Amazon Robotics and Microsoft, participated in the Gordon-CenSSIS Scholars Program, and served as president of the IEEE student chapter. She was recently selected as the 2017-18 executive director of Generate, Northeastern's product development studio, which is part of the Sherman Center for Engineering Entrepreneurship Education. In all her activities, Leger notes that she has been supported and encouraged not only by her professors and advisors, but also her fellow students.

"Most of the female students here were probably at the top of their high school classes, and we are definitely focused on achievement," Leger adds. "But there's really no sense of competition among us. We support each other and, in turn, we're supported by the diverse faculty here. I feel that everyone at Northeastern wants me to succeed and is invested in my success. That's a great feeling."

## Encouraging the Next Generation

What's especially impressive about Northeastern's multicultural students is their commitment to fostering a new generation of engineering diversity.

"One of my greatest female mentors at Northeastern is the director of the Center for STEM Education, Claire Duggan, whose mission is to reach out to potential engineers at a very young age," Leger states. "I've been working with her to actively lead STEM-related activities for K-12 students who lack exposure to science, technology, engineering, and math in their own curricula. A lot of the students we work with are underrepresented minorities, and it's so rewarding to get STEM in front of them, so they can see it as a potential career path."

In addition to mentoring students on the Northeastern campus, Courtney Johnson also focuses time and energy on reaching out to even younger students. He visits his high school as often as possible to talk about his own path to Northeastern, as well as available scholarships and job opportunities. "It's important that these kids see someone who looks like them and went to the same high school, who is excelling in a STEM field," says Johnson. "By raising awareness of engineering as a career choice, we can increase the diversity of this field and grow the community of minority students and, eventually, engineering professionals."

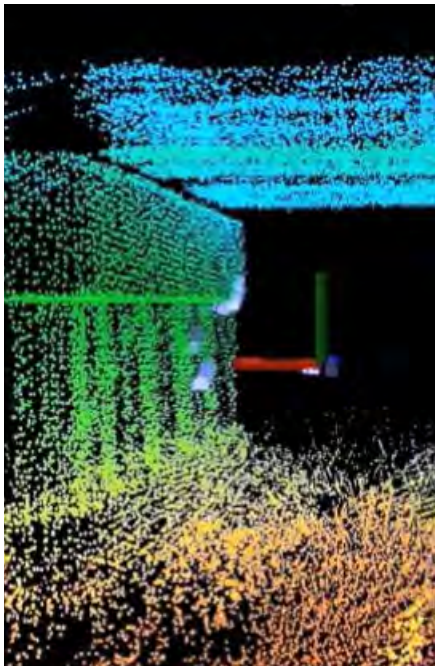
"Our efforts are designed to help foster interest in STEM in the early years, provide opportunities to enable them to pursue an engineering education, and then put the programs and support systems in place so they have maximum opportunity to be successful while at Northeastern and beyond," concludes Harris.

# BRIDGING A TECHNOLOGY GAP

Flying robots? The concept almost seems science fiction. But that is exactly what Jerome Hajjar, professor and chair of civil and environmental engineering at Northeastern, is developing to enable faster, more effective, and safer inspection of bridges, buildings, dams, and other structures.

Working with a team from Carnegie Mellon University, Hajjar is developing an advanced technology system called the Aerial Robotic Infrastructure Analyst, or ARIA. It uses small low-flying robots known as micro air vehicles, or MAVs, coupled with 3-D imaging and state-of-the art planning, modeling, and analysis, to inspect structures and automatically identify problems, track their progress, and assess the need for follow-up.

"Today the inspection of structures is incredibly time-consuming and labor-intensive," explains Hajjar. "For example, inspectors of large bridges access the structure via scaffolding built for the specific purpose of looking at a single section of the bridge. Then that scaffolding is taken down and reconstructed a little further along the bridge."



Captured footage from MAV inspecting bridge infrastructure, part of the Aerial Robotic Infrustructure Analyst technology system

Instead, MAVs, which are programmed to fly and navigate autonomously, can safely and efficiently address places that are difficult or dangerous to reach, as well as those that must be inspected repeatedly.

Hajjar says, "Collecting visual information is only the beginning. We're creating powerful analytic tools that determine the nature and significance of any damage captured by the robots, so engineers can plan an appropriate course of action."

# Welcome New Faculty

The College of Engineering has hired nearly **61** faculty since 2012, and **23** in 2016.


Michael Allshouse


Debra Auguste


Ambika Bajpayee


Mehdi Behroozi


Chiara Bellini


Sidi Bencherif


Chun-An Chou


Pau Closas


Guohao Dai


Hui Fang


Sam Felton


Francisco Hung


Xiaoning (Sarah) Jin


Michael Kane


Xue (Shelley) Lin


Steve Lustig


Amy Mueller


Jessica Oakes


Sarah Ostadabbas


Hari Parameswaran


Aatmesh Shrivastava


Devesh Tiwari


Qi (Ryan) Wang

## New Faculty Hires in 2016

### ASSISTANT PROFESSORS

**Michael Allshouse**, PhD MIT

**Ambika Bajpayee**, PhD MIT

**Mehdi Behroozi**, PhD University of Minnesota

**Chiara Bellini**, PhD The University of Calgary

**Sidi Bencherif**, PhD Carnegie Mellon University

**Chun-An Chou**, PhD Rutgers University

**Pau Closas**, PhD Universitat Politècnica de Catalunya

**Hui Fang**, PhD University of California, Berkeley

**Samuel Felton**, PhD Harvard University

**Xiaoning (Sarah) Jin**, PhD University of Michigan

**Michael Kane**, PhD University of Michigan

**Xue (Shelley) Lin**, PhD University of Southern California

**Amy Mueller**, PhD MIT

**Jessica Oakes**, PhD University of California, San Diego

**Sarah Ostadabbas**, PhD UT Dallas

**Hari Parameswaran**, PhD Boston University

**Aatmesh Shrivastava**, PhD University of Virginia

**Devesh Tiwari**, PhD North Carolina State University

**Qi (Ryan) Wang**, PhD Virginia Tech

### ASSOCIATE PROFESSORS

**Guohao Dai**, PhD MIT

**Francisco Hung**, PhD North Carolina State University

**Steve Lustig**, PhD Purdue University

### PROFESSOR

**Debra Auguste**, PhD Princeton University

### PROMOTIONS

#### » TO ASSOCIATE PROFESSOR

**Philip Larese-Casanova** (CEE) PhD University of Iowa

**Edgar Goluch** (CHE), PhD University of Illinois at Urbana-Champaign

**Ningfang Mi** (ECE), PhD College of William and Mary

#### » TO PROFESSOR

**Yong-Bin Kim** (ECE) PhD Colorado State University

**Ozlem Ergun** (MIE, ECE) PhD Massachusetts Institute of Technology

**Moneesh Upmanyu** (MIE) PhD University of Michigan

# Young Investigator Recognitions

These faculty recognitions bring the total young investigator awards in the college to **60**, including **34** NSF CAREER and **12** DOD Young Investigator awards.

**Kaushik Chowdhury**, associate professor of electrical and computer engineering, has been awarded a Presidential Early Career Award for Scientists and Engineers by the United States Government. Chowdhury was also awarded a DARPA Young Faculty Award for his project, entitled "Reconfigurable and Application Independent Design for Radios."

**Pau Closas**, assistant professor of electrical and computer engineering, received an ION Early Achievement Award "for mathematically profound contributions to the design of advanced navigation receivers and for efforts in disseminating GNSS technology."

**Yongmin Liu**, assistant professor of mechanical and industrial engineering and interdisciplinary with electrical and computer engineering, received both a SPIE Defense and Commercial Sensing Rising Researchers Award and an NSF CAREER Award for his project, entitled "Spin Plasmonics for Ultrafast All-Optical Manipulation of Magnetization in Hybrid Metal-Ferromagnet Structures."

