ANNUAL REPORT 2022-23

Northeastern University Electrical and Computer Engineering

Northeastern University College of Engineering

With over 230 tenured/tenure-track faculty and 18 multidisciplinary research centers and institutes with funding by eight federal agencies, the College of Engineering is a leader in experiential education and interdisciplinary research focused on discovering solutions to global challenges to benefit society. Northeastern's global university system–with engineering programs on campuses across the U.S. and in multiple countries–provides flexible academic offerings, innovative partnerships, and the ability to scale ideas, talent, and solutions.

About Northeastern

Founded in 1898, Northeastern is a global research university and the recognized leader in experiential lifelong learning. Our approach of integrating real-world experience with education, research, and innovation empowers our students, faculty, alumni, and partners to create worldwide impact.

Northeastern's personalized, experiential undergraduate and graduate programs lead to degrees through the doctorate in 10 colleges and schools across our 13 campuses worldwide. Learning emphasizes the intersection of data, technology, and human literacies, uniquely preparing graduates for careers of the future and lives of fulfillment and accomplishment.

Our research enterprise, with an R1 Carnegie classification, is solutions oriented and spans the world. Our faculty scholars and students work in teams that cross not just disciplines, but also sectors–aligned around solving today's highly interconnected global challenges and focused on transformative impact for humankind.

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

DEAR COLLEAGUES, FRIENDS, AND STUDENTS,

It is my great pleasure to report that the Department of Electrical and Computer Engineering at Northeastern University continued its march to greater heights in 2022-2023. Our faculty were awarded over \$45 million in research grants. This year, Professor Ali Abur was elected a Member of the National Academy of Engineering–a distinct honor we are all proud to announce. Dean Gregory Abowd was awarded the Association for Computing Machinery (ACM) Special Interest Group on Computer-Human Interaction (SIGCHI) Lifetime Research Award. Prof. Kevin Fu became a Fellow of AAAS and ACM, Prof. Raymond Fu, Fellow of ACM, Prof. Vincent Harris, Fellow of National Academy of Inventors, and Associate Prof. Yongmin Liu became a Fellow of Optica and SPIE. This year also saw several of our assistant professors recognized through early-career awards. Xiaolin Xu received the NSF CAREER Award, Francesco Restuccia received the Office of Naval Research (ONR) and Air Force Office of Scientific Research (AFOSR) Young Investigator Awards, and Xufeng Zhang received the AFOSR Young Investigator Award.

Our students have been equally successful. Siddhartha Simon, CS and CE'24, received the Barry Goldwater Scholarship; Alex Marley, EE'22, received the Schwarzmann Scholarship and was named one of BostonInno 25 under 25; Jonathan Tan, EE'23, and Michael Shen, CE'23, were the recipients of the NSF Graduate Research Fellowship Program Award; and electrical engineering PhD student Jack Guida was the recipient of the National Defense Science and Engineering Graduate Research Fellowship. Benoni Vainqueur, CE and CS'23, received the Graduate Education for Minorities (GEM) PhD Engineering Fellowship. Computer engineering PhD student Ana Veroneze Solórzano won a prestigious ACM Special Interest Group on High Performance Computing (SIGHPC) Computational and Data Science Fellowship. The Northeastern Team, advised by Associate Prof. Alireza Ramezani, won the prestigious Artemis Competition and the NASA Big Idea Competition. As of this year, approximately 40 of recent ECE PhD students have become tenure-track faculty in various institutions around the world.

In 2023, outstanding faculty joined our department, including David Horsley who joined us as a full professor at the Oakland campus from the University of California, Davis; Mingzhong Wu joined as a full professor from Colorado State University; Hessam Mahdavifar as associate professor from the University of Michigan, and Silvia Zhang as associate professor from Washington University at St. Louis. Derya Aksaray, Marco Colangelo, Mallesham Dasari, Najme Ebrahimi, Kristina Johnson, and Yasin Yazicioglu joined the department as assistant professors.

In addition to launching two new master's degrees, including an MS in Internet of Things and an MS in Wireless and Network Engineering, we had our first cohort of MS students begin their studies at Northeastern's Seattle campus. ECE is diligently working to expand our undergraduate and graduate offerings at the Northeastern Oakland campus. Professor Stefano Basagni is leading the launch and rollout of ECE global programs. With a deep-rooted focus on global experiential education and research excellence, the ECE department at Northeastern is continuing to train a more equitable and diverse engineering workforce.

Sincerely,

Srinivas Tadigadapa, PhD Chair of Electrical and Computer Engineering

s.tadigadapa@northeastern.edu

For more details, visit our website at ECE.NORTHEASTERN.EDU.



Quick Facts electrical and computer engineering



Investigator Awards

Professional

Society Fellowships Graduate

Growth

Enrollment

up **68**%

vs. 2017

NORTHEASTERN UNIVERSITY ELECTRICAL AND COMPUTER ENGINEERING

solutions to global challenges to

benefit society.

