



Northeastern University
College of Engineering

2020 | 2021

SCHOLARSHIP REPORT ELECTRICAL AND COMPUTER ENGINEERING

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With over 195 tenured/tenure-track faculty, 17 multidisciplinary research centers and institutes, and funding by eight federal agencies, the College of Engineering is a leader in experiential education and interdisciplinary research, with a focus on discovering solutions to global challenges to benefit society.

Northeastern University

Founded in 1898, Northeastern is a global research university and the recognized leader in experience-powered lifelong learning. Our world-renowned experiential approach empowers our students, faculty, alumni, and partners to create impact far beyond the confines of discipline, degree, and campus.

Our locations—in Boston; the Massachusetts communities of Burlington and Nahant; Charlotte, North Carolina; London; Portland, Maine; San Francisco; Seattle; Silicon Valley; Toronto; and Vancouver—are nodes in our growing global university system. Through this network, we expand opportunities for flexible, student-centered learning and collaborative, solutions-focused research.

Northeastern's comprehensive array of undergraduate and graduate programs—in on-campus, online, and hybrid formats—lead to degrees through the doctorate in nine colleges and schools. Among these, we offer more than 140 multidisciplinary majors and degrees designed to prepare students for purposeful lives and careers.



**We are a leader
in experiential
education and
interdisciplinary
research, focused
on Engineering
for Society**

DEAR COLLEAGUES, FRIENDS, AND STUDENTS,

I am delighted to report that despite the challenges posed by the pandemic, the faculty and students in Northeastern University's Department of Electrical and Computer Engineering (ECE) continued to thrive and advance their research and studies with unbridled enthusiasm and outstanding success.

Applications of artificial intelligence and machine learning in next generation engineered systems have been a major focus of the department in the last year. Assistant Professor Xue Lin was funded by DARPA to build a scalable learning system for reverse engineering of deception in both machine-centric and human-centric attacks. Robert D. Black College of Engineering Distinguished Professor Michael Silevitch led the AI Jumpstart program funded by the State of Massachusetts to connect small businesses with academic faculty to facilitate integration of machine learning techniques to improve their overall competitiveness and productivity. The team led by Dennis Picard Trustee Professor Mario Sznaier received a Multidisciplinary University Research Initiative (MURI) award by the Office of Naval Research, entitled "Control and Learning Enabled Verifiable Robust AI" (see page 7). Associate Professor Stratis Ioannidis and Professor Edmund Yeh were funded by the NSF to pioneer a data-centric approach to distributed machine learning. Professor Kaushik Chowdhury, William Lincoln Smith Professor Tommaso Melodia, and Associate Professor Stratis Ioannidis are part of the NSF AI Institute for Future Edge Networks and Distributed Intelligence (AI-EDGE). AI-EDGE aims to leverage the synergies between networking and AI to design future generations of wireless edge networks that are highly efficient, reliable, robust, and secure, and facilitate solving longstanding distributed AI challenges. In 2021, Northeastern University received the rare designation by the Federal Communications Commission as a Spectrum Innovation Zone, a status that will afford researchers at the university new opportunities to build and test the next generation of wireless technology.

In the last year, our faculty have been the recipient of several prestigious awards, including the NSF CAREER Awards (Assistant Professor Cristian Cassella and Associate Professor Mahshid Amirabadi), IEEE Technical Committee on Secure and Dependable Measurement Early-Career Award (Assistant Professor Yanzhi Wang), the DSN-2021 Rising Star in Dependability Award (Assistant Professor Devesh Tiwari), Fulbright Award (University Distinguished Professor Dagmar Sternad), amongst several others. College of Engineering Distinguished Professor David Kaeli was appointed to serve as the Editor-in-Chief of ACM Transactions on Architecture and Code Optimization. Our students have been equally successful in garnering prestigious awards. Spencer Lake Jacobs-Skolik, an electrical engineering major, was awarded the Barry Goldwater Scholarship. Jacob Kaplan, a computer engineering and computer science major, was awarded the Fulbright student award. Northeastern's Electric Racing (NER) student organization won first place in the Formula Hybrid+Electric competition all-electric vehicle class.

This year, the department added eight new tenure-track faculty in the areas of IoT, Robotics, Smart Devices and Systems, Control Theory, and Ubiquitous Computing. Two new research faculty appointments were made to augment the strategic growth and vision of the department. The year also saw the addition of a new concentration to our MS program—Hardware and Software for Machine Intelligence. In the last year the department completed the renovations of approximately 5000 sq. ft. of undergraduate laboratories and classroom spaces. The space now includes new equipment for the undergraduate electromagnetics class and Keysight supported state-of-the-art equipment for networks and communications laboratory. The new capstone/makerspace laboratory now houses comprehensive LDKF PC board making capabilities among other new equipment.

This annual scholarship report provides a more comprehensive overview of the exceptional academic and professional accomplishments of our faculty and students for the 2020-2021 academic year. With excellence as our focus, we look forward to training a more equitable and inclusive engineering workforce around the world.



Sincerely,

Srinivas Tadigadapa, PhD
Chair of Electrical and
Computer Engineering
s.tadigadapa@northeastern.edu

**For the latest highlights, please visit us at
ECE.NORTHEASTERN.EDU.**

QUICK FACTS ELECTRICAL AND COMPUTER ENGINEERING

The department offers **8** research concentrations and is either the lead or partner of **11** federally-funded research centers and institutes.

Newest Research Centers and Institutes:

- Center for Hardware and Embedded Systems Security and Trust
- Institute for Experiential AI
- Institute for Experiential Robotics
- Institute for the Wireless Internet of Things
- Northeastern SMART Center

\$48M

External Research Awards FY2021

- 8% DHHS
- 55% NSF
- 1% Foundation/Non-Profit
- 18% DOD
- 11% Federal/Other
- 5% Industry/Corporation
- 2% DOE

69

TENURED/TENURE-TRACK
Faculty

31

Professional Society Fellowships
Including **14** IEEE Fellows

41

Young Investigator Awards
Including **18** National Science Foundation CAREER Awards

2021 NSF CAREER Award Recipients

Mahshid Amirabadi, Associate Professor
Cristian Cassella, Assistant Professor

Promotion

Mahshid Amirabadi
Associate Professor



Stefano Basagni
Full Professor



300

Doctoral Students

345

Masters Students

Graduate Student Enrollment
Up 25%
vs. 2015



QUICK FACTS COLLEGE OF ENGINEERING

With **200** tenured/tenure-track faculty and **17** multidisciplinary research centers and institutes with funding by eight federal agencies, the College of Engineering is a leader in experiential education and interdisciplinary research, with a focus on discovering solutions to global challenges to benefit society.