**Jose Martinez-Lorenzo**, assistant professor of mechanical and industrial engineering and interdisciplinary with electrical and computer engineering, received an NSF CAREER Award for his project, entitled "4D mm-Wave Compressive Sensing and Imaging at One Thousand Volumetric Frames per Second."

# Family Affair

When Christopher Webb, E'17, made the decision to enroll in Northeastern's College of Engineering, he became part of a family legacy that began with his grandfather Edward Webb, E'59.

The tradition continued with Chris' parents—Douglass, ME'86, and Elaine, E'86—high school sweethearts who came to Northeastern together. Chris' uncle, Dan Webb, E'93, met his wife Rochelle, E'93, MS Information Systems '99, on the Northeastern campus. Another uncle, John Meyers, E'93, also graduated from the College of Engineering.

Though the Boston-based Webb family has degrees spanning all the engineering disciplines, Chris is proud to follow in the footsteps of his grandfather by earning a degree in chemical engineering.

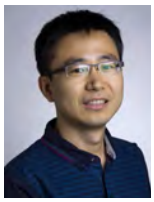
"When my family visits me, they all talk about the changes on the campus like the new T station," says Chris. "But the bigger changes are in the classrooms and labs. With all the new materials, technologies, and processes like laser-based additive manufacturing, engineering is a whole new world now—and it's really an exciting time to be an engineer. But one thing hasn't changed, and that's the quality of education all of us received here."

His mother, Elaine agrees. "When my father-in-law enrolled at Northeastern in the 1950s, it was known as a working man's, blue-collar school where you could do co-ops and get experience," she notes. "Today it's one of the world's most prestigious universities, with leadership in robotics, cybersecurity, and nanotechnology. But Northeastern remains a benchmark school for earning a cooperative degree that equips students with the skills demanded by the global engineering industry."

Edward Webb, now 80, is planning to attend Commencement and watch the third generation of his family receive a Northeastern engineering degree. "My dad suffers from Parkinson's and it can be difficult for him to get around, but he wouldn't miss this for the world," says Douglass. "It's the continuation of a journey he started 63 years ago when he walked into the registrar's office for the first time."

# Recent Fellows

*Selected engineering faculty who have been elected as Fellows of national professional societies.*



**Raymond Fu**, associate professor of electrical and computer engineering, has been selected as a **Fellow** of the International Association for Pattern Recognition. Fu was seleted for his contributions to pattern recognition, data mining, and visual intelligence. In addition to this award, he has also won five Young Investigator Awards from the Army Research Office, Office of Naval Research, the International Neural Network Society, IEEE Computational Intelligence Society, and National Academy of Engineering-Grainger Foundation.

**Laura Lewis**, Cabot Professor of chemical engineering and jointly appointed professor of mechanical and industrial engineering, was selected as an American Physical Society **Fellow**. She received her fellowship "for investigations of fundamental structure-property relationships in functional magnetic materials from a unified perspective, specifically for advancing permanent magnet, magnetic cooling, and biomedical applications."

## FACULTY NEWS

**Thomas Webster**, professor and chair of the Department of Chemical Engineering and Art Zafiropoulo Chair in Engineering, developed a novel self-assembling nanomolecule that is being exclusively licensed by Audax Medical, Inc. for use in tissue regeneration. Also, the International Association of Science and Technology for Development awarded Webster the Plenary Award for his lab's contributions to commercializing nanomedicine.

**Nadine Aubry**, dean of the College of Engineering, has been elected to the prestigious American Academy of Arts and Sciences. Dean Aubry is also a member of the U.S. National Academy of Engineering and a Fellow of the National Academy of Inventors, American Association for the Advancement of Science, American Institute of Aeronautics and Astronautics, American Physical Society, and the American Society of Mechanical Engineers.


Associate Professor, of mechanical and industrial engineering, **Ashkan Vaziri's** research, "Lattice Materials with Reversible Foldability," was featured on the cover of *Advanced Engineering Materials*. The research presents a new class of lattice materials, where a controlled simultaneous folding of lattice walls results in a significant size reduction, while preserving the overall shape of the original lattice.

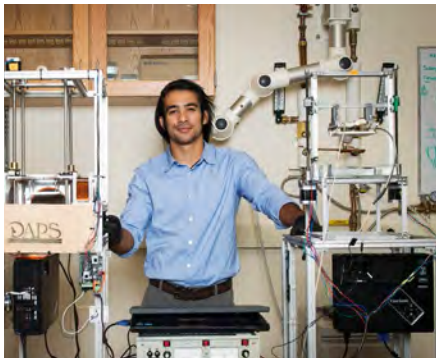
**Edward Beighley**, associate professor of civil and environmental engineering, received a $651K grant from NASA for research supporting the Surface Water and Ocean Topography (SWOT) satellite mission. SWOT will make the first global survey of Earth's surface water, providing understanding of how water bodies change over time. Insights gained from SWOT will help quantify the potential impacts of climate and land cover change on surface water dynamics with a sufficient resolution for community scale planning and management. Beighley's research will focus on understanding how hydrologic processes are integrated along SWOT measurement boundaries, new methods for improving SWOT data products such as river discharge, and quantifying the potential benefits of SWOT data products in hydrologic applications. As part of his research, he will work with the global insurance industry to develop new methods for integrating SWOT measurements into flood hazard applications.

Assistant Professor **Stratis Ioannidis**, Associate Professor **Deniz Erdogmus**, and Professor **Jennifer Dy** of electrical and computer engineering were awarded an $800K National Science Foundation grant to create an "Assistive Integrative Support Tool for Retinopathy of Prematurity." In collaboration with researchers at the MGH/HST Athinoula A. Martinos Center and the Oregon Health & Science University, the team will use machine learning techniques to build an assistive tool to detect retinopathy of prematurity (ROP) in infants with multimodal clinical data. ROP is a leading cause of childhood visual loss worldwide.

In an effort led by **Jacqueline Griffin**, industrial engineering professor, and civil and electrical engineering professors, **Ali Abur**, **Octavia Camps**, **Jerome Hajjar**, **Mario Sznaier**, and **Edmund Yeh,** and George J. Kostas Institute for Homeland Security Director Peter Boyton, as well as professors from the College of Science and College of Computer and Information Science, the National Science Foundation awarded a $2.5M grant for "Identification and Control of Uncertain, Highly Interdependent Processes Involving Humans with Applications to Resilient Emergency Health Response," to pioneer a new approach to enable communities to withstand and bounce back quickly from hazards. The multidisciplinary research seeks to develop a comprehensive framework for designing and operating resilient communities by modeling them as partially engineered networked cyber-physical-human systems.

## STUDENT NEWS

**Joshua Martin**, a PhD student in mechanical and industrial engineering, won first prize in the Young Stress Analyst Competition. His invited lecture at the British Society for Strain Measurement in Exeter, England was on magnetic 3D printing. Martin is also the co-founder of 3DFortify, which won gold prize at the 2016 MassChallenge.



# READY FOR LAUNCH

Joseph Alim, BS/MS'17, came to Northeastern with a passion for mechanical and bioengineering. Through his co-op and extracurricular experiences, Alim realized he was equally interested in business and entrepreneurship.

"I was doing my third co-op at Medtronic, a medical device manufacturer, working in project management when I reaffirmed my interest with the business aspect of companies—from finance and product development through sales and marketing," Alim recalls. "I knew then that I wanted to add a business component to my studies at Northeastern."