2

Our New Faculty



Marco Colangelo Assistant Professor

PhD: Massachusetts Institute of Technology, 2023 **Scholarship Focus**: Applied superconductivity, single-photon detectors, cryogenic devices, and nanofabrication technology



Mallesham Dasari Assistant Professor

PhD: Stony Brook University, 2021 **Previously**: Postdoc, Carnegie Mellon University **Scholarship Focus**: Immersive media, XR systems, networks, mobile, wireless, and wearable computing



Najme Ebrahimi Assistant Professor

PhD: University of California, San Diego, 2017 Previously: Assistant Professor, University of Florida Scholarship Focus: Broadband, energy-efficient, reconfigurable, and high data rate RF, mm-wave, and THz integrated circuits and systems; and security, connectivity, and localization of IoTs Awards:

DARPA Young Faculty Award, 2021

DARPA Director's Fellowship, 2023



David Horsley Professor

PhD: University of California, Berkeley, 1998 Previously: Professor, University of California, Davis Scholarship Focus: Micro-electromechanical systems (MEMS), design and manufacturing of microfabricated sensors and actuators, mechatronics, and control systems Awards:

- Fellow, IEEE
- Fellow, National Academy of Inventors
- NSF CAREER Award



Kristy Johnson Assistant Professor

Jointly Appointed: Communication Sciences and Disorders PhD: Massachusetts Institute of Technology, 2021 Previously: Postdoc, Harvard Medical School Scholarship Focus: Human-computer interaction, autism, genetic disorders, personalized healthcare, affective computing, speech-related technology, machine learning for rare populations, wearable sensors



Hessam Mahdavifar Associate Professor

PhD: University of California, San Diego, 2012
Previously: Associate Professor, University of Michigan, Ann Arbor
Scholarship Focus: Coding and information theory for wireless communications, data storage and privacy, and security
Award: NSF CAREER Award, 2020

More New Faculty members listed on the next page.

Our New Faculty



Mingzhong Wu Professor

Jointly Appointed: Physics PhD: Huazhong University of Science and Technology, 1999 Previously: Professor, Colorado State University Scholarship Focus: Topological quantum materials, magnetic thin films, spin transport, spin torque, spin waves, and ferromagnetic resonance

Awards:

- Fellow, American Physical Society
- Fellow, IEEE
- Professor Laureate, CNS, Colorado State University, 2019-2021



Yasin Yazicioglu Assistant Professor

Jointly Appointed: Mechanical and Industrial Engineering PhD: Georgia Institute of Technology, 2014 Previously: Research Assistant Professor, University of Minnesota Scholarship Focus: Distributed control, optimization, and learning with applications to cyber-physical systems, networks, and robotics



Xuan "Silvia" Zhang Associate Professor

PhD: Cornell University, 2012 **Previously**: Associate Professor, Washington University

Scholarship Focus: Artificial intelligence (AI) hardware, machine vision sensors, machine learning for electronic design automation, efficiency/security/privacy for autonomous systems, computerarchitecture, integrated circuits/VLSI design Award: NSF CAREER Award

Newest Academic Programs and Campuses

MS in Internet of Things

The Internet of Things (IoT) revolution is reshaping how industries meet today's most pressing challenges. Through the Master of Science in Internet of Things, students gain the interdisciplinary knowledge and skills to understand, design, and implement the autonomous wireless networked systems of tomorrow. Students take a combination of coursework, supervised research spanning multiple colleges at Northeastern University and the Institute for the Wireless Internet of Things, and/or gain industry experience with the cooperative education program.

MS in Wireless and Network Engineering

The Master of Science in Wireless and Network Engineering uniquely combines concepts from electrical engineering and computer engineering to provide a multifaceted understanding of the field. Through coursework and experiential learning, including research and/or industry experience with the co-op program, students master skills ranging from hardware design and electromagnetic characterization to communication techniques and networking protocols for present and future network generations—from 5G to 6G and beyond.

Expanding Across our Global University Network

MS in Electrical and Computer Engineering with a concentration in Computer Networks and Security is now also offered at the **Roux Institute in Portland, Maine**. In addition to offering academic programs, the Roux Institute has research facilities for the Institute for the Wireless Internet of Things, and the Institute for Experiential AI.

MS in Electrical and Computer Engineering with concentrations in Hardware and Software for Machine Intelligence and Computer Vision, Machine Learning, and Algorithms are now also offered at the **Seattle, Washington** campus.

Faculty by Research Area

Communications, Control and Signal Processing

Kaushik Chowdhury Pau Closas Ken Duffy Jennifer Dy Najme Ebrahimi **Deniz Erdogmus** Mahdi Imani Vinay Ingle Stratis Ioannidis Kristina Johnson Josep Jornet Hanoch Lev-Ari Hessam Mahdavifar Jose Martinez Lorenzo Tommaso Melodia Sarah Ostadabbas Purnima Ratilal-Makris Francesco Restuccia Masoud Salehi Bahram Shafai Milad Siami Hanumant Singh Milica Stojanovic

Computer Networks and Security

Stefano Basagni Kaushik Chowdhury Mallesham Dasari Ken Duffy Yunsi Fei Josep Jornet Engin Kirda Dimitrios Koutsonikolas Tommaso Melodia Francesco Restuccia Wil Robertson Xiaolin Xu Xuan "Silvia" Zhang

