Northeastern University Bioengineering

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,

Measuring the impact of fundamental research is never easy, in part because it may take decades for the full impact of a discovery to be obvious. Research on the immunogenicity of mRNA and its alteration through chemical modification seemed quite obscure until a globe engulfing virus triggered a pandemic that was dramatically quenched by vaccines made possible by that 'obscure' research. It may take a while for effective therapies to emerge from our research. But the possibility of our work making an impact is the driver that keeps us going. Engineering in a biological context-whether it be a novel device for assisting the visually impaired, a 3D printed vascular system for tissue engineering; a new paradigm for design of asthma therapies-always has the potential of great impact. In this report, you will find a few stories of the research that we at Northeastern are doing now and get a glimpse of our hopes for its impact in the future.

At Northeastern, students and faculty work together to combine classroom, research, and experiential learning in a vibrant bioengineering community that spans the entire University. With over 70 tenured/tenure-track and affiliated faculty, the Department of Bioengineering offers research that encompasses the entire breadth of biological and biomedical engineering.

Our co-op program is working with companies across the sector to provide bioengineering students with cutting-edge opportunities within the Boston biotech industry and beyond. Career opportunities are rapidly expanding as the industry focuses on development of entirely new classes of products, instrumentation, and implants. The opportunities afforded our students through these placements are extraordinary.

This Annual Report provides a glimpse into the many activities of our faculty and the energy and breadth of their research. When you see stories that intrigue, entice, or excite, I hope you will take the time to further explore the details through our website, publications, and activities.

Sincerely,

Lee Makowski, PhD Department Chair Bioengineering I.makowski@northeastern.edu

For more details, visit our website at **BIOE.NORTHEASTERN.EDU**.



Quick Facts **BIOENGINEERING**



Promotion



Harikrishnan Parameswaran

Associate Professor

Institute of Mechanobiology

National Academy

University Distinguished Professor



NIH Early-Stage Investigator R35 MIRA Award

Elizabeth Libby Assistant Professor

Quick Facts COLLEGE OF ENGINEERING

With 238 tenured/tenure-track faculty and 18 multidisciplinary research centers and institutes with funding by eight federal agencies, the College is a leader in experiential education and interdisciplinary research focused on discovering solutions to global challenges to benefit society.





Including 72 NSF CAREER Awards, and 26 DOD Young **Investigator Awards**

Professional Society Fellowships



Co-op Employer Partners (AY2021-2023)

TOTAL ENROLLMENT (Fall 2022)

10,046 62% Graduate 38% Undergraduate

Graduate Enrollment Growth

up 68% vs. 2017

Our New Faculty



Abraham Joy Professor and Chair

PhD: Tulane University, 2000 Previously: Professor, University of Akron

Scholarship Focus: Design and use of biomaterials for wound healing; antimicrobial/antibiofilm strategies; soft-tissue replacement; polymer condensates; and sustained delivery of therapeutics

Abraham Joy will join in January 2024 as Professor and Chair of the Department of Bioengineering. He comes to Northeastern from the University of Akron where he has been a professor of polymer science since 2020, and was an associate professor from 2016 to 2020, and assistant professor from 2010-2016. Since 2021, he has also been a National Science Foundation program director in the Biomaterials (BMAT) program of DMR. Joy's research interests are in the areas of design and use of biomaterials for wound healing; antimicrobial/antibiofilm strategies; soft-tissue replacement; polymer condensates; and sustained delivery of therapeutics. He is also an editor of the journal Polymers for Advanced Technologies, and an associate editor for Frontiers in Bioengineering and Biotechnology.

Joy obtained his PhD in chemistry from Tulane University, where he researched organic asymmetric photoreactions. Following his doctoral work, he carried out his postdoctoral work at the Georgia Institute of Technology, working on charge migration in synthetic oligonucleotides. Subsequently, he was an NIH Ruth Kirschstein postdoctoral fellow at Rutgers University, where he worked on designing biomaterials for modulating cellular functions. Joy is a recipient of the Burroughs Welcome Award, 3M Non-tenured Faculty Award, and an NSF CAREER Award.



Daniel Grindle Assistant Teaching Professor

PhD: Virginia Tech, 2023 Teaching Focus: Biomechanics, capstone design, and bioengineering measurement



Benjamin Gyori Associate Professor

Jointly Appointed: Khoury College of Computer Sciences PhD: National University of Singapore, 2014 Previously: Harvard Medical School, Director of Machine Assisted Modeling and Analysis Scholarship Focus: Intersection of systems biology, bioinformatics, and artificial intelligence to understand how biological cells work and react to drugs and environmental signals



Christa Haase Assistant Professor

Jointly Appointed: Physics PhD: ETH Zurich, 2015 Previously: Instructor, Harvard Medical School, Massachusetts General Hospital Scholarship Focus: Role of spatial organization in directing biological function, development of a new generation of spatial and single cell analysis tools



Stephanie Noble Assistant Professor

Jointly Appointed: Psychology PhD: Yale University, 2019 Previously: Postdoc, Yale University Scholarship Focus: Statistical and computational tools to facilitate more precise human neuroscience inference and prediction

More New Faculty members listed on the next page.