Alim's dual focus on engineering and business made him an ideal candidate for the Galante Engineering Business Program, which provides an opportunity for students to earn the distinction of a Galante Engineering Business Certificate, while also pursuing a BS in engineering and an MS in engineering management. Edward Galante, E'73, through a generous gift, enabled the College of Engineering to found the program after recognizing through his own career experience the value that a business foundation can provide engineers in the workplace. Upon completion, Galante Program courses can also be applied toward achieving an MBA at Northeastern.

As a Galante Fellow, Alim combines coursework in mechanical engineering with classes in diverse business-related topics such as financial management, customer-driven innovation, and organizational psychology. He also participates in and helps plan with other Fellows events such as workshops, a corporate speaker series, and networking opportunities.

Alim applies the knowledge he's gained from the Galante Program every day on the job. He is co-founder and chief operating officer of ScholarJet, a venture that links high school and college students with action-based scholarship opportunities. "The Galante Engineering Business Program is helping me bring my startup's vision to life through strategic thinking and practical planning," Alim says.

"To encourage philanthropy, ScholarJet enables donors to create and donate to scholarships that reflect what they believe in. There can be scholarships for designing a robot, developing an app or even volunteering at a local school," explains Alim. This innovative company was created in 2015 with co-founder Tuan Ho, also a mechanical engineering student.

Upon graduation, Alim plans to devote his full attention to getting ScholarJet off the ground. "Through my experience at Northeastern, I have developed valuable skills and confidence to take this leap," Alim states. "I feel ready to begin revolutionizing the concept of educational scholarships."

Learn more about the **Galante Engineering Business Program at** coe.neu.edu/galante

YouTube Check out Joseph's spotlight video


Professor **Yun Raymond Fu**, PhD Candidate **Yue Wu**, Postdoc **Jun Li**, and Postdoc **Yu Kong** won first place at the 2016 Association for Computing Machinery Multimedia Conference MSR Image Recognition Grand Challenges.

**Sarada Symonds**, a third year computer engineering and computer science student, was awarded the 2016 GE Women's Network Scholarship by the Society of Women Engineers. This award is given to only 40 students nationwide.


**Sheng Li**, a fifth year PhD candidate in computer engineering, was awarded The Baidu Scholarship for his research accomplishments and academic record. This award is only given to ten students worldwide.

**Jaclyn Lock**, PhD candidate in bioengineering, was awarded first place in the Materials Engineering & Sciences Division poster competition at the annual American Chemical Institute for Chemical Engineers meeting. Lock's poster "Dextran Sodium Sulfate Exposure Affects Intestinal Mucus Integrity" was selected out of 50 posters in the competition.

# ALUMNI SPOTLIGHT

## Engineering and Business: A Potent Formula


## On the *Cutting* Edge

As an engineer with a passion for entrepreneurship, Russell Layton, E'98, is revolutionizing ice skating with his company's innovative Sparx skate-sharpening system. Launched in March 2016, today more than 3,000 Sparx sharpeners have been shipped to all 50 U.S. states and almost every Canadian province. It's used by NHL and NWHL teams, colleges, leagues, rinks, and everyday hockey families. Layton is especially proud to count the Northeastern University men's and women's NCAA hockey teams among his Sparx customers.

A lifelong hockey player—and now a hockey parent—Layton conceptualized Sparx to answer a common frustration. "Until recently, getting your skates sharpened meant loading them in the car and traveling to someone with specialized equipment and expertise. It's a real inconvenience," Layton points out. "As a result, for as long as skating sports have been around, athletes have routinely delayed sharpening their skates, which seriously compromises performance."

In contrast, Layton's invention is a portable, affordable, easy-to-use system. "Anyone can use this piece of equipment," says Layton. "It automatically aligns the skate for optimal sharpening, so the user only has to push a button."

The sharpener design, which is already covered by eight patents, is the result of Layton's years of hands-on engineering experience. During seven years at medical equipment manufacturer Hologic, Layton transitioned from directing R&D to directing business development. As he focused on such issues as corporate finance, technology licensing, and acquisitions of small start-up companies, Layton realized he wanted to start his own business.

But it didn't happen overnight. Layton was innovating in his head for years—a decade in fact. His idea evolved from a solution where users could mail in their blades to be sharpened to the "at-home" sharpening solution of today. "As technology, design, and maker equipment progressed, developing an 'at-home' solution became more economically feasible for an entrepreneur to go after this niche market opportunity," explains Layton.

**"My engineering background fueled the innovation process… my understanding of business helped me successfully bring it to market."**

— Russell Layton, E'98

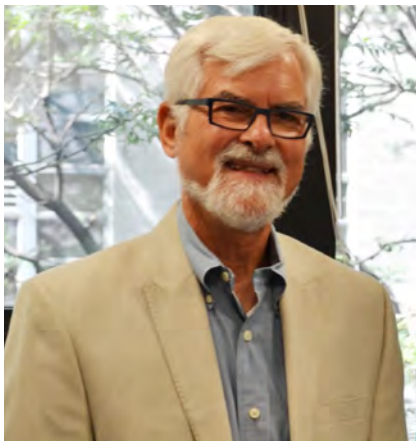
Commenting on his success, Layton says, "I had a great product idea that met a real-world need. My engineering background fueled the innovation process and gave me the technical know-how to make my idea a reality, and my understanding of business helped me successfully bring it to market."

He also points out the value of hard work and strategic planning—two skills he learned at Northeastern.

"I was one of those students who didn't have to work hard in high school to excel," Layton recalls. "When I arrived at Northeastern, the rigorous discipline and the challenging curriculum were real game-changers for me. I had a rough first semester, but I set an ambitious goal of recovering from a tough start and graduating with honors—and, with careful planning and a strong work ethic, I achieved that goal. It's a lesson from Northeastern I've carried with me my entire life, and it has certainly helped me achieve success as an entrepreneur."

# FACULTY SPOTLIGHT

## Celebrating a Legacy of Contributions



After decades of service to Northeastern, the College of Engineering, and the professional community, John Cipolla, professor of mechanical and industrial engineering, has taken the next step on his life's journey—enjoying retirement.

During his 45 years at Northeastern, Professor Cipolla has served in many capacities, arriving as an assistant professor in the Department of Mechanical Engineering in 1971. He was promoted to associate professor in 1976 (tenured in 1977), became a full professor in 1981, and was appointed department chair in 1991. In 1995, he was named the Donald W. Smith Professor, and oversaw the formation of the merged Department of Mechanical, Industrial and Manufacturing Engineering, serving as the chair of the combined department until 2003 when he was appointed vice provost for Graduate Education. He also served as interim chair from 2006 to 2007. In 2007, he was named a College of Engineering Distinguished Professor and upon his retirement became a COE Distinguished Professor, Emeritus.

Professor Cipolla has been involved in sponsored research projects in a variety of areas, including the kinetic theory of gases applied to heat and mass transfer, studies in plasma physics, optical fiber manufacture, and aerosol mechanics. His teaching has been in thermofluids engineering and in applied mathematics in both the graduate and undergraduate programs.

He was elected a Fellow of the American Society of Mechanical Engineers (ASME) in 1991, and has been recognized with several ASME awards, including the Dedicated Service Award in 2011 and the Edwin F. Church Medal in 2014 for distinguished contributions to mechanical engineering education. He served as a member and chair of the ASME Department Heads Committee as well as the ASME Committee on Engineering Accreditation. Additionally, he served for ten years as a member of the ASME Committee on Honors, including two years as its chair, and also represented ASME as a program evaluator for the Accreditation Board for Engineering and Technology (ABET) and as a member of the ABET Board of Directors.

Professor Cipolla's legacy and support will live on at Northeastern. In 2015, he and his wife, Katharine, endowed the John and Katharine Cipolla Graduate Student Support Fund in the Department of Mechanical and Industrial Engineering.