Computer Systems and 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 Xuan "Silvia" Zhang

Computer Vision, Machine Learning, and Algorithms

Derya Aksaray **Octavia Camps** Jennifer Dy **Deniz Erdogmus** Yun Raymond Fu Mahdi Imani Stratis Ioannidis Kristina Johnson Hessam Mahdavifar Jose Martinez Lorenzo Waleed Meleis Sarah Ostadabbas David Rosen Milad Siami Lili Su Yanzhi Wang Xiaolin Xu

Electromagnetics and Optics

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

Microsystems, Materials, and Devices

Cristian Cassella Marco Colangelo Ravinder Dahiya Benjamin Davaji Najme Ebrahimi Siddharth Ghosh **Canek Fuentes Hernandez** David Horsley Yong-Bin Kim Nicol McGruer Sunil Mittal Marvin Onabajo Matteo Rinaldi Aatmesh Shrivastava Soner Sonmezoglu Nian X. Sun Srinivas Tadigadapa Mingzhong Wu Xufeng Zhang

Power Electronics, Systems and Controls

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

Robotics

Derya Aksaray Ravinder Dahiya Kris Dorsey Michael Everett Jose Martinez Lorenzo Taskin Padir Alireza Ramezani David Rosen Bahram Shafai Milad Siami Hanumant Singh

Ali Abur Elected a Member of the National Academy of Engineering

Ali Abur, professor of electrical and computer engineering, has been elected a Member of the National Academy of Engineering (NAE). Election to the NAE is considered the highest professional distinction accorded to an engineer. Abur was recognized for his contributions to power system state estimation and power engineering education.

Abur says, "Being appointed to the National Academy of Engineering is the pinnacle of engineering. It is very rewarding to see your lifelong work being recognized by your peers."

Abur has worked for decades on ways to improve the reliability and efficiency of electric power transmission systems. Over the course of his career, these systems have become steadily more diverse, sophisticated, and complex, posing continuous challenges to power system operators. High-profile system failures that led to widespread blackouts in the northeast during the 1970s inspired Abur's early efforts to improve power network monitoring techniques. He innovated the use of measurements to estimate the states of systems, as well as methods for detecting and correcting errors in those measurements and improving real-time network modeling. His research using phasor measurement technology in the 1990s helped pave the way for development of fast and robust state estimators using wide-area synchronized measurements and resulted in improvements in system reliability.

More recently, he has worked closely with the independent system operator ISO New England on methods (for which he received a patent) to detect and remove errors, many of which had previously gone unnoticed, in their vastly complex network model databases. Effective, practical solutions such as these have helped improve an industry that our entire society depends on every minute of every day.

Abur came to Northeastern in 2005, joining the Department of Electrical and Computer Engineering as a professor and serving as department chair until 2013. Throughout his research career he has completed close to 50 projects sponsored by federal and state agencies, as well as the energy industry. His service to the profession has included serving as Associate Editor for *IEEE Transactions on Power Systems and IEEE Power Engineering Society Letters*, as well as chairing IEEE's PES Awards Subcommittee and PES IEEE Fellows Subcommittee. He currently serves as co-chair of the IEEE PES Working Group on Power System State Estimation Algorithms.

Abur was also instrumental in launching the CURENT (Center for Ultra-Wide Area Resilient Electric Energy Transmission Networks) Engineering Research Center, originally funded by the National Science Foundation and Department of Energy, now graduated and selfsustaining. He continues to serve as the Northeastern campus director of this multi-university engineering research center, the first in the area of smart power transmission and home to both hardware and software testbeds.

Among Abur's awards and recognitions are the IEEE Power & Energy Society Outstanding Power Engineering Educator Award and IEEE PES Boston Chapter Outstanding Engineering Award, both in 2014. He was elected a Fellow of the IEEE in 2003, and an American Electric Power Faculty Fellow, Texas A&M University, that same year. Decades of speaking engagements at industry and academic gatherings throughout the United States and internationally are a testament to Abur's impact in the power transmission field.

Membership in the NAE honors those who have made outstanding contributions to "engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature" and to "the pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education."

Abur says, "I am humbled by the honor and grateful for the recognition of my work. Earning trust is paramount for me—being honest, meticulous, and reliable in one's work is what makes it valuable and useful to others."

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Being appointed to the National Academy of Engineering is the pinnacle of engineering. It is very rewarding to see your lifelong work being recognized by your peers."

ALI ABUR

Professor of Electrical and Computer Engineering

Gregory D. Abowd Receives ACM SIGCHI Lifetime Research Award

Gregory D. Abowd, dean of the College of Engineering and professor of electrical and computer engineering, received the Association for Computing Machinery (ACM) Special Interest Group on Computer-Human Interaction (SIGCHI) Lifetime Research Award. The award is presented to individuals for outstanding contributions to the study of human-computer interaction. It recognizes the very best, most fundamental, and influential research contributions, and is awarded for a lifetime of innovation and leadership.