5

Engineering Departments

104

YOUNG INVESTIGATOR Awards

Including **58** NSF CAREER Awards, and **18** DOD Young Investigator Awards

84

Professional Society Fellowships

949

Graduate Students
Placed on Co-op
(2020-2021)

TOTAL ENROLLMENT (Fall 2020)

7873

49.8% Graduate
50.2% Undergraduate

Enrollment Growth (2015 to 2020)

52% MS

34% PhD

16% BS



RECENT FACULTY HIRES



GREGORY D. ABOWD
Professor, Electrical and Computer Engineering, and Dean of the College of Engineering
D.Phil, University of Oxford, United Kingdom, 1991
Scholarship focus: Mobile and Ubiquitous



MAHDI IMANI
Assistant Professor, Electrical and Computer Engineering
PhD, Texas A&M University, 2019
Scholarship focus: Machine learning and data analytics, control theory and reinforcement learning, bayesian optimization and statistical learning, statistical signal processing and integrated sensing



BENYAMIN DAVAJI
Assistant Professor, Electrical and Computer Engineering
PhD, Marquette University, 2016
Scholarship focus: Integrated microsystems, data-guided design and nanofabrication, ultrasound microsystems for sensing and computation, and MEMS calorimetry for microbiology and biosensor development



SUNIL MITTAL
Assistant Professor, Electrical and Computer Engineering
PhD, University of Maryland, 2014
Scholarship focus: Topological phenomena, non-Hermitian physics, quantum photonics, nonlinear photonics, two-dimensional materials



KRISTEN DORSEY
Associate Professor, Electrical and Computer Engineering
PhD, Carnegie Mellon University, 2013
Scholarship focus: Soft robotics, wearable devices, active and multifunctional materials, flexible electronics



DAVID ROSEN
Assistant Professor, Electrical and Computer Engineering
PhD, Massachusetts Institute of Technology, 2016
Scholarship focus: Robotics, optimization, geometry and topology, probability and statistics, machine learning



CANEK FUENTES-HERNANDEZ
Associate Professor, Electrical and Computer Engineering
PhD, University of Arizona, 2004
Scholarship focus: Flexible and stretchable organic microelectronics and optoelectronics, device physics and engineering for sensing and energy generation, high throughput manufacturing and heterogeneous integration



XUFENG ZHANG
Assistant Professor, Electrical and Computer Engineering
PhD, Yale University, 2016
Scholarship focus: Spin wave dynamics; magnon-based coherent information processing; quantum hybrid magnonics; integrated microwave, photonic, magnonic, and mechanical devices

FACULTY BY RESEARCH AREAS

Communications, Control & Signal Processing

Kaushik Chowdhury
Pau Closas
Jennifer Dy
Deniz Erdogmus
Vinay Ingle
Stratis Ioannidis
Josep Jornet
Hanoch Lev-Ari
Jose Martinez Lorenzo
Tommaso Melodia
Sarah Ostadabbas
Purnima Ratilal-Makris
Francesco Restuccia
Masoud Salehi
Bahram Shafai
Milad Siami
Hanumant Singh
Milica Stojanovic

Computer Networks & Security

Stefano Basagni
Kaushik Chowdhury
Yunsi Fei
Josep Jornet
Engin Kirda
Dimitrios Koutsonikolas
Tommaso Melodia
Francesco Restuccia
Wil Robertson
Xiaolin Xu

Computer Systems & Software

Yunsi Fei
David Kaeli
Mieczyslaw Kokar
Dimitrios Koutsonikolas
Miriam Leeser
Xue Lin
Fabrizio Lombardi
Ningfang Mi
Gunar Schirner
Devesh Tiwari
Yanzhi Wang
Xiaolin Xu
Edmund Yeh

Computer Vision, Machine Learning, & Algorithms

Octavia Camps
Jennifer Dy
Deniz Erdogmus
Yun Raymond Fu
Stratis Ioannidis
Jose Martinez Lorenzo
Waleed Meleis
Sarah Ostadabbas
Milad Siami
Lili Su
Hao Sun
Yanzhi Wang

Electromagnetics & Optics

Charles DiMarzio
Siddharth Ghosh
Vincent G. Harris
Yongmin Liu
Edwin Marengo
Jose Martinez Lorenzo
Hossein Mosallaei
Carey Rappaport
Purnima Ratilal-Makris
Michael B. Silevitch
Milica Stojanovic
Nian X. Sun
Srinivas Tadigadapa

Microsystems & Devices

Cristian Cassella
Siddharth Ghosh
Yong-Bin Kim
Nicol McGruer
Marvin Onabajo
Matteo Rinaldi
Aatmesh Shrivastava
Nian X. Sun
Srinivas Tadigadapa
Hongli (Julie) Zhu

Power Electronics, Systems & Controls

Ali Abur
Mahshid Amirabadi
Bradley Lehman
Bahram Shafai
Milad Siami
Eduardo Sontag
Mario Sznaier
Wei Xie

Robotics

Jose Martinez Lorenzo
Taskin Padir
Alireza Ramezani
Bahram Shafai
Milad Siami
Hanumant Singh



Cristian Cassella, assistant professor, electrical and computer engineering

NSF CAREER Award to Exchange Massive Data in Crowded and Noisy Mediums

Cristian Cassella, assistant professor, electrical and computer engineering, received a \$409K National Science Foundation CAREER Award for “Giant Tunability through Piezoelectric Resonant Acoustic Metamaterials for Radio Frequency Adaptive Integrated Electronics.”

For advanced technologies to succeed, such as cloud-storage, edge-computing, machine learning, artificial intelligence (AI), and fifth-generation (5G) wireless communication, new hardware components such as more stable frequency synthesizers (FSs) based on novel materials and techniques need to be developed. Also, the internet of things has created a growing number of wireless nodes within an already congested spectrum.

To address this, Cassella and his research team are developing a new class of passive, tunable, and high-performance integrated resonant devices called Piezoelectric Resonant Acoustic Metamaterials (pRAMs). pRAMs have unique, artificially produced, and reconfigurable modal features that can be

leveraged to form more stable frequency synthesizers as well as to increase the limited resilience to interference of the existing radios. They will enable new stable frequency synthesizers, adaptive front ends for IoT radios, and many other on-chip transducers for sensing and communication.

For several years, Cassella has been developing communication devices that utilize the unique and combined features of electrical and acoustic domains, including components that provide frequency references similar to those used to regulate the motion of a clock. He realized that by leveraging these components, future radios can more easily and more efficiently discriminate data streams from different service bands—such as Bluetooth or Wifi—making sure that any received electromagnetic wave reaches the most adequate radio component responsible for extracting the desired information.

Cassella hopes pRAMs will enable future generations of connected wireless nodes to be more immune from cyberattacks, while consuming less and less power in favor of longer battery lifetimes. This new technology has ramifications not only in communications, but also in sensing applications where the strong magnetosensitive response of pRAMs will be investigated to form new chip-scale magnetometers with exceptional sensitivities suitable for critical biomagnetic applications and more.



Mahshid Amirabadi, associate professor, electrical and computer engineering

NSF CAREER Award to Improve Renewable Energy Systems

An energy system is only as reliable as its weakest link, which is why **Mahshid Amirabadi**, associate professor of electrical and computer engineering, has received a \$400K CAREER Award from the National Science Foundation to improve the weakest links in renewable energy systems.