## IN MEMORIAM

### Emeritus Professor Arthur R. Foster, Mechanical and Industrial Engineering Department

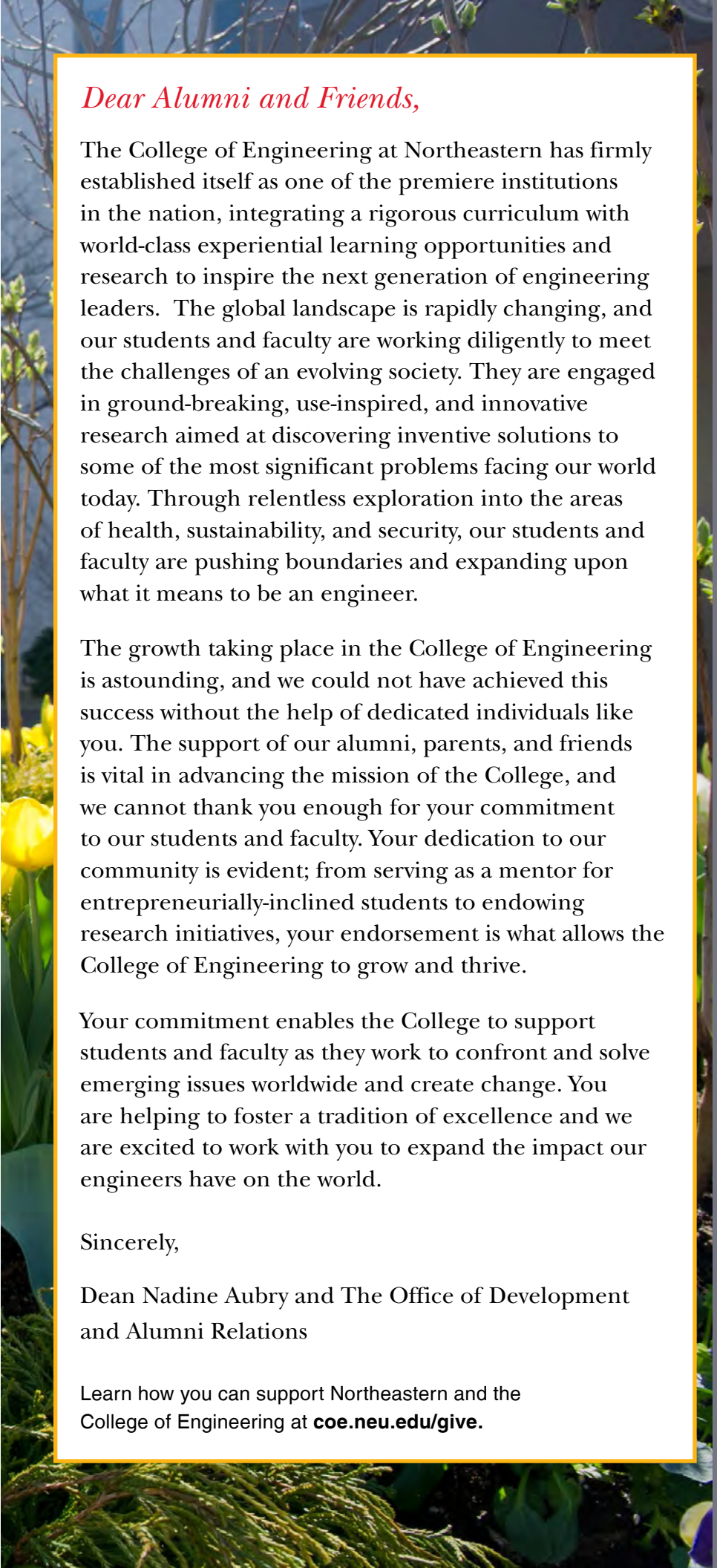
Professor Foster was a U.S. Navy veteran, who graduated from Tufts University with his BS in mechanical engineering, and earned his master's degree from Yale. He joined what was then the Department of Mechanical Engineering in 1948, and served as the department chair from 1961 until 1976. He fondly recalled two sabbatical leaves during his career, both spent teaching abroad as a Fulbright Scholar, one in Ecuador and the other one in Colombia. Foster was described by a former colleague as "a consummate professional and true gentleman," and was a generous benefactor to the University. He retired from Northeastern in 1989.

### Professor Emeritus Alexander Gorlov, Mechanical and Industrial Engineering Department

Professor Gorlov earned his bachelor's degree in bridge and tunnel engineering from the Moscow Institute of Transport Engineers in 1954 and his doctorate in mechanical and structural engineering in 1961. After being forced to emigrate to the U.S., in 1976 he joined the faculty at Northeastern, where he created the Hydro-Pneumatic Power laboratory with the goal of extracting power from tidal energy. He published more than 100 technical papers and books and held 25 patents in fields ranging from structural analysis to theoretical mechanics. Gorlov's most prestigious invention—the inexpensive, dam-free, and environmentally friendly Gorlov Helical Turbine—won the 2001 American Society of Mechanical Engineers Thomas A. Edison Patent Award and was named one of *Popular Science's* top inventions of the year. It is installed on the Eiffel Tower and the newest Prudential building in Boston. He retired from teaching in 2001, but continued to apply for grants and offer his expertise to student researchers for the next decade.

### Alumnus George J. Kostas, E'43, H'07

Born Sept. 2, 1919, George J. Kostas, E'43, H'07, was a native of Haverhill, Massachusetts, and the son of Greek immigrants. He earned a bachelor's degree in chemical engineering at Northeastern in 1943 and completed the executive MBA program at Columbia University in 1967. In 2007, he received an honorary doctorate of science from Northeastern. Kostas maintained a longstanding relationship with Northeastern. He invested $2 million to found and establish the George J. Kostas Nanoscale Technology and Manufacturing Research Center, and later made a $12 million investment to create Northeastern's George J. Kostas Research Institute for Homeland Security. Recently, he also made two generous gifts of $2 million and $1 million. Kostas' forward-thinking investments not only underscored his commitment to supporting research that addresses great societal challenges, but also paved the way for growth and discoveries that have multiplied the impact of his gifts many times over. Work at the George J. Kostas Nanoscale Technology and Manufacturing Research Center, for example, led the National Science Foundation to create a national center of excellence at Northeastern.



## *Dear Alumni and Friends,*

The College of Engineering at Northeastern has firmly established itself as one of the premiere institutions in the nation, integrating a rigorous curriculum with world-class experiential learning opportunities and research to inspire the next generation of engineering leaders. The global landscape is rapidly changing, and our students and faculty are working diligently to meet the challenges of an evolving society. They are engaged in ground-breaking, use-inspired, and innovative research aimed at discovering inventive solutions to some of the most significant problems facing our world today. Through relentless exploration into the areas of health, sustainability, and security, our students and faculty are pushing boundaries and expanding upon what it means to be an engineer.

The growth taking place in the College of Engineering is astounding, and we could not have achieved this success without the help of dedicated individuals like you. The support of our alumni, parents, and friends is vital in advancing the mission of the College, and we cannot thank you enough for your commitment to our students and faculty. Your dedication to our community is evident; from serving as a mentor for entrepreneurially-inclined students to endowing research initiatives, your endorsement is what allows the College of Engineering to grow and thrive.

Your commitment enables the College to support students and faculty as they work to confront and solve emerging issues worldwide and create change. You are helping to foster a tradition of excellence and we are excited to work with you to expand the impact our engineers have on the world.