Abowd is a world leader in the invention and application of ubiquitous computing technologies. His work has defined the field over the past three decades, and his intellectual contributions have shaped two major themes in ubiquitous computing: context-aware computing and automated capture and access of live experiences. He has shown how a variety of application areas—the classroom, the home, autism, and healthcare—benefit from innovations in mobile and ubiquitous technologies. Two particularly trailblazing projects, Classroom 2000 and the Aware Home, demonstrated "living laboratories" to advance technological advancements as well as understanding the impact when those technologies are woven into everyday life. His research has resulted in public-domain software toolkits and commercial solutions in the home and health sectors. As the parent of two sons on the autism spectrum, Abowd initiated a research program in technologies to support this neurodiverse population, resulting in several commercial

Dean Abowd is one of the world's top scholars in ubiquitous computing, software engineering, and technologies for autism. This lifetime achievement award from SIGCHI is a spectacular recognition of the impact of his work."

DAVID MADIGAN Northeastern Provost and Senior Vice President for Academic Affairs

products. In the process, he started a non-profit, the Atlanta Autism Consortium, that connects stakeholder communities across research, clinical practice, education, and families, and he was recognized by the State of Georgia for his efforts in establishing that organization.

Abowd's leadership to the research community cemented ubiquitous computing as a core topic in HCI research. He hosted UbiComp 2001 in Atlanta, rebranding and establishing it as the premier forum in the area. He served on the founding editorial board for *IEEE Pervasive Computing Magazine* and was the co-founding Editor-in-Chief of *Foundations and Trends in HCI*. In the mid 2010's, he created the *Proceedings of the ACM in Interaction, Mobile, Wearable, and Ubiquitous Technologies (IMWUT),* serving as the Founding Editor-in-Chief.

Abowd has been recognized by ACM as a Fellow, a member of the SIGCHI Academy, recipient of the SIGCHI Social Impact Award, and the ACM Eugene Lawler Humanitarian Award. After 26 years at Georgia Tech, Abowd became Dean of Engineering at Northeastern University in 2021. He received his master's and doctorate degrees from the University of Oxford, where he attended as a Rhodes Scholar.

View a video recording of Dean Gregory Abowd's SIGCHI Lifetime Research Award acceptance lecture.



Faculty Fellows

AAAS Fellow

College of Engineering Distinguished Professor **Yun Raymond Fu**, electrical and computer engineering, jointly appointed in Khoury College of Computer Sciences, was elected as an American Association for the Advancement of Science Fellow in the Information, Computing & Communication section. Election as a Fellow honors members whose efforts on behalf of the advancement of science or its applications in service to society have distinguished them among their peers and colleagues.

ACM and AAAS Fellow

Professor **Kevin Fu**, electrical and computer engineering, jointly appointed in the Khoury College of Computer Sciences, was named a Fellow of the Association for Computing Machinery for contributions to computer security, and especially to the secure engineering of medical devices. He was also named an American Association for the Advancement of Science Fellow in the Information, Computing & Communication section. Additionally, Fu received the Association for the Advancement of Medical Instrumentation & MedCrypt Cybersecurity Visionary Award for his groundbreaking research that demonstrated that implantable devices like pacemakers can be vulnerable to hackers and his efforts to mitigate these risks. He was also appointed to the White House President's Council of Advisors on Science and Technology (PCAST) Working Group.

NAI Fellow

University Distinguished and William Lincoln Smith Professor **Vincent Harris**, electrical and computer engineering, has been named a Fellow of the National Academy of Inventors (NAI). The NAI Fellows program highlights academic inventors who have demonstrated a spirit of innovation in creating or facilitating outstanding inventions that have made a tangible impact on the quality of life, economic development, and the welfare of society. Election as an NAI Fellow is the highest professional distinction awarded to academic inventors.

Fellow of Optica and SPIE

Associate Professor **Yongmin Liu**, mechanical and industrial engineering, and electrical and computer engineering, was elected a Fellow Member of Optica for significant contributions to the fundamental and application of nanophotonics–plasmonics and photonic metamaterials in particular. He was also selected as a Fellow of the International Society for Optics and Photonics (SPIE). SPIE Fellows are members of distinction who have made significant scientific and technical contributions in the multidisciplinary fields of optics, photonics, and imaging.









Young Investigator Awards

NSF CAREER Award to Enhance the Security of Machine-Learning Hardware Accelerators

Assistant Professor **Xiaolin Xu**, electrical and computer engineering, received a \$600,000 National Science Foundation CAREER Award to generate new security components and metrics to evaluate the security of products built on Field Programmable Gate Array-based Machine Learning (FPGA-ML) accelerators, especially in critical domains like aerospace, defense, and autonomous driving. In many cases, hardware can be used to increase the speed and efficiency of machine learning, but

along with this solution comes inherent security risks. Xu seeks to mitigate the security risks by systematically investigating the threats and defenses of FPGA-ML acceleration systems so performance can increase without compromising safety.