“Our main goal is to reduce the cost of electricity from renewable energy,” says Amirabadi. “That’s what we have to do to make renewables dominant, which is so important to the environment. Additionally, increasing the reliability of renewable energy systems is crucial to building public trust.”

Power converters are a key component in transferring power from solar panels and wind turbines into the grid. Amirabadi is developing the next-generation power converter—a universal, silicon-carbide based, converter that will be smaller, cheaper and more reliable than those that rely on traditional electrolytic capacitors.

The current converters used in residential solar systems have an average life of 5 to 10 years compared to the 25-year life of solar panels, which means that the overall reliability of the system is

cut by more than half. The cost to repair, replace, ship, or install new converters in the system due to this unreliability drives up the overall cost of renewable energy.

Because Amirabadi’s converter will be universal it eliminates the need for a series of cascading converters to handle power conversion between sources, and loads with different forms, voltage amplitudes, and frequencies in a complex power system.

“Therefore, the same converter can be used throughout complex systems, as opposed to our current situation where you need many different kinds of converters,” she says.

Amirabadi’s research builds upon her previous work, including two recent patents: a reliable converter for systems with unequal instantaneous input and output power such as residential solar systems (2019) and a general capacitive-link universal converter that uses soft switching technology to increase efficiency (2020).

She says that several of her proposed converters have been successful in the prototyping process and she is approaching the commercialization stage for those topologies. For now, she hopes to license the inventions through an existing company, but in the future she hopes to launch a startup of her own.

\$7.5 Million DoD MURI Award for Control and Learning Enabled Verifiably Robust AI



Mario Sznaier, Dennis Picard Trustee Professor, electrical and computer engineering

Mario Sznaier, Dennis Picard Trustee Professor, electrical and computer engineering (ECE), is leading a multi-university team that was awarded a \$7.5 million, five-year grant from the Department of Defense (DoD) as part of the Multidisciplinary University Research Initiative competition.

Sznaier's project, titled "Control and Learning Enabled Verifiable Robust AI (CLEVR-AI)," is sponsored by the Office of Naval Research and includes co-PIs from Northeastern—Professor **Octavia Camps** and Assistant Professor **Milad Siami**, both from ECE, and University Distinguished Professor **Eduardo Sontag**, ECE and bioengineering—and from UC Berkeley, the

University of Michigan, and Johns Hopkins.

Sznaier and his team are designing control systems capable of utilizing artificial intelligence (AI) and machine learning methods to learn from and interact within complex environments in a safe way. Like living systems, the resulting systems will adapt to novel scenarios, where data is generated—and decisions are made—in real time.

The research will lead to a new neurally inspired framework for learning and control, where insights from dynamical systems are used to design verifiable and safe machine learning algorithms, and insights from machine learning and neuroscience are used to design the next generation of learning-enabled control systems. This framework will be a key enabler for designing a new class of truly autonomous systems that are aware of high-level mission specifications and low-level physical constraints and capabilities.

This capability will benefit a variety of mission-critical applications such as providing situational awareness to humans like first responders experiencing information overload in a disaster area, and for monitoring large uninhabited spaces such as coastlines and forests for potential hazardous situations.

"There is a disconnect between the promise of AI and the low level of autonomy in existing systems," explained Sznaier. "The issue we are working to solve is how to make an autonomous system learn about new situations in its environment while still making safe decisions in real time. This is something that researchers have struggled with; it's hard to task something that is self-learning to perform safety-critical actions in unknown, previously unseen environments."

Self-learning autonomous systems need to operate in a closed-loop system, meaning they are making continuous corrections on their actions and learning as they go. The problem is that if a system makes an incorrect action, then those continuous corrections compound themselves. In extreme examples, the self-driving car hits a stop sign, or the self-driving drone crashes.

Sznaier's team members comprise a wealth of knowledge in diverse areas, such as control theory, machine learning, computer vision, and bioengineering. This academic expertise is enhanced by university capabilities, such as Northeastern's flight facility for unmanned autonomous systems and the University of Michigan's Mcity Test Facility, a purpose-built proving ground for testing automated vehicles under controlled and realistic conditions.

Pioneering a Human-Centric Artificial Intelligence Research and Applications Hub

Northeastern University has allocated \$50 million to the new Institute for Experiential AI, a pioneering research hub that places human skills and intelligence at the forefront of artificial intelligence applications. Leading experts in computer science, engineering, ethics, humanities, law, public policy, health, security, and sustainability will collaborate to develop applied human-centric AI solutions that tackle the world's toughest challenges.

The Institute for Experiential AI is university-wide, based out of the Roux Institute at Northeastern—a graduate education and research campus in Portland, Maine, born from a \$100 million investment in the university by David and Barbara Roux (see page 11). Designed to educate generations of talent in the digital and life sciences sectors, the Roux Institute also acts as a driving force for sustained economic growth in Portland, the state of Maine, and northern New England.

"Northeastern has committed to building the top research institute in the world focused on Experiential AI," says founding Executive Director **Usama Fayyad**. "No one has claimed this space yet and I'm excited for our chance to lead this field."

To accelerate research and advance practical applications of AI in several domains, the Institute for Experiential AI is recruiting 30 new research and teaching faculty, data scientists, and postdoctoral fellows. In addition, faculty from colleges within the university such as the College of Engineering and Khoury College of Computer Sciences will conduct and collaborate on multidisciplinary research as part of the institute.

The Institute for Experiential AI will partner with industry, government, and academia to educate the next generation of AI professionals and lead efforts to create ethical and responsible human-centric AI. The institute also plans to be a prominent contributor to the global AI ecosystem and a key driver of experiential AI in New England through targeted activities in the region.

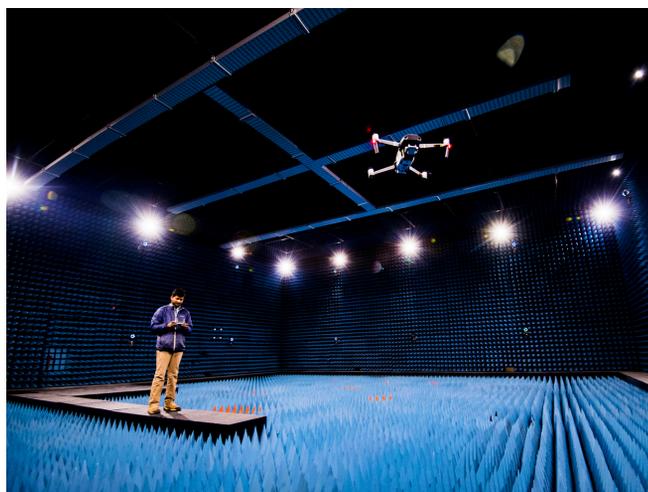


Photo by Matthew Modoono



New Wireless Testing and Emulation Facilities Push Innovation to New Heights

Northeastern is at the leading edge of wireless research and in recent years has added to its sophisticated facilities. In 2019, the Expeditionary & Unmanned Aircraft Systems Lab was opened at the Innovation Campus in Burlington, Massachusetts. In 2020, Colosseum, the world's largest wireless testbed built by the Defense Advanced Research Projects Agency (DARPA) and part of Northeastern's Institute for Wireless Internet of Things, was added at the Burlington location. And in 2021, Northeastern received a rare designation as a Spectrum Innovation Zone by the Federal Communications Commission. The Innovation Zones at the Boston and Burlington, Massachusetts, campuses establish the university as the fourth such hub in the U.S. and the first to



The indoor anechoic chamber of the Expeditionary Cyber and Unmanned Aircraft System Lab

enable experimentation for wireless communications and sensing technologies above 100 gigahertz, including a frequency band that is crucial for the development of 6G technologies.