Sincerely,

Dean Nadine Aubry and The Office of Development and Alumni Relations

Learn how you can support Northeastern and the College of Engineering at **coe.neu.edu/give.**

*KEY*
**Deceased*
*PNT designates parent(s) of a current student or 2016 graduate*

## Benefactors

*The following donors are College of Engineering alumni or friends who have made a lifetime commitment of $1 million or more to Northeastern University, or friends who have made a lifetime commitment of $1 million or more to the College of Engineering by June 30, 2016. Benefactors are members of The Huntington Society.*

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*William DiPietro, E'42*
*Maureen Egan*
*Edward G., E'73, and Catherine Galante*
*Francis A., E'59, and Joan A. Gicca*
*Bernard M., H'07, and Sophia Gordon*
*James W., E'54, and Sandra R. Healy*
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*Robert J., E'68, H'00, and Mao Shillman, PNT*
*Lorraine C. Snell*
*Sy, ME'68, H'12, and Laurie Sternberg*
*Arthur W., E'61, and Lisa Zafiropoulo*
*Anonymous*

## The Huntington Society

*Current members through June 30, 2016*

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*Zafer Chaoui, PNT*
*John W., Jr., and Katharine Cipolla*
*John J. Cochrane, E'60*
*Manuel, E'57*, and Rose M. Correia*
*Alexander C. Derry, E'54**
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*John S. Driscoll, LA'57*
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*Robert H. Goodale, E'55*
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*J. Barry Herring*
*David L. House, ME'69*
*William S., E'69, and Diane Howard*
*Chaitanya Kanojia, ME'93, and Tracie Longman*
*Warren R., E'58, ME'61, and Maredith W. Kundert, BB'58*
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*John A. Massa, E'59, ME'66*
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*Metri R., E'92, ME'95, and Ferial Metri*
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*James P., E'88, and Amie M. Smith, AS'87*
*Francis L., E'62, ME'64, and Marilyn Tempesta*
*Rimantas M. Veitas, E'80*
*Mohamad A. Zameli and Dina Tabbara, PNT*
*Anonymous*

# Supporting a STRONGER FUTURE

When Vilas Mujumdar tells people that he's made a $1 million gift to Northeastern's College of Engineering to support research and academic studies in infrastructure resilience, they're surprised to learn he's not a Northeastern alumnus. But, for this globally recognized expert on system-level resilience and public policy and its effect on reducing natural hazard risk, this critical issue crosses institutional and disciplinary boundaries.

"I've spent my career focusing on the resilience of urban systems in the event of a natural disaster," says Mujumdar, who has served as a private consultant for over 30 years and also headed seismic safety for the state of California in the 1990s. Later, he worked as director of Engineering Research Centers – Natural Hazards at the National Science Foundation. "As climate change accelerates, we're going to see more frequent and more intense natural hazards. Therefore, we need to ensure we have the policies in place to create strong infrastructure systems that can withstand these events."

The American Association of Engineering Societies (AAES) recently recognized Mujumdar with the prestigious 2017 Kenneth Andrew Roe Award. The award honors an AAES member who has been making significant contributions in promoting unity among the engineering societies represented by AAES—which includes two million members from ASCE, ASME, IEEE, and other significant engineering groups. According to AAES, Mujumdar was selected for "his leadership contributions that have helped shape public policy for natural hazard reduction through a holistic systems approach."

Mujumdar chose to make his philanthropic gift to Northeastern because the university is a recognized global leader in civil and environmental engineering, with a focus on urban infrastructure resilience and public policy. "From years of working with faculty and researchers at Northeastern, and based on further detailed communications with Dean Nadine Aubry, I knew that the College of Engineering has the commitment, the expertise, and the multidisciplinary environment to tackle this complex issue. I knew that Northeastern would get the work done," Mujumdar states.

The new **Vilas Mujumdar Strategic Resilience Fund** will help the Department of Civil and Environmental Engineering recruit faculty and graduate students who focus on this topic. "I want to inspire and encourage young engineers to make a real difference," emphasizes Mujumdar. "I'm happy to play even a small part in developing new solutions to a pressing issue that affects billions of people, in communities all around the world."

## Frank Palmer Speare Society

*The Frank Palmer Speare Society is named for Northeastern's first president and recognizes donors who have made estate provisions or other planned gifts in support of the university. The list below honors alumni of the college of Engineering who are members of the Frank Palmer Speare Society.*

**KEY**
** Deceased*
*† indicates new Speare Society member*
*PNT designates parent(s) of a current student or 2016 graduate*

*Robert B., E'47, and Sara Angus*
*George J. Antonucci, E'63, ME'65*
*Charles T. Barooshian, E'59*
*Harry R. Bedell, Jr., E'50*
*Robert Gilbert, E'80, and Paola Blank*
*Richard B., Jr., E'69, and Lennie Bourne*
*Thomas W., E'71, and Linda Frear Brahms*
*Donald M. Brown, E'52*
*Paul G., LC'64, UC'69, and Gail Burda*
*Ralph R. Burwell, E'50*
*Peter M. Bzowski, E'68, and Orla Uber*
*Anthony J., E'48, and Ann Caggiano*
*Lynne S. Champion, E'69*
*Joel Barry Chase, E'67*
*Peter C., ME'87, and Leslie Chatel*
*Harold T., E'63, and Kathleen Connors*
*Carl E., E'56, ME'64 and Claire T. Dantas, UC'83*
*Robert F., E'61, ME'68, and Susan R. Daylor, PNT*
*Norman J. Deinha, E'72*
*Robert A. Derrah, E'55*
*Thomas J., Jr., E'73, MBA'78, and Marie Falvey DeSisto, N'77*
*David A., E'59, and Louise Doane*
*Roger J., E'63, and Rochelle K. Dolan, E'63*
*Richard F., E'52, and Mary Jean Ebens*
*Donald K., E'55, and Donna Ellsworth*
*Frederick J. Emmett, Jr., ME'67*
*Mark D. Epstein, E'10, DMSB'11*
*William E. Epstein, E'72*
*Rita F. Fahy, LA'78, ME'89*
*Robert R. Feier, MS'64, ME'69*
*David S., E'47, and Diane L. Feinzig*
*Yves J. Fournier, ME'67, ME'72*
*George C. Frost, E'50*
*N. Paul, ME'58, and Jacquelyn Deegan Galluzzi*
*Francis A., E'59, and Joan A. Gicca*
*Robert M., E'62, and Deanne Glorioso*
*Robert L., E'59, and Frances Z. Goldberg*
*John J., E'44, B'49, and Alice M. Goode*
*Richard A., E'76, and Christine M. Grenier*
*Louis L., E'59, and Janice M. Guerriere*
*Stephen P., E'78, and Kathryn Hannabury*
*William T., IV, MS'70, and Joan L. Hathaway*
*James W., E'54, and Sandra R. Healy*
*Kenneth W. Henderson, E'53*
*Kenneth W., E'56, and Barbara P. Hiseler*
*Charles S., E'91, and Lisa Hocking*
*George M. Jett, E'70*
*Carl R. Johnson, E'73*
*Thomas J., E'69, ME'71 and Carol J. Kerr, Ed'73, MEd'76*
*Marilyn B. Kloss, E'82*
*Jeffrey R., E'74, ME'76, and Diane S. Kontoff*
*Stanley P. Kovell, E'55*
*Frank Kozacka, E'71*
*Kenneth Kroohs, E'72*
*Frederick H., E'57, and Carole Kurtz*
*Theodore, E'64, and Terri Lavoot*
*Milan W., E'57, and Corinne K. Lawson*
*Herbert A., E'50, and Rose F. Lerner, LA'53*
*Irving M., E'57, and Lenore Levine*
*G. Raymond Luddy, III, E'69*
*Linda M., E'82, and Robert B. MacIntosh*
*Robert T., E'72, and Loretta Maddock*
*Mark D., E'63, and Jean Grant Malkasian*
*Roger M. Marino, E'61, H'96*
*Charles D. Mason, E'54*
*John A. Massa, E'59, ME'66*
*Donald F., E'56, and Gladys A. Meade*
*Dominic Meo, III, E'68*
*Joseph Metelski, E'61*
*Marcus A. Moche, E'10*
*Jack W. Morrissey, E'67, and Laura Von Doenhoff*
*John D. Morrissey, E'59*
*Ramesh K. Motwane, E'77*
*William H. Newman, III, E'77*
*Edward T., E'59, ME'66, and Carol O'Keefe*
*Steven, E'64, and Helice Picheny*
*Victor L., LC'70, MBA'81, and Carmel Poirier*
*Mary L. Pottle, E'48, MEd'60*
*Roger R. Potvin, E'64*
*Charles H., Jr., E'55, ME'60, and Imelda C. Price*
*Donald J. Price, LI'57, B'59, MBA'63*
*Joseph J. Prifti, E'59, ME'64, PhD'67*
*Alonzo C., Jr., E'45, and Margaret H. Rand*
*Leon W., E'47, and Marilyn Rank*
*Eugene M., Jr., E'60, MEd'65, H'95, and Corinne C. Reppucci, LA'64, MEd'71*
*Michael Riccio, E'70*
*Michael P. Richardson, UC'91, SET'95*
*Kenneth J. Ritchie, E'49, MBA'54*
*Ricard V. Scheuerman, E'76*
*Richard A., E'71, and Martha Schoenfeld*
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*Stephen J., Jr., LI'57, H'94, and Genevieve Sweeney*
*John R. Thurell, Jr., E'49, ME'55*
*Stephen C. Toebes, E'91, E'93*
*Edward H. Tutun, E'47*
*David E., DMSB'84, and Ann Violette, E'85, PNT*
*Edward L., E'59, and Carolyn R. Wax*
*Lawrence G. Welch, E'79, ME'80, MBA'02*
*Ronald P. Weston, ME'66*
*William O., LI'79, and Roberta Wheeler*
*Robert W. Whiteacre, III, E'47*
*John J. Wroblewski, E'70*
*Joe, ME'88, and June Sue Zheng*
*John A. Zukowski, LI'55*
*Anonymous*