Office of Naval Research Young Investigator Program Award for Polymorphic Wireless Computing for Ultra-Wideband 6G Spectrum Dominance

Francisco Restuccia, assistant professor of electrical and computer engineering, received an Office of Naval Research Young Investigator Program Award focused on finding the right tradeoff between communication needs and the computational capabilities of wireless devices. To help make 6G a reality, he is using advanced concepts in neural network design to enable real-time

and autonomous modification of wireless communication networks based on user and device needs. For example, if a user is completing a task that requires more data, the network would self-adapt to increase the computational speed. To accomplish this, Restuccia is researching novel techniques that will seamlessly adapt not only the underlying algorithmic structure, but also the hardware and software components of 6G wireless devices, while operating at several gigahertz of bandwidth.

Air Force Office of Scientific Research Young Investigator Program Award to Establish Theoretical Foundations of Next-Generation Dynamic Data-Driven Wireless Systems

To ensure that wireless networks function accurately and reliably, even if they become congested or compromised, **Francisco Restuccia**, assistant professor of electrical and computer engineering, is exploring new ways to enable complex real-time wireless transmissions within a cyber-physical system. With a Young Investigator Program Award from the Air Force Office of Scientific Research, his research is optimizing the cyber portion of these networks mathematically by creating multiple logical networks on shared physical infrastructure and applying application-level semantic optimization to the problem. Using network slicing and semantic approaches, and taking into account changing spectrum conditions, Restuccia aims to dynamically compress sensed data to minimize demand on the network, while ensuring that application demands are satisfied. He is also focused on making sure that artificial intelligence/machine learning algorithms can reliably comply with the constantly shifting limitations of a network and the similarly changeable demands of an application by adapting the AI/ML models in real time, almost continuously, and certifying the performance.

Office of Naval Research Young Investigator Program Award to Develop a Novel Terahertz System-on-a-Chip

Assistant Professor **Xufeng Zhang**, electrical and computer engineering, received an Office of Naval Research Young Investigator Program Award to develop a novel terahertz (THz) systemon-a-chip (SOC). The SOC takes advantage of recent advancements in silicon photonics, superconducting devices, and terahertz (THz) instrumentation. With its comprehensive on-chip signal processing capabilities, including THz generation, routing, manipulation, and detection, it

will address current challenges of THz systems and enable the frequency band to be suitable for a broad range of practical applications, including quantum networks and wireless communication for 6G and 7G networks.







Faculty Honors and Awards

SELECTED HIGHLIGHTS



IFAC Award on Non-Linear Control Systems

University Distinguished Professor **Eduardo Sontag**, electrical and computer engineering, and bioengineering, received the International Federation of Automatic Control (IFAC) Technical Committee Award on Non-Linear Control Systems, which is described as the "highest distinction on nonlinear control systems research." Given every three years, the award recognizes individuals who have made outstanding technical contributions in the nonlinear control area and supplied remarkable service to IFAC.



NAI Senior Member

Srinivas Tadigadapa, professor and chair of electrical and computer engineering, was selected as a National Academy of Inventors (NAI) Senior Member. NAI Senior Members are active faculty, scientists, and administrators from NAI Member Institutions who have demonstrated remarkable innovationproducing technologies that have brought or aspire to have a real impact on society's welfare.



IEEE Wireless Communications Technical Committee Outstanding Young Researcher Award

Professor **Josep Jornet**, electrical and computer engineering, received the IEEE Wireless Communications Technical Committee (WTC) Outstanding Young Researcher Award for his pioneering contributions to the field of terahertz communications. The award recognizes active members of the WTC within the IEEE Communications Society who have been involved significantly with research related to the area of wireless communications and who have completed their PhD within the past 10 years.



Blavatnik National Award for Young Scientists Finalist

Professor **Kaushik Chowdhury**, electrical and computer engineering, was selected as a finalist for the 2023 Blavatnik National Awards for Young Scientists in Physical Sciences and Engineering for addressing the global need of telecommunications spectrum scarcity, as well as improve connectivity by designing next-generation wireless systems and machine learning-based network operations. This prestigious award is the largest unrestricted prize for early career scientists and honors outstanding young scientists and engineers under the age of 42.

Faculty Grants and Publications

SELECTED HIGHLIGHTS

\$1.3M NSF Award for Hydrophone Array System for Real-Time Oceanic Acoustic Monitoring

Professor Purnima Ratilal-Makris, electrical and computer engineering, was awarded a \$1.28 million National Science Foundation grant for "Large-Aperture 160-Element Coherent Hydrophone Array System Upgrades and Operational Readiness Testing for Real-Time Continental-Shelf Scale Ocean Acoustic Monitoring." The system provides a transformative approach for sensing vast areas of the ocean, enabling ocean discoveries to be made while at sea, with real-time feedback that allows the data collection procedure to be adapted and optimized on-the-fly. Ratilal-Makris was also one of eighteen members selected for the newly formed Ocean Research Advisory Panel (ORAP), who will serve as advisors to the White House Office of Science and Technology Policy (OSTP) and the interagency Ocean Policy Committee (OPC).