The Expeditionary Cyber & Unmanned Aircraft Systems Lab

A 1.8 million cubic-foot outdoor test cage with flight path to the 50'x50'x22' indoor anechoic chamber, the Expeditionary Cyber and Unmanned Aircraft Systems (UAS) Lab, funded by the U.S. Navy Office of Naval Research, is the first of its kind in the United States. It is designed for military and business leaders to partner with the university in cyber-security testing on drones. In 2019, The Air Force Life Cycle Management Center provided a \$2.8 million grant to fund research through its unit at nearby Hanscom Air Force Base.

The walls, floor, and ceiling of the radio-silent drone testing facility are lined with hundreds of blue protruding arrowheads, made of foam, which are designed to absorb radio frequency waves. They transform the square room into an anechoic chamber that enable government and private researchers to join with Northeastern and other universities in creating defenses against potential drone attacks. The facility is also encased with a Faraday cage of conducting material that creates an electromagnetic shield.

The indoor facility is connected to a netted enclosure outdoors, measuring 150' by 200'—large enough for GPS testing. Drones can be navigated in and out between the two areas for seamless exercises in all conditions. Additionally, sophisticated equipment enables researchers to understand expeditionary cyber, including handling electromagnetics and cyber over a very large frequency range; effects on navigation; and effects on global positioning signals, and how those can be corrupted at the expeditionary edge.

William Lincoln Smith Professor **Tommaso Melodia**, electrical and computer engineering, and director of the Institute for the Wireless Internet of Things, conducts research on unmanned aerial systems and on using drones to create new applications for societal benefit. "As a user of the UAS lab, my work is at the intersection of autonomous robotic drones and connectivity; how these drones are

connected with each other so they can exchange information,” says Melodia. “We’re working on new technologies to connect drones that operate at a high frequency rate—specifically 60 GHz—that’s known as millimeterwave communications, one of the foundational technologies for 5G and beyond. What this facility enables us to do is fly drones of different sizes that carry payloads, like millimeter-wave radios, and test their performance.”

Among the applications that Melodia and his team are working on are creating an on-demand mobile network of drones to provide additional wireless connectivity in specific locations when needed. They are also looking at using drones to provide connectivity in disaster scenarios. For example, in catastrophic hurricanes where entire wireless networks are wiped out, a network of drones could provide temporary connectivity to help locate survivors or provide disaster relief. Melodia and his team fly connected drones in the large anechoic chamber and its Faraday cage, which prevents signals generated outside to get inside the chamber. “That means you get a much higher fidelity performance because there’s no interference,” he says. It’s a great tool for doing research in this space and for evaluating use cases.”

Likewise, the outdoor facility provides the team with the ability to fly multiple drones in a controlled situation. “We conducted a demo for the Air Force with eight different drones flying in this environment,” says Melodia. “We could not have created a credible demo without access to a facility of this size.”

Other researchers are also benefiting from the capabilities of the UAV Lab, including Dennis Picard Trustee Professor Mario Sznaier, electrical and computer engineering, who is leading a \$7.5 million DoD Multidisciplinary University Research Initiative Award for control and learning-enabled verifiable robust AI.

Colosseum—the World’s Largest Wireless Emulator

Part of the university’s Institute for the Wireless Internet of Things (WIOT), Colosseum is the world’s largest wireless network emulator with hardware in the loop. It was originally developed by DARPA through an investment of \$20 million and transferred to Northeastern in 2020 through an additional \$6 million investment by the National Science Foundation to make Colosseum a shared instrument open to the research community. It is part of the WIOT’s Platforms for Advanced Wireless Research Program Office (PAWR), which is co-led by U.S. Ignite and Professor Tommaso Melodia of Northeastern. PAWR provides researchers with facilities to experimentally evaluate wireless networked systems in real-life testing scenarios. Colosseum allows researchers to virtually test their ideas before taking them to one of the program’s real-world testing sites.

Colosseum is a data center with 24 racks of 256 software-defined radios, 128 servers, and a vast number of FPGA and GPU processors, enabling the implementation of artificial intelligence and machine learning algorithms with radio hardware in the loop. This massive processing power means that Colosseum can emulate, in real-time, the 65,536 channels generated between all the radios, and their evolution in time. The system generates



Colosseum, the world's largest radio frequency emulator, is located at the Innovation Campus in Burlington, Massachusetts, and is part of the Institute for the Wireless Internet of Things, directed by William Lincoln Smith Professor Tommaso Melodia, electrical and computer engineering.

more than 52 terabytes of data per second, far exceeding the amount of information contained in the entire print collection of the Library of Congress. As a result, Colosseum can create virtual complex wireless environments and emulate wireless signals traveling through space and reflecting off multiple objects between transmitters and receivers. With Colosseum any realistic network scenarios can be created, investigated, and reproduced. In addition to its simulation capabilities, Colosseum can do AI and machine learning processes. Extensive AI research at Northeastern is benefiting from Colosseum such as the Institute for Experiential AI and the Massachusetts-funded AI Jumpstart Program.

Colosseum offers a tremendous opportunity for users in academia, industry, and government. It can help advance research, translate it to the real world, and support innovation to commercialize technologies for real-world impact.



Stefano Basagni, professor, electrical and computer engineering



Sara Wadia-Fascetti, vice provost, PhD Network, and professor, civil and environmental engineering



Luca Caracoglia, associate professor, civil and environmental engineering

One Program, Two PhDs, Two Continents

Northeastern’s new international doctorate program—the Global Experiential PhD—provides students with an opportunity to earn separate PhDs from two universities in two continents while dramatically expanding the breadth of their research. As an added benefit, the program also expands the international job opportunities for graduates.

“It’s like having two passports,” says Professor of Electrical and Computer Engineering **Stefano Basagni**, a thesis research advisor in the program. “To get a job at an American company, it helps if you have an American PhD, and the same is largely true of a European degree in the European Union.”

For **Irene Tallini**, PhD’24, computer engineering, the program provides the opportunity to conduct research in the United States while maintaining her relationship with Sapienza University of Rome, where she earned both her undergraduate and master’s degrees.