# Dean's Society | College of Engineering

*Listed below are College of engineering alumni and friends who have made gifts or pledge paymets of $1,000 or more to any College of Engineering designation, and College of Engineering alumni who have given to any Northeastern designation at that level during the FY16 (July 1, 2015 through June 30, 2016). Every effort was made to ensure the accuracy of this list. Our apologies for any errors or omissions that have occurred.*

KEY
*Deceased
PNT designates parent(s) of a current student or 2016 graduate

## FOUNDER'S LEVEL
($25,000 and Higher)

Norman J. Deinha, E'72
Jonathan DiVincenzo, E'88, PNT
David S., E'47, and Diane L. Feinzig
Edward G., E'73, and Catherine Galante
Chaitanya Kanojia, ME'93, and Tracie Longman
Robert R., E'73, and Louise Kursmark
Francis A., E'63, and Marlene Long
Linda M., E'82, and Robert B. MacIntosh
John E., E'87, and Allison Moalli
Timothy P. Moore, SET'87, E'88
George P. Sakellaris, ME'75, MBA'82, and Caterina Papoulias-Sakellaris
Winslow L. Sargeant, E'86
Michael J., E'68, and Ann Sherman
Robert J., E'68, H'00, and Mao Shillman, PNT
Gordon H., Jr., E'66, ME'73, and Jane Slaney
James P., E'88, and Amie M. Smith, AS'87
Anonymous

## VISIONARY'S LEVEL
($10,000 - $24,999)

James G., E'47, and Ifigenia Boulogiane
Alexander A. Bove, Jr., LI'61, UC'63
Joseph J. Bradley, ME'95
Ronald Brown, E'58, ME'65
Kamil V. Chaoui, E'16
Thomas J., Jr., E'73, MBA'78, and Marie Falvey DeSisto, N'77
Jon A. Ebacher, E'66, ME'68
Frederick J. Emmett, Jr., ME'67
Charles E., Jr., E'86, and Gail Evirs
Howard W. Evirs, Jr., E'51, MBA'70
Richard T., II, E'86, and Alicia Gedney, N'86, PNT
Steven D., PhD'96, and Amie Gray
David L. House, ME'69
William S., E'69, and Diane Howard
Saul Kurlat, ME'62
Roger M. Marino, E'61, H'96
Donald F., E'56, and Gladys A. Meade
Peter J. Ogren, E'69
Russell L. Peterson, E'63, ME'70
Steven, E'64, and Helice Picheny
Victor L., LC'70, MBA'81, and Carmel Poirier
Frederick , ME'67, and Judy Schmid
Richard A., E'71, and Martha Schoenfeld
Richard H. Sioui, E'64
Francis L., E'62, ME'64, and Marilyn Tempesta
Matthew D., E'87, and Kathy Puyana Theall
Mark A. Walsh, SET'90
Ahmad Zameli, E'14
Anonymous

## PATRON'S LEVEL
($5,000 - $9,999)

Quincy L. Allen, E'82
James E. Averill, E'86
Heather M., E'79, ME'87, and Thomas Ford, E'78
Yves J. Fournier, ME'67, ME'72
Charles H. Gall, E'67
Francis A., E'59, and Joan A. Gicca
C. Gerald Gnerre, E'49
Louis L., E'59, and Janice M. Guerriere
Stephen P., E'78, and Kathryn Hannabury
Kenneth W., E'56, and Barbara P. Hiseler
Jennifer E. Judge, E'14
Dianne T., ME'01, and David R. Kaeli, PNT
Gerald M. Karon, E'54, MBA'61
Christine M. Keville, ME'90
Michael M., E'55, and Arlene Lanes
Edward C. McCarthy, E'70
Timothy J. McGrath, E'73, and Roberta A. Ferriani, LA'70
John D. Morrissey, E'59
Milan M. Patel, E'96
Donato F. Pizzuti, E'63, ME'67
Stephen R., E'81, and Karen L. Pritchard, DMSB'81
Alonzo C., Jr., E'45, and Margaret H. Rand
Eugene M., Jr., E'60, MEd'65, H'95, and Corinne C. Reppucci, LA'64, MEd'71
Patrick A., Sr., E'59, and Yvonne Rivelli
William J. Roache, E'75
Bret R. Siarkowski, E'87
Sy, ME'68, H'12, and Laurie Sternberg
Stephen P. Tereshko, E'75
Joseph M. Vecchio, E'63, ME'69
Robert E. White, E'70
Christopher H. Willis, E'82
Donald R., E'68, and Barbara Wood, N'68
Richard R. Yuse, E'74, ME'76
John A. Zorzy, E'80
Anonymous

## FELLOW'S LEVEL
($2,500 - $4,999)

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Paul F. Bailey, E'70
Gary J. Broberg, E'89
Elvino M., E'83, and La-salete C. Da Silveira, PNT
George D. Dick, LC'63, UC'67
Robert N., E'58, ME'63, and Felicia B. Donadio, LA'60
Rita F. Fahy, LA'78, ME'89
Robert L., E'59, and Frances Z. Goldberg
Edward J. Higgins, E'52
Tom Korbas, E'73
William E. Mackey, Jr., E'58, ME'66
Robert C., E'54, H'97, and Anne Marini
Ralph E. M. Noblin, E'76
George A. Papa, E'71
Richard A., E'69, and Bernyd P. Rosenberg, PAH'67
Steven K. Ruggieri, E'74
Edward T., Jr., E'70, and Linda M. Vitone, LA'71
Anonymous