\$4M DARPA Award for Ultra-Small, Fast, High-Resolution Infrared Sensors

Matteo Rinaldi, professor of electrical and computer engineering (ECE) and director of the Northeastern SMART research center, is leading a \$4 million Defense Advanced Research Projects Agency (DARPA) grant under the DARPA Optomechanical Thermal Imaging (OpTIm) program. The project focuses on the development of Nano-opto-mechanical Piezoelectric Resonant Infrared-sensitive Metamaterials for Quantum-Limited Photodetection. Collaborators include Cristian Cassella, associate professor of ECE, Yongmin Liu, associate professor of mechanical and industrial engineering, jointly appointed in ECE, Benjamin Davaji, assistant professor of ECE, Zhenyun Qian, associate research professor of ECE, and Siddhartha Ghosh, assistant professor of ECE.

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Faculty Grants and Publications

\$1.2M Award to Increase AI Security with Privacy-Preserving Machine Learning as a Service

Assistant Professor **Xiaolin Xu**, electrical and computer engineering, in collaboration with faculty from Lehigh University and the University of Connecticut, was awarded a \$1.2 million grant from the National Science Foundation for "Accelerating Privacy-Preserving Machine Learning as a Service: From Algorithm to Hardware." The project aims to accelerate machine learning as a service by developing efficient, scalable, and encryption-conscious computing paradigms.

Developing Secure Next-Generation Cellular Networks

Assistant Professor **Francesco Restuccia**, electrical and computer engineering, and William Lincoln Smith Professor **Tommaso Melodia**, electrical and computer engineering, and Associate Professor **Alina Oprea** of Northeastern's Khoury College of Computer Sciences, were awarded a \$900,000 National Science Foundation grant for "Resilientby-Design Data-Driven NextG Open Radio Access Networks." The project studies security threats to machine learning algorithms used to achieve real-time resource optimization across space, time, frequency, and devices. It also develops solutions to protect them, focusing on the Open Radio Access Networks (Open RAN) architecture.





Enabling Data Privacy with GPU-Accelerated Encryption

College of Engineering Distinguished Professor **David Kaeli**, electrical and computer engineering,

in collaboration with Boston University, was awarded a \$1.2 million National Science Foundation grant for "Architecting GPUs for Practical Homomorphic Encryption-based Computing." Fully Homomorphic Encryption (FHE) currently provides strong data privacy guarantees for cloud computing because it enables operations on encrypted data; but processing encrypted data using FHE takes multiple orders of magnitude longer than processing unencrypted data. The project will explore the use of graphics processing units (GPUs) to accelerate FHE-based computing in the cloud.

New DoD Open6G Industry-University Cooperative Research Center

The technical effort of the Department of Defense's new Open6G industry-university cooperative research center is housed at Northeastern as part of the Institute for the Wireless Internet of Things led by electrical and computer engineering faculty. Open6G focuses on future open, programmable, and disaggregated 6G systems.

First CHIPS and Science Act's Research Grant for Open, Interoperable Wireless Networks

Northeastern's Institute for the Wireless Internet of Things, led by William Lincoln Smith Professor **Tommaso Melodia**, electrical and computer engineering, received the first research grant from the CHIPS and Science Act's Wireless Innovation Fund of the National Telecommunications and Information Administration, which is part of the Commerce Department. The award will be used to test approaches to building open and interoperable next-generation wireless networks. The CHIPS and Science Act provides \$1.5 billion over the next decade to support the development of open and interoperable wireless networks.

\$1.2M Award to Secure Scientific Cyberinfrastructures

Assistant Professor **Xiaolin Xu**, electrical and computer engineering, is leading a \$1.2 million National Science Foundation grant, in collaboration with Professor **Miriam Leeser**, electrical and computer engineering, and the University of Massachusetts, for "CAREFREE:Cloud infrAstructure ResiliencE of the Future foR tEstbeds, accelerators and nEtworks." The goal of the research project is to secure scientific cyberinfrastructures, in the form of next-generation cloud systems, that include network-attached accelerators.





\$1.4M NSF Award to Advance Worldwide Navigation Security with Distributed Al

Associate Professor **Pau Closas** and Assistant Research Professor **Tales Imbiriba**, electrical and computer engineering, in collaboration with Tampere University and the University of Vaasa in Finland, was awarded a \$1.4 million National Science Foundation award for "Distributed AI for Enhanced Security in Satellite-aided Wireless Navigation (RESILIENT)." The project will develop tools for interference management in geolocation applications such as Global Navigation Satellite Systems.





The Dependencies Between El Niño and River Flow

Research conducted by Professor **Jennifer Dy**, electrical and computer engineering, and College of Engineering Distinguished Professor **Auroop Ganguly**, civil and environmental engineering, on "Explainable Deep Learning for Insights in El Niño and River Flows" was published in **Nature**.