“This program provides huge intercultural opportunities,” Tallini says. “The professors in Northeastern’s Electrical and Computer Engineering department are experts in their sectors and I’m also excited about having access to the university’s unique facilities.”

As an engineer focused on wireless communication among underwater and aerial drones, Tallini is particularly interested in Colosseum, the world’s largest radio frequencies emulator (which is part of Northeastern’s Institute for the Wireless Internet of Things), and the Cyber and Unmanned Aircraft Systems R&D facility, both of which are situated at Northeastern’s Innovation Campus in Burlington, Massachusetts.

Because students spend half of their time at each institution, they are exposed to two different research cultures and the expertise of faculty with different areas of specialization. The program is also intentionally flexible to enable interdisciplinary research, thereby allowing students to pursue research in different fields at each institution. They must apply to each program independently and fulfill all of

the academic requirements of both programs. Under the supervision of a research supervisor from each institution, they write a single dissertation that earns them a separate PhD in each country.

The first two partners with the Northeastern program are Sapienza University of Rome and the University of Hong Kong. There are additional partnerships in the works.

“Northeastern is building a selective network of educational institutions around the globe,” says Vice Provost **Sara Wadia-Fascetti**, who is head of Northeastern’s PhD Network and professor of civil and environmental engineering. “We are a global institution—a networked institution. This increases mobility for our students and further extends our research outside Boston.”

“This program is based on the concept of convergence, which is a key component of interdisciplinary research,” says Wadia-Fascetti. “It’s important to maximize a student’s exposure to many different concepts and cultural experiences that connect ideas to one another and translate disciplines to one another. This exposure influences both the scope and direction of their research.”

Students aren’t the only ones who benefit from these partnerships, says Associate Professor of Civil and Environmental Engineering **Luca Caracoglia**, who along with Basagni has a longstanding relationship with Sapienza University and helped spearhead the new partnership.

Caracoglia, who is an expert on wind engineering and wind load effects, recently hosted a workshop bringing together Northeastern and Sapienza faculty who focus in structural engineering and geotechnical/geo-environmental engineering and who are currently advising civil engineering PhD students.

“For faculty, it’s a way to bring new perspectives to our research ideas and collaborate with experts in Italy through our students,” Caracoglia says.

Basagni agrees, adding that the program also provides important benefits for the university as a whole. “This is a way to attract the best students from universities around the world while enhancing our international visibility and connectedness.”



Expanding Research and Education with the Roux Institute at Northeastern

The Roux Institute at Northeastern University is a graduate education and research campus in Portland, Maine, made possible by a \$100 million investment in the university from David and Barbara Roux in 2020. It is designed to transform Maine's economy by making it a hub for innovation in experiential artificial intelligence, digital engineering, advanced life sciences, and entrepreneurship. Its new model of graduate education and entrepreneurship is powered by Northeastern's experience forging industry partnerships. Currently, the Roux Institute has over 40 industry, academic, and civic partners.

With The Roux Institute's focus in AI and digital engineering, Northeastern's Institute for Experiential AI, led by Executive Director **Usama Fayyad**, will be based at the Roux Institute, and Professor **Jennifer Dy**, electrical and computer engineering, has been appointed director of experiential AI postdoc education there. New bioengineering faculty have joined as part of the Roux Institute's leadership team. Associate Professor **Aileen Huang-Saad** is director of life science and engineering programs, focused on developing interdisciplinary, experiential learning programs that will embed learners in the growing life sciences and engineering industries in Maine and at the Roux. Professor **Rai Winslow** is director of life sciences and medicine research. He will work at the leading edge of computational medicine, harnessing Big Data for predictive disease outcomes. Additionally, Professor **Jack Lesko**, mechanical and industrial engineering, jointly appointed in civil and environmental engineering, joins as director of engineering research. A materials researcher, he will focus on building deep industry collaborations. Also, Assistant Professor **Francesco Restuccia**, electrical and computer engineering, joined the Roux Institute to lead research conducted there as part of the Institute for the Wireless Internet of Things.

A research agreement was signed in May 2020 between the Roux Institute at Northeastern and the University of Maine as part of the mission to help build the Maine tech and life science economy with the power of Northeastern's research and learning enterprise in the areas of artificial intelligence, Earth and climate sciences, health and life sciences, manufacturing, and marine science. Seed funding was awarded to five collaborative research teams—including bioengineering, and electrical and computer engineering faculty. The one-year projects were selected from a pool of twenty-one applications through a rigorous review process and are the first funded as part of the collaborative research initiative established between the two universities. Each team was awarded \$50,000, and they work together to pursue larger external funding programs through federal and private sponsors.

As part of this, Assistant Professor **Sarah Ostadabbas**, electrical and computer engineering, in collaboration with the University of Maine, is leading a project to look at artificial intelligence's role in examining the interplay between newborns' pacifier use and Sudden Infant Death Syndrome. **Srinivas Tadigadapa**, professor and chair of the Department of Electrical and Computer Engineering, in collaboration with the University of Maine, is leading a project to develop a new biofluid analysis instrument that would have unprecedented sensitivity and selectivity, and could have broad applications for health care and medical diagnoses. And, Assistant Professor **Xue Shelley Lin**, electrical and computer engineering, is combining real-time deep learning and human-vehicle collaboration techniques in autonomous vehicles to assist older and visually impaired passengers. Working with a team of researchers from the Virtual Environment & Multimodal Interaction Laboratory at the University of Maine, she is building algorithms to lay the foundation of work so engineers can integrate deep learning—a branch of artificial intelligence that can help algorithms analyze huge amounts of high-dimensional info rapidly—and plug that information into the computing systems in self-driving cars.

The Roux Institute has also spurred engineering research collaborations with industry such as College of Engineering Distinguished Professor **David Kaeli**, electrical and computer engineering, who is conducting data visualization research with Maine fisheries. Also, Associate Professor and Director of the Institute for Experiential Robotics **Taskin Padir** who is working with industry partners in Portland to develop collaborative robots for recycling and seafood industries to provide workers with better experiences in challenging work environments.

In October 2020, the Harold Alfond Foundation donated \$100 million to the Roux Institute to provide financial aid for graduate-level students, funding for post-doctoral research, and support for co-ops with Maine employers. The Roux Institute will create additional research, entrepreneurship, education, and experiential learning opportunities for students and faculty across Northeastern's global network as it expands.

Faculty Highlights



Assistant Professor **Yanzhi Wang**, electrical and computer engineering, received the **IEEE Technical Committee on Secure and Dependable Measurement (TCSDM) Early-Career Award** for his “contribution to deep learning model

compression and real-time, mobile deep learning AI acceleration for precise calibration.” The award recognizes a junior researcher from either academia or industry who has demonstrated outstanding contributions to the field of secure and dependable measurement and systems in the early stage of his/her career development.