## ASSOCIATE'S LEVEL
($1,000 - $2,499)

Alfred F. Andersen, E'67, ME'71
Carlton C. Anderson, E'50
David J., E'83, and Claire M. Anderson, PNT
Jerrold D. Atlas, E'57
Frederick G. Aufiero, Jr., E'67, ME'79
Robert J. Averill, E'57, ME'59
Philip Ayers, E'69, L'74
Jonathan E. Bachand, E'03
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Robert E., E'60, and Ruth S. Binder, LA'60
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Stephan G., E'90, and Nancy Braun, AS'91
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Alan B. Butler, E'67
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Nassib G. Chamoun, E'84, and Maureen P. Kelly-Chamoun, PNT
Lynne S. Champion, E'69
Ming Chang, E'69, ME'72
Gep D. Chin, E'55
Supadej Chirasavinuprapand, E'86, ME'87
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Brian C. Considine, E'62, ME'64
Steve D. Daigle, E'94
Joseph G. Davis, E'65
Roger P. Day, E'75, and Joan Hong
Robert F., E'61, ME'68, and Susan R. Daylor, PNT
Kevin B. Deasy, E'64
Robert A. Derrah, E'55
Robert A. Desantis, E'64
Roger J., E'63, and Rochelle K. Dolan, E'63
Daniel G. Dufresne, E'62
Maarten A. Eenkema van Dijk, E'14
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Daniel D. Fay, E'88
Ronald M. Fish, E'81
Sidney Freedman, E'57
Thomas L. Gallerani, E'64, MBA'69
Albert J. Glassman, E'57
Robert M., E'62, and Deanne Glorioso
Diane, E'89, and Charles J. Gore, E'89, ME'96
Roger H. Grace, E'66, ME'69
David L. Greaves, E'71
Stephanos S., ME'62, and Katherine A. Hadjiyannis
Mark X. Haley, E'71
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Anthony M. Helies, ME'70
Timothy J. Higgins, E'79
Carl T. Hoefel, Jr., E'79, MBA'88
K. Steven Horlitz, ME'73
Dennis A. Huebner, E'67, ME'76
David H., E'67, and Janet A. Hurwitz
Scott J. Israel, ME'82
Carl R. Johnson, E'73
Barton B., E'82, and Ann Marie Jones, BHD'82, PNT
Nicholas H. Katis, E'88
Robert E. Kearney, E'71
Marilyn B. Kloss, E'82
Adam J. Kulczyk, E'03, MBA'10, and Evelyne Giguere
Edward J. Lenormand, E'66, ME'71
Louis Y. Lin, E'87
William J., E'98, and Michele Loconzolo, E'93
John M. Looney, ME'67
G. Raymond Luddy, III, E'69
Bruce R. MacDonald, E'86, PNT
Qunkai Mao, ME'00, and Cuie Hu, ME'02
Peter E. McCabe, E'88
Michael B. McGrath, E'70
William C. McLeod, E'68
Marvin Menzin, ME'62, ME'79
Paul. J. Merluzzi, Jr., E'66
David C. Mores, E'72, ME'76
Edward F. Mosel, E'72
Ramesh K. Motwane, E'77
Richard Paul Moynihan, E'58
Khai H. Ngo, E'02
Kenneth O. Nilsen, E'69
Ralph Noistering, E'72
Robert A. Norbedo, E'66, ME'70
Gonzalo B. Otaola, E'83, and Claudia E. Cortina
Arthur A., E'60, and Dianne L. Pappas
Carlos F. Pena, E'02
Michael C. Pilla, ME'75
Albert B. Pincince, E'63
John, E'69, and Priscilla M. Promise, Ed'69
David A. Race, E'75, ME'76
Joseph M. Ranahan, E'05
David A. Ranhoff, E'78
John E. Reardon, E'58
Carlo Sartori Pacifici, E'14
Donald W. Saulnier, E'51
Robert A., E'69, and Eileen M. Segerson, LA'81
Jane Song, ME'00
Cyriaque Sukam, ME'00
Edward C. Swift, E'52
Edward H. Tutun, E'47
Ogbonnay A. Ukohaajike, E'88
Jaishri K. Vemuganti, ME'99
Albert Vezza, ME'64
Daniel Wapner, E'68
Richard L., E'70, and Christine White
Anonymous

# When Opportunity Knocks

*Every choice, every decision creates a twist or turn in life's journey. Ramesh Motwane's (E'77) journey is an American success story seeded from his ambition, resilience, and leadership.*

Starting with a diploma in civil engineering from Gandhidam Civil Engineering Institute in India, Motwane boldly left his homeland of India early in his career for a position in Kuwait as a resident engineer. "Opportunity knocked, and I took it," he says.

Four years later, it knocked again. Motwane sought to come to the United States for a better life. Visas at that time from India to the U.S. took a decade, but since Motwane was in Kuwait, he was granted a visa is just 11 days. "My decision to relocate to Kuwait gave me the opportunity to emigrate to the U.S.; without that my life would be very different today," he explains.

But when Motwane arrived in the Boston-area, opportunity didn't come calling. "Everyone wanted to hire someone with local experience, local education. I had none. I went to interviews with a suit and tie. People here don't go to construction sites dressed like that. I didn't know," he says. Motwane didn't give up. He humbly took a night shift position as a machinist, and while doing so exploited the opportunity. Motwane, explained, "No one wanted to work at night. So there was a lot of overtime. I used that to my advantage and saved up $11,000 [a value of $64,000 in 2017] in just 14 months in a new country!" With his savings, Motwane invested wisely, putting a deposit down on a house in Needham, Massachusetts.

Owning a home in a new country in such a short time was a tremendous accomplishment, but it was not enough. Motwane explained, "I was an engineer, but doing odd jobs. Maybe I should go back to India, I thought. Then I saw an ad from Northeastern, saying 'Come to our open house. We'll give you credit for your qualifications.'" Again, opportunity knocked and Motwane answered. Within four weeks he was enrolled in the engineering program, choosing to forego transferring 48 credits. "It had been over 13 years since I was in school. I wanted to start over so that it was fresh and local," he says, "but at the same time I needed an accelerated

*"I would not be where I am today without Northeastern making my education possible. I want to pay back what I can to the institution that made such a difference in my life."*

— Ramesh Motwane, E'77

path to make completing the degree possible."