ANNUAL REPORT 2022-2023 15

Faculty Grants and Publications

\$13M U.S. Army Grant for Wireless Research

The Kostas Research Institute (KRI) at Northeastern University has been awarded \$13 million by the U.S. Army Research Laboratory for foundational research into Cognitive Distributed Sensing in Congested Radio Frequency Environments. This contract will fund the first year of a planned four-year research program anticipated to be funded up to \$47.4 million. Led by KRI, the program is a collaboration among five universities–Northeastern University, Northern Arizona University, University of Houston, University of Massachusetts-Amherst, and University of North Texas. **Deniz Erdogmus**, professor of electrical and computer engineering and chief technology officer for KRI, is the principal investigator of research activities at Northeastern.



Out-of-Plane Printed Electronics on Flexible Substrates



Professor **Ravinder Dahiya**, electrical and computer engineering, published "Out-of-Plane Electronics

on Flexible Substrates using Inorganic Nanowires Grown on High Aspect Ratio Printed Gold Micropillars" in *Advanced Materials*. The paper describes a new method of creating nanowire-based electronics that are more efficient in their manufacture and performance than current methods allow, potentially enabling more sensitive sensors or efficient energy harvesters.



More Efficient Deep Neural Networks for Edge Devices

Associate Professor **Yanzhi Wang**, electrical and computer engineering, in collaboration with

the University of Pittsburgh, was awarded a \$600,000 grant from the National Science Foundation for "Expediting Continual Online Learning on Edge Platforms through Software-Hardware Co-designs." The research uncovers redundancy in fine-tuning and enhances the computation efficiency to achieve practical, efficient, and adaptive continual online learning on edge devices.

Using Visual Correspondences to See the World in Motion



Associate Professor **Xue "Shelley" Lin**, electrical and computer engineering, in collaboration with

Assistant Professor Huaizu Jiang of Northeastern's Khoury College of Computer Sciences, was awarded a \$600,000 National Science Foundation grant for "Toward Efficient and Robust Dynamic Scene Understanding Based on Visual Correspondences." The project aims to solve disparate visual correspondence problems with a unified model. The research is expected to unlock novel applications and improve dynamic scene understanding in the areas of Augmented Reality, sports broadcasting, sports analytics, robotics, and more. The project outcomes may also unveil new markets and economic opportunities through solutions that augment cognitive and physical abilities of users in their daily lives.



Learn more about our accomplished faculty

Student Successes

SELECTED HIGHLIGHTS



Siddharth Simon, E'24, computer engineering and computer science, is a pre-med student driven to use computer software and data engineering to make an impact in medicine by improving access to care as well as patient outcomes. He was awarded a 2023 Barry Goldwater Scholarship, one of the nation's most prestigious merit-based awards for undergraduate students planning to pursue research careers in natural sciences, engineering, and mathematics.



National Defense Science and Engineering Graduate Research Fellowship

PhD student **Jack Guida**, electrical engineering, advised by Assistant Professor **Siddharta Ghosh**, electrical and computer engineering, was awarded

a National Defense Science and Engineering Graduate Research Fellowship. He is researching microscale acoustics and integrated photonics as part of the Northeastern SMART research center.

National Science Foundation Graduate Research Fellowship Program Award Recipients

The NSF GRFP recognizes and supports outstanding graduate students who have demonstrated the potential to be high-achieving scientists and engineers early in their careers. **Jonathan Tan**, E'23, electrical engineering, and **Michael Shen**, E'23, computer engineering, received the award in 2023.

Schwarzman Scholarship and One of BostInno's 25 Under 25

Alex Marley, E'22, electrical engineering, was awarded the highly selective Schwarzman Scholarship and named one of BostInno's 25 Under 25. BostInno's annual list recognizes company



founders, nonprofit leaders, stand-out employees and students under the age of 25 who are already leaders in the Boston startup community. The Schwarzman Scholarship supports up to 200 Scholars annually from the U.S., China, and around the world for a one-year master's in global affairs at Beijing's Tsinghua University.



ACM SIGHPC Computational and Data Science Fellowship

Ana Veroneze Solórzano, PhD '26, computer engineering, won a prestigious Association for Computing Machinery Special Interest Group on High Performance Computing (SIGHPC) Computational and Data Science Fellowship. This competitive international fellowship is given to early-career graduate students who demonstrate excellence in both academic achievement and community leadership.

First Place at NASA BIG Idea Competition

A Northeastern student team, advised by Assistant Professor **Alireza Ramezani**, electrical and computer engineering, won the prestigious Artemis Award, the top honor at NASA's 2022 Breakthrough, Innovative, and Game-changing (BIG) Idea Challenge for their COBRA: Crater Observing Bio-inspired Rolling Articulator. Their snake-inspired robot sidewinds and tumbles, which will expand NASA's lunar and Martian exploration toolkits.



Graduate Education for Minorities PhD Engineering Fellowship

Benoni Vainqueur, E'23, computer engineering and computer science, received the Graduate Education for Minorities (GEM) PhD Engineering

Fellowship, which offers students opportunities and access to dozens of the top engineering and science firms and universities in the nation.



Best Paper Award at IEEE IFCS-EFTF

Nicolas Casilli, E'21, MS'21, PhD'26, electrical engineering, who is advised by Associate Professor Cristian Cassella, received the Best Paper award at the IEEE International Frequency Control Symposium and the European Frequency and Time Forum (IEEE IFCS-EFTF 2023) for his paper "An Ising Tag with a LiNbO3 Resonator for Temperature Threshold Sensing."