University Distinguished and William Lincoln Smith Professor **Vincent Harris**, electrical and computer engineering, has been named a **Senior Member of the National Academy of Inventors (NAI)**. NAI Senior Members are active faculty, scientists, and administrators from NAI Member Institutions who have demonstrated remarkable innovation producing technologies that have brought, or aspire to bring, real impact on the welfare of society. They also have growing success in patents, licensing, and commercialization.



Associate Professor **Charles Dimarzio**, electrical and computer engineering, has been named a **Senior Member of SPIE**, the international society for optics and photonics. Senior members are members honored for their scientific

excellence across the broad spectrum of optics and photonics research and applications, their active involvement with the optics community and SPIE, and significant performance that distinguishes them from their peers.

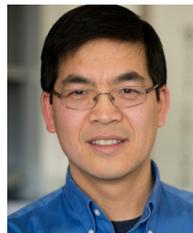


University Distinguished Professor **Dagnar Sternad**, biology, jointly appointed in electrical and computer engineering, has been selected for the **Fulbright Award** for the academic year 2021-2022 to work on “Variability and Redundancy in Motor Learning” at the Santa Lucia Foundation at the University of Rome Tor Vergata, Italy. The Fulbright Program is devoted to increasing mutual understanding between the people of the United States and the people of other countries. Fulbright is the world’s largest and most diverse international educational exchange program.

A core feature of our neuromotor system is that it affords a manifold of strategies for the same task goal. Due to this redundancy, sensorimotor learning means identifying this subset of solutions and shaping the ever-present variability along this manifold. Sternad will develop a novel mathematical approach that quantifies this progression from exploration to exploitation of the solution manifold. Using throwing as model task, the research team will show that variability in high-dimensional full-body movements and its distribution reveals mechanisms underlying learning and adaptation. Results from this research allow more fine-grained insights into learning, essential for many disciplines including rehabilitation.



Assistant Professor **Devesh Tiwari**, electrical and computer engineering, was selected to receive the **IEEE/IFIP DSN-2021 Rising Star in Dependability** for outstanding contributions and potential for creative ideas and innovative research in the field of dependable and resilient computer systems and networks. He is also leading a **\$500K National Science Foundation grant** for creating “HARMONIA: New Methods for Colocating Multiple QoS-Sensitive Jobs.” The project will provide a family of novel unconventional resource strategies leveraging the principles of Bayesian Optimization (BO), but introducing novel innovations to BO and demonstrating its usefulness toward data center resource management.



As part of a collaborative team of researchers from multiple institutions, Professor **Nian Sun**, electrical and computer engineering, and Professor **Hongwei Sun**, mechanical and industrial engineering, were awarded **\$660K in pledged funding as one of five third place winners of The Trinity Challenge (TTC)**, for their project Disease Surveillance with Multi-modal Sensor Network & Data Analytics, which is a wastewater surveillance system designed to operate in remote areas with little access to health services. It is a wireless sensor network, with patented sensor technologies, that detects pathogens in air and water up to one week before cases present in humans. TTC is a competition to invent the most effective methods by using data, analytics, and digital tools to ensure that health emergencies similar to the COVID-19 pandemic don’t upend societies in the future. Dame Sally Davies, master of Trinity College, Cambridge, and former chief medical advisor to the United Kingdom, in September 2020, brought together Northeastern University, Microsoft, Google, the Bill & Melinda Gates Foundation, and other industry leaders to participate in the challenge.

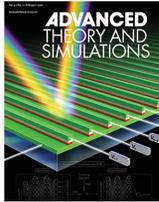




Professor **Miriam Leeser**, electrical and computer engineering, in collaboration with University of Massachusetts Amherst, was awarded a \$300K collaborative **EAGER National Science Foundation grant** for “CNS: PRATE: P4 Research enabled by Accelerators in national Testbeds.” The goal of the project is to make Field Programmable Gate Arrays (FPGAs) available to the cloud research community and to directly attach them to the network to enable enhanced data communication.



Associate Professor **Stratis Ioannidis** and Professor **Edmund Yeh**, electrical and computer engineering, in collaboration with Carnegie Mellon University, have been awarded a **\$1 million grant from the National Science Foundation** to pioneer a data-centric approach to distributed machine learning. The project utilizes advances in Named Data Networking (NDN) to enable new types of distributed learning algorithms that intelligently move data and model components through heterogeneous networks of sensors, while optimally harnessing the networks’ diverse computation, energy, and bandwidth resources. The project is expected to improve the performance of machine learning algorithms in a vast number of potential applications, ranging from smart cities to satellite data analysis to augmented reality.



The research of Professor **Hossein Mosallaei**, electrical and computer engineering, titled “Machine Learning: TCO-Based Active Dielectric Metasurfaces Design by Conditional Generative Adversarial Networks,” was featured on the cover of **Advanced Theory and Simulations**.



Associate Professor **Josep Jornet** (PI), and Professor **Matteo Rinaldi**, electrical and computer engineering, in collaboration with the University at Buffalo, the State University of New York, were awarded a **\$600K National Science Foundation grant** for “Control of Information Processing and Learning in Neuronal Networks through Light-mediated Programming of Genomic Networks,” to wirelessly reprogram neurons to restore or enhance memories.



The physical DNA interactions within the genome, or network of genes, determine gene activities and thereby the development and function of cells, similarly as the software determines the operation of the hardware in a computer. Being able to program genomic interactions in cells is at the basis of transformative applications. Optogenetics, or the control of the genome function through light, offers an unprecedented means to, for example, control brain development and function and design new corrective treatments of cancer and other diseases. The research project will study information processing and learning (and, thus, memory) in neuronal networks orchestrated by the light manipulation of the genome. For this, new photonic and electronic tools will be developed to program the genome in neurons and to study both the resulting changes in the structure and activity in networks of living neurons. The research goes beyond refining tools; it uses them specifically to study how information is processed in the brain, by controlling the genome of one cell at a time. This can be used to stop neurodegenerative diseases and restore lost functionalities in neurons, or, even more ambitious, enhance certain brain abilities.

Northeastern is part of a team led by the Ohio State University that was awarded \$20 million for the **NSF AI Institute for Future Edge Networks and Distributed Intelligence (AI-EDGE)**. Northeastern is responsible for \$1.8 million led by electrical and computer engineering faculty, including Professor **Kaushik Chowdhury** (PI), and co-PIs William Lincoln Smith Professor **Tommaso Melodia** and Associate Professor **Stratis Ioannidis**. AI-EDGE will leverage the synergies between networking and AI to design future generations of wireless edge networks that are highly efficient, reliable, robust, and secure, and facilitate solving longstanding distributed AI challenges.



Professor **Kaushik Chowdhury** (PI), William Lincoln Smith Professor **Tommaso Melodia** (co-PI), and Assistant Professor **Francesco Restuccia** (co-PI), electrical and computer engineering, are leading a **\$1.8M National Science Foundation grant**, in collaboration with Rice University, for “RFDataFactory: Principled Dataset Generation, Sharing and Maintenance Tools for the Wireless Community.” RFDataFactory aims to make available categorized datasets suitable for research related to machine learning in 5G and beyond networks, and advance fundamental understanding and design tools for accessing, creating, sharing, and storing wireless datasets. Restuccia was also awarded, in collaboration with University of California-Irvine, a \$415K NSF grant for “Reliable Task Offloading in Mobile Autonomous Systems Through Semantic MU-MIMO Control.”