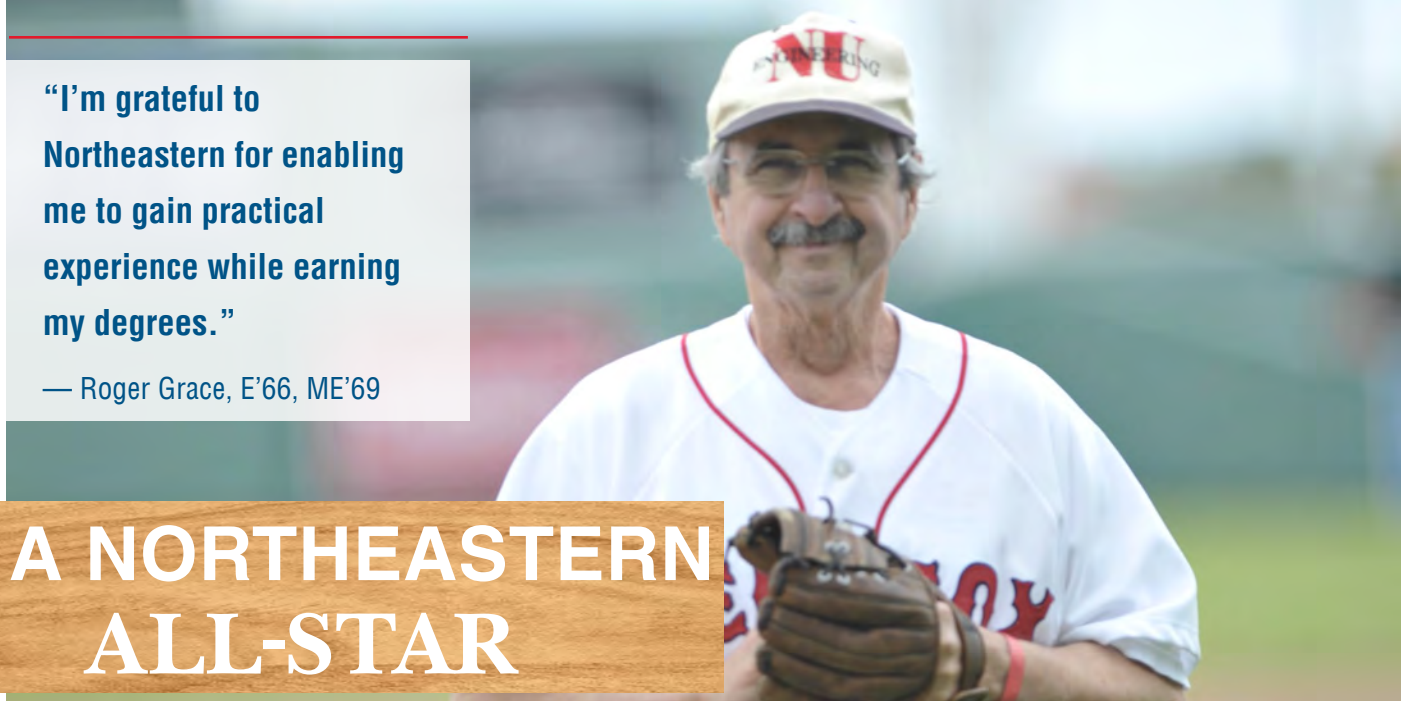
With years of work experience in India and Kuwait, Motwane urged for a waiver to the co-op experience. His perseverance paid off. "I am forever grateful to the then Dean Spencer of the College of Engineering," he says. "He came to my rescue. Without his help I would not be where I am today."

Motwane pursued his education without breaks and completed the program in under 3.5 years. But upon graduation, the economy was such that no one was hiring. He didn't give up. Eventually, he landed a job for a construction company handling a small scale building project in Salisbury, Massachusetts. He says, "Everything that could go wrong with that job, went wrong, and the company still made money. I thought, I should open my own business." And that dream became reality when he realized that the equity in his Needham home increased his initial investment nearly five times. "It was a sign. I seized the opportunity, and from there everything I touched turned to gold," says Motwane.

In less than nine years and not yet 40 years old, Motwane's business, Eastern Contractors, Inc., was so successful that he purchased a new Rolls Royce in 1986. Ultimately, his company grew to a half-billion dollar enterprise with 560 employees, and in 2003 was named the second largest Indian-run business in the U.S. by the *India Abroad* newspaper, behind only Bose Corporation. After closing his business in 2008, today Motwane reaps the benefits of the opportunities he's seized over the years, including his Bentley luxury car and a sprawling beautiful home with indoor pool. He also remains a longstanding charter member of TiE Angels, a non-profit organization nurturing early-stage entrepreneurs. Additionally, he actively supports his alma mater in India, which has recently named its MBA program after him: Tolani Motwane Institute. Masters of Business Administration. Gujrat Technological University, Adhipur, Kutch.

"We come into this world with nothing. And we leave with nothing. It is when we are here, during our life, should we make use of what we have," explains Motwane. And part of that includes giving back. Motwane is generously giving 40 percent of his estate to Northeastern University's College of Engineering.

"I would not be where I am today without Northeastern making my education possible. I want to pay back what I can to the institution that made such a difference in my life," says Motwane. It is advice he shares with others too. "Don't forget the people who came forward to help you when you needed it the most—professors, staff, and others, starting with your parents, and try to donate what you can whether that is $1, $100, or $1 million," he says.



**"I'm grateful to Northeastern for enabling me to gain practical experience while earning my degrees."**

— Roger Grace, E'66, ME'69

# A NORTHEASTERN ALL-STAR

As an electrical engineer who transformed himself into a strategic marketing consultant, Roger Grace, E'66, ME'69, has had an amazing track record of success. If you ask this energetic alum what's behind his impressive achievements, he's quick to answer.

"I attended Northeastern for eight years—first as an undergraduate doing co-ops, then as a graduate student employed at Raytheon," says Grace. "That combination of classroom learning and hands-on experience jumpstarted my career. I'm grateful to Northeastern for enabling me to gain practical experience while earning my degrees."

As an undergraduate co-op at Avco, an aerospace firm in Wilmington, Massachusetts, Grace rose from the role of a technician to that of an antenna design engineer. "I was at the top of the food chain, doing the same work as college graduates," explains Grace. "I left Northeastern with three years of professional experience. I didn't have the highest grades in our graduating class, but I received the highest job offer at graduation from a West Coast firm. However, I decided to stay in Boston and attend Northeastern for graduate school."

Grace earned his masters at Northeastern as a Raytheon Company Fellow, then worked for the company for several years, managing teams of engineers developing electronic warfare systems. He later worked at Ford Aerospace in Palo Alto, California, designing satellite communications systems.

"I realized that I enjoyed managing people and projects, working with executives, and bringing technologies to market," notes Grace. He founded his own consultancy, Roger Grace Associates, in 1982 to help companies from startups to Fortune 100 companies commercialize their products. Grace has demonstrated his gritty entrepreneurship passion for over 30-plus years serving his many high-tech clients, and through his 1990 to 2003 adjunct faculty position at the University of California Berkeley, College of Engineering where he team-taught the marketing segment of a class on entrepreneurship and business plan development. As an acknowledged world expert in the commercialization of sensor technology, he was duly recognized with the inaugural "Sensor Industry Impact Award" by *Sensors Magazine* in June 2016. Grace was honored with the Northeastern University Distinguished Engineering Alumnus Award in 2004.

Over the years, Grace has maintained close ties to Northeastern, serving on President Joseph Aoun's West Coast Council and the Advisory Board of the College of Engineering. In October 2016, Grace helped organize and was the general chair of an all-day workshop on printed sensors and systems at Northeastern's Silicon Valley campus, at which several representatives of the College of Engineering gave presentations, along with Provost James Bean.

Grace has also endowed scholarships that help students write their own success stories. "It only makes sense to give back to the University—and to support the next generation of hard-working engineers and entrepreneurs," he states.

A native of Somerville, Massachusetts, Grace is just as passionate about the Red Sox as he is about Northeastern. On February 23, he experienced a lifelong dream when he threw out the first pitch at the team's 2017 opening day ceremony at Jet Blue Park in Ft. Myers, Florida, using a baseball glove dear to his heart; it was given to him from his father when Grace was in Little League.

Roger Grace, Lincoln Park, Somerville Mass., Little League in the 1950s

"The Cochrane Fellowship Fund is a way to give back in recognition of the opportunities that Northeastern has given me."

*—John Cochrane, E'60*

John "Jack" Cochrane has watched Northeastern evolve dramatically over more than six decades, first as a civil engineering student and later as a faculty member. But, he says, one constant remains: the university's "progressive, rigorous engineering program that gave me my start."

Cochrane, E'60, earned his MS and PhD from Rensselaer Polytechnic Institute, and returned to Northeastern in 1965, joining its civil and environmental engineering faculty—ultimately serving as department chair and retiring as professor emeritus. A licensed engineer, he has consulted on environmental projects in the Northeast and was active in numerous professional societies.

Today, Cochrane is deepening his commitment to Northeastern by endowing the Cochrane Fellowship Fund through an outright gift and provision in his will. The fellowship will support talented graduate students in the Department of Civil and Environmental Engineering, equipping them with a solid foundation "for a thriving and rewarding career," he says.


Northeastern University
*Office of Gift Planning*

***617.373.2030 • giftplanning@neu.edu***
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# Northeastern University
## College of Engineering

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