Robotics Team Wins \$1 Million in Global Competition

Team Northeastern won \$1 million in third place at the ANA Avatar XPrize robotics global competition. The competition is aimed at developing human-operated robotic "avatar" systems that can complete tasks and replicate a person's senses, actions, and presence to a remote location in real time. The student team is advised by Professor **Taskin Padir**, electrical and computer engineering, and director of the Institute for Experiential Robotics, and Assistant Professor **Peter Whitney**, mechanical and industrial engineering.



Student Spotlights

Guillem Reus-Muns, PhD'23

COMPUTER ENGINEERING Advised by Kaushik Chowdhury, Professor of Electrical and Computer Engineering

Guillem Reus-Muns joined Northeastern's PhD program in the spring of 2018 after completing his bachelor's degree in telecommunications systems engineering at the Polytechnic University of Catalonia.

Reus-Muns led a National Science Foundation (NSF) project on applied machine learning for wireless, and his work resulted in several foundational discoveries that will shape next-generation wireless standards. He has published in the most selective conferences and topmost journals on this topic, including *IEEE Transactions on Mobile Computing, IEEE Transactions on Vehicular Networks, IEEE Transactions on Networking,* and *IEEE Sensors.* To date, he has published a total of 14 peer-reviewed research papers and submitted two patents.

His doctoral thesis contains several contributions of significant impact. He demonstrated the first results in identifying drone types by designing deep-learning models that uniquely operate on input RF signals, revealing existing vulnerabilities of existing UAV systems and contributing to the creation of safer airspaces in both civil and defense scenarios. He implemented models on emitter identification that operate at scale on the Platforms for Advanced Wireless Research (PAWR) experimental testbed in Salt Lake City, Utah, demonstrating the benefit of the \$100 million investment made in PAWR by the NSF and an industry consortium. He designed a method that allowed commonplace 802.11 Wi-Fi signals to function as radar pings, an approach being actively incorporated into the 6G standard. His machine learning method for choosing the best channel model for cellular links in given geographical terrain is being incorporated by telecom operators for site-planning activities. Finally, he led research on open programmable radio access networks with industry collaborators including Qualcomm and NVIDIA, supporting translational research that has near-term deployment potential. During his PhD, he also interned at Mathworks, Nokia Bell Labs, and NVIDIA.

Following graduation, Reus-Muns took his passion for designing and developing new wireless technologies to Apple, which he joined as a wireless systems engineer.



Student Spotlights



Yu Yin, PhD'23 COMPUTER ENGINEERING

Advised by Yun Raymond Fu, COE Distinguished Professor of Electrical and Computer Engineering , and Khoury College of Computer Sciences

After completing a bachelor's degree from the School of Electronic Engineering at the Wuhan University of Technology and a master's degree in electrical and computer engineering at Northeastern University. **Yu Yin** began a PhD in computer engineering at Northeastern in 2019. Yin's research interests broadly include visual synthesis and understanding, multimodality fusion, and transfer learning. She is devoted to developing machine learning frameworks and synthetic data generators to make computer vision and AI systems more accurate, affordable, and scalable. Her primary focus during her doctoral studies was synthetic data generators, which provide a reliable and controllable source for training machine learning models while reducing the reliance on real-world data collection. Her dissertation mainly investigates the potential for understanding human behavior by recreating it using image synthesis.

Yin's technical contributions have led to more than two dozen peer-reviewed papers on leading AI and data mining conferences, such as the IEEE Conference on Computer Vision and Pattern Recognition, AAAI Annual Conference, ACM International Multimedia Conference, SIAM International Conference on Data Mining, IEEE International Conference on Data Mining, and top IEEE transaction journals, such as *IEEE Transactions on Image Processing* and *IEEE Transactions on Multimedia*. In recognition of her research contributions, Yin received the National Science Foundation I-Corps grant in 2022 and the Northeastern University Dissertation Completion Fellowship in 2023. She also worked at Microsoft and Zillow as a research intern.

Throughout her academic journey, Yin has actively contributed to the academic community. She served as a teaching instructor for a data visualization course at Northeastern, chaired workshops on image recognition and analysis at several prominent conferences, and served as a reviewer and program committee member for multiple prestigious journals and conferences.

Upon completing her PhD, Yin commenced her role as an assistant professor of computer and data sciences at Case Western Reserve University's School of Engineering in the fall of 2023.



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COVER IMAGE

Xufeng Zhang (L), assistant professor of electrical and computer engineering (ECE), is developing a small, integrated terahertz (THz) system to harness the frequency's enormous power in a more usable size. This research earned him an Office of Naval Research Young Investigator Program Award. Zhang is collaborating with others at Northeastern,

including Josep Jornet (R), professor, ECE. He is also using unique lab facilities at Northeastern's Institute for the Wireless Internet of Things. Scan the QR code to read the full article.



Photo by Bella Martinez/Northeastern University