College of Engineering Distinguished Professor **David Kaeli**, electrical and computer engineering, has been appointed to serve as **Editor-in-Chief of ACM Transactions on Architecture and Code Optimization**. ACM, the world’s largest educational and scientific computing society, delivers resources that advance computing as a science and a profession.

Faculty Highlights



Professor **Fabrizio Lombardi**, electrical and computer engineering, was selected for several **IEEE leadership positions**, including president-elect for 2021 and president for 2022-2023 of the IEEE Nanotechnology Council,

the vice president for 2021 of the IEEE Computer Society, and was one of three elected as a member of IEEE of the 2021 Publications Services and Product Board (PSPB).



University Distinguished Professor **Eduardo Sontag**, electrical and computer engineering, jointly appointed in bioengineering, was awarded a **\$750K grant from the Air Force Office of Scientific Research**, titled "Network Motifs and

Responses of Nonlinear Systems." The award will support his research into the mathematical foundations of biomolecular feedback control and signal processing. The project aims to explain how responses to external stimuli provide information regarding the internal structure of synthetic and natural cellular networks, elucidating the behavior of natural systems as well as helping to improve feedback control in engineered systems.



The **Advanced Robotics Manufacturing Institute** awarded funding to Associate Professor **Taskin Padir**, electrical and computer engineering, and director of the Institute for Experiential Robotics, for his project creating robotic

technology that can assist manufacturing workers eliminate the need to send masks for healthcare personnel to outside labs for testing. He is building a system that integrates robotic components and machine learning to speed up the testing, while using the intelligence of a human, who can supervise and assist the robot. The system includes sensors that would help a robotic arm handle different objects quickly and efficiently. In this \$1.1 million project funded by the Office of the Secretary of Defense, he is partnering with Merox Manufacturing, the largest producer of US-sourced PPE in Fall River, Massachusetts, and Boston Engineering Corporation in Waltham, Massachusetts.



Learn more about our accomplished faculty



College of Engineering Distinguished Professor **David Kaeli** and Assistant Professors **Yanzhi Wang**, **Xue (Shelley) Lin**, and **Devesh Tiwari**, electrical and computer engineering, were awarded a **\$570K National Science Foundation grant** for the "Acquisition of a Heterogeneous Multi-GPU Cluster to Support Exploration at Scale." The project aims to acquire a heterogeneous Multi-GPU cluster, constructed out of state-of-the-art GPUs devices, interconnected with emerging NVLink and HDR networks, network-attached non-volatile memory (NVM) storage for GPU caching, and interconnected by a smart HDR infiniband switch, to enable, accelerate, explore, and support applications at scale from different domains. It will enable computational scientists to exploit GPU parallelism in new ways by programming the smart network switch and caching selectively to hide memory and interconnect latency.



Professor **Ali Abur** was awarded a **\$750K Department of Energy grant** from the Solar Energy Technologies Office for "Graph-Learning-Assisted State and Event Tracking for Solar-Penetrated Power Grids with Heterogeneous Data Sources." The project uses artificial intelligence and machine learning techniques to integrate a diverse set of measurements and use them to calculate the state of the power grid. The resulting tool will be able to detect topology changes and faults in the grid and update grid models accordingly, which will improve the situational awareness of power grids that contain large amounts of solar energy sources. This will be accomplished by exploiting a large volume of data and measurements available from a highly diverse set of measurement devices. The project will also provide tools to detect and identify unexpected disturbances or switching events by exploiting the recently developed sparse estimation methods in the data analytics area.



Robert D. Black College of Engineering Distinguished Professor **Michael Silevitch**, electrical and computer engineering, is leading a new Massachusetts **AI Jumpstart Program** to connect small business owners in the state with academic faculty experts to learn how machine learning can grow their companies. Northeastern received a \$2.2 million state grant that will be used primarily for high-speed computer equipment, and to provide for faculty consultants, both of which will be available to selected companies program. Northeastern contributed an additional \$2 million, raising the program's total value to more than \$4 million.

Assistant Professor **Xue "Shelley" Lin**, electrical and computer engineering, in collaboration with Michigan State University, received a **\$1 million grant from DARPA** for "Intelligent Diagnosis for Machine and Human-Centric Adversaries." The project will build a scalable learning system for reverse engineering of deception, which can automatically recover and index attack toolchain signatures in both machine-centric and human-centric attacks, with targets to fool machine learning decisions and human decisions, respectively.



Assistant Professor **Xiaolin Xu**, electrical and computer engineering, in collaboration with Embry-Riddle Aeronautical University and UMass Dartmouth, was awarded a **\$500K National Science Foundation grant** for "Bolstering UAV Cybersecurity Education through Curriculum Development with Hands-on Laboratory Framework." Unmanned aerial vehicles (UAVs), or drones, have rising applications in civilian and military scenarios. At the same time, serious cybersecurity concerns have been raised about UAVs, wherein they are identified as targets of cyber-attacks or potential attack vectors for malicious actors. The research seeks to improve UAV and cybersecurity education through the development of curriculum materials and hands-on laboratory platform.

Student Highlights



Spencer Lake Jacobs-Skolik, E'22, electrical engineering, was awarded the **Barry Goldwater Scholarship**—the United States' premier award to encourage and foster outstanding students to pursue research careers in the fields of the natural sciences, engineering, and mathematics.

Siyue Wang, PhD'22, computer engineering, won **first place for Best Presentation** in the Fourth Workshop for Women in Hardware and Systems Security (WISE 2020). She presented her recent work on "Intrinsic Examples: Robust Fingerprinting of Deep Neural Networks" with her advisor Assistant Professor **Xue (Shelley) Lin**.



Malith Jayaweera, PhD'23, computer engineering, won **first place in the student research competition** at the International Symposium on Code Generation and Optimization (CGO) 2021 for his research on "Data

vs Instructions: Runtime Code Generation for Convolutions."

Joseph Robinson, PhD'20, computer engineering, received the **Outstanding Reviewer Award** at the 15th IEEE International Conference on Automatic Face and Gesture Recognition.

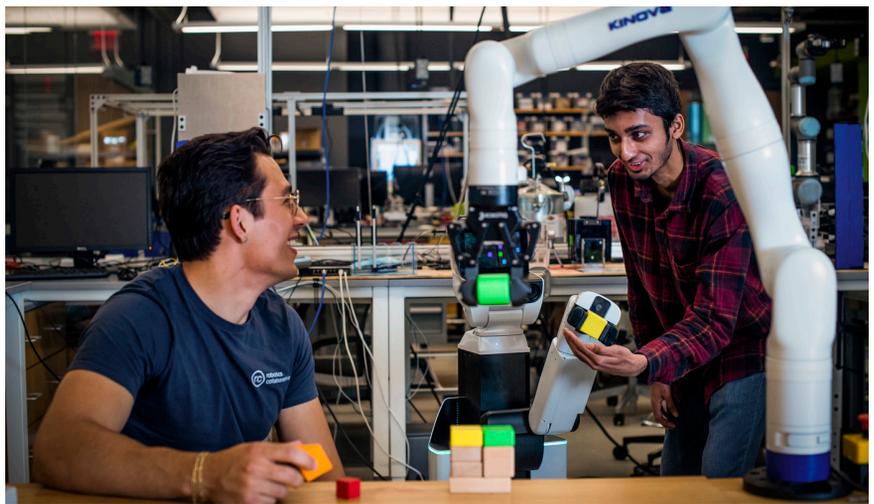


Jacob Kaplan, E'21, computer engineering and computer science, received a **U.S. Fulbright student award**. He will pursue an English teaching assistantship in Taiwan. The Fulbright U.S. Student

Program is America's premier international exchange fellowship, with a mission to promote mutual understanding between the people of the United States and the people of other countries.



The Northeastern University team has been selected as a **finalist in NASA's 2021 RASC-AL Competition**, which stands for Revolutionary Aerospace Systems Concepts-Academic Linkage. They presented to NASA and aerospace industry leaders their "Venusian Atmospheric and Land Exploration: a Human-Assisted Low-Latency Approach (VALHALLA)" project at the virtual event.



Six robotics engineering students **attended an elite, selective robotics summer school organized by the Danish government** and private companies there. It was held at the University of Southern Denmark in Odense, Denmark, the hub for more than 50 robotics companies. Global universities with renowned robotics departments were invited to participate. Northeastern's robotics lab located at the Interdisciplinary Science and Engineering Complex houses more than \$1 million worth of robots. Among research specialties is advancing the relationship between humans and machines and this is what the students focused on while in Denmark. Student participants included **Stephen Alt**, E'22, computer science, **Sadjad Asghari-Esfeden**, PhD'21, computer engineering, **Syed Mohammad Asjad**, ME'22, robotics, **Areeba Aziz Rajput**, ME'22, electrical and computer engineering, **Nathaniel Hanson**, PhD'24, computer engineering, and **Jagatpreet Nir**, PhD'23, computer engineering.

Northeastern Electric Racing (NER) student organization won first place in the Formula Hybrid+Electric competition all-electric vehicle class. NER is building an all-electric formula-style race car to compete in the Formula Hybrid+Electric SAE Collegiate Design Series competition organized by Dartmouth University. Over the course of the competition, the team must design, engineer, validate, and build a car to compete with top universities from around the world in the year-end events held at the New Hampshire Motor Speedway.



Yulun Zhang, PhD'21

COMPUTER ENGINEERING

Advised by Yun Raymond Fu, Professor of Electrical and Computer Engineering

After completing an MS in Control Engineering at Tsinghua University, Yulun Zhang joined the Department of Electrical and Computer Engineering PhD program at Northeastern in 2017, working in the Synergetic Media Learning Lab, advised by Professor Yun Raymond Fu. The SMILE Lab, as it is known, focuses on the frontier research of artificial intelligence, especially machine learning, computer vision, and data mining. Zhang's research broadly includes computer vision applications: image/video restoration (e.g., super-resolution, denoising, deblurring), synthesis (e.g., style transfer, texture transfer), biomedical image enhancement and analysis, and deep model compression, computational imaging (e.g., spectral compressive imaging). His doctoral study mainly focuses on image restoration and generation by designing more efficient network structures. In addition to his research at the SMILE Lab, Zhang was a fellow at Harvard University in the Visual Computing Group. He also was a research intern at Adobe Research for two summers. To date, over 30 of Zhang's publications have been accepted, including several papers in top computer vision conferences, like CVPR, ICCV, ECCV, ICLR, and top IEEE transaction journals, such as IEEE TPAMI (IF: 17.730) and IEEE TIP (IF: 10.865). His image super-resolution works residual dense network (RDN) and residual channel attention network (RCAN) rank as top 10 most cited papers on the CVPR 2018 and ECCV 2018 conferences, respectively. Additionally, he has over 4375 citations, according to Google Scholar, and his released code in Github has received over 2000 stars. He received the Best Student Paper Award at the IEEE International Conference on Visual Communication and Image Processing (VCIP) in 2015. He also won the Best Paper Award at the IEEE International Conference on Computer Vision (ICCV) RLQ Workshop in 2019. After graduation, Zhang plans to continue conducting research at a university.



Alexandria Will-Cole, PhD'23

ELECTRICAL ENGINEERING

Advised by Nian Sun, Professor of Electrical and Computer Engineering

Alexandria Will-Cole joined Professor Nian X. Sun's Advanced Materials and Microsystems Lab in 2019 to pursue a PhD in Electrical Engineering at Northeastern University. Prior to her doctoral studies, she completed her MS in Materials Science and Engineering from Drexel University and her BA in Physics from the University of Arizona. Though her educational background is not traditional for an electrical engineering student, it has aided in her interdisciplinary doctoral studies. Her research lies at the intersection of materials physics and spintronics, with a focus on multifunctional materials, particularly magnetoelectric composites and multiferroics. In 2020, she was awarded the National Defense Science and Engineering Graduate (NDSEG) Fellowship sponsored by the Office of Naval Research for magnetoelectric heterostructures and device research. Magnetoelectric composites, which are layered magnetic and piezoelectric materials, allow for coupling between magnetism and electricity. These multifunctional composites can enable novel devices for communication, energy harvesting, and magnetic field sensing applications. Prior to the NDSEG fellowship, she was the recipient of two other graduate fellowships, the Alsaif Doctoral Fellowship, and the National Science Foundation Translational Applications in Nanoscale Multiferroic Systems (NSF TANMS) Doctoral Fellowship. TANMS is a multi-institutional engineering research center focused on research, technology translation, and education associated with magnetism on the micro- to nano-scale. Since joining Northeastern, Will-Cole has fostered and participated in research collaborations with the National Institute of Standards and Technology and Department of Energy Sandia National Laboratories. Particularly inspired following a workshop on machine learning implementation, she pursued a collaboration with the National Institute of Standards and Technology focused on optimizing magnetoelectric materials with machine learning. Alongside her research pursuits, she has mentored several undergraduate students through the TANMS Undergraduate Research Program in 2020 and 2021. In alignment with her passion for uplifting other women in engineering, she has organized virtual professional development events for women and allies in physical science and engineering through the Multiferroics Women's Conference for Research and Fellowship. After graduation, Will-Cole aims to continue her research career at a national laboratory with continued emphasis on applied multifunctional nanomaterials and device development.

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COVER IMAGE

Professor Hanumant Singh, electrical and computer engineering (ECE), works on drones as part of his autonomous robot research. Northeastern's robotics lab located at the Interdisciplinary Science and Engineering Complex houses more than \$1 million worth of robots.