Our New Faculty



David Simpson Associate Teaching Professor

PhD: Georgia Institute of Technology and Emory University, 2009
Previously: Assistant Professor, Wentworth Institute of Technology
Scholarship Focus: Influence of stem cells on modulations of calcium signaling in "injured" fibroblasts, regenerative medicine therapeutics for human clinical trials design



Amir Vahabikashi Assistant Professor

PhD: Northwestern University, 2016
 Previously: Postdoc, Northwestern University; co-founder, VertigoMetric Diagnostics
 Scholarship Focus: Cell and nucleus mechanobiology, soft bioelectronics for organoid/tissue scale mechanobiology and regenerative engineering, mechanotransduction, implantable bioelectronics



Lei Wang Assistant Professor

Jointly Appointed: Biology PhD: Colorado State University, 2018 Previously: Postdoc, Massachusetts Institute of Technology Scholarship Focus: Mammalian synthetic biology tools to advance cancer cellular therapy, regenerative medicine, and microfluidic human organ models



Ning Wang Professor

ScD: Harvard University, 1990 **Previously**: Professor, University of Illinois at Urbana-Champaign **Scholarship Focus**: Cell mechanics, mechanotransduction, mechanobiology



Jing-Ke Weng Professor

Jointly Appointed: Chemistry and Chemical Biology PhD: Purdue University, 2009 Previously: Associate Professor, Massachusetts Institute of Technology Scholarship Focus: Natural product biochemistry, plant abiotic and biotic interactions, carbon sequestration, agricultural biotechnology, food allergy, drug discovery

Faculty by Research Area

Biomechanics, Biotransport, and Mechanobiology

Rouzbeh Amini Chiara Bellini Guohao Dai Eno Ebong Frank Loth Jessica Oakes Harikrishnan Parameswaran Jeffery Ruberti Sandra Shefelbine Amir Vahabikashi Ning Wang

Biomedical Devices and Bioimaging

Samuel Chung Qianqian Fang Christa Haase Mark Niedre Stephanie Noble Tao Sun Meni Wanunu Mohammad Abbas Yaseen

Molecular, Cell, and Tissue Engineering

Anand Asthagiri Ambika Bajpayee Samuel Chung Guohao Dai Eno Ebong Miten Jain Abraham Joy Elizabeth Libby Lee Makowski Mona Minkara Mark Niedre Harikrishnan Parameswaran Sara Rouhanifard Jeffrey Ruberti Meni Wanunu

Systems, Synthetic, and Computational Bioengineering

Saeed Amal Benjamin Gyori Miten Jain Erel Levine Herbert Levine Elizabeth Libby Mingyang Lu Mona Minkara Jessica Oakes Nikolai Slavov Eduardo Sontag Kiran Vanaja Lei Wang Jing-Ke Weng Raimond Winslow

Faculty Honors and Awards

SELECTED HIGHLIGHTS

\$1.96M NIH Early Stage Investigator R35 MIRA Award for the Battle Against Antibiotic Resistance

What if your child came down with pneumonia and no antibiotic could treat it? Or your spouse developed MRSA during a hospital visit and the best anyone could do is say, "Good luck?"

As traditional antibiotics lose their effectiveness, many deadly diseases have become more difficult to treat. In fact, the World Health Organization declared that "antibiotic resistance is one of the biggest threats to world health, food security, and development."

This is why **Elizabeth Libby**, assistant professor of bioengineering, recently received a five-year, \$1.96 million Early Stage Investigator R35 MIRA (Maximizing Investigator's Research Award) grant from the National Institutes of Health. Libby's research is focused on how bacteria develop resistance at the cellular level knowledge that will be crucial to the development of more effective antibiotics.

To do this, she is exploring an ancient class of signaling systems—the Hanks-type serine/threonine kinases and phosphatases—which determines and regulates cell growth and behavior, including susceptibility to common antibiotics such as penicillin and cephalosporins.

"This primordial signaling system is extremely important because it's a key contributor to the failure of antibiotic treatment in major diseases such as tuberculosis, MRSA, strep throat, and C-diff," says Libby.

Building new proteins

Libby was trained as a physicist and microbial geneticist but made a switch early in her career to synthetic biology.

"I'm fascinated by how we can use biological parts that exist in nature to create new biological functions," she explains. "My group has built new proteins that can sense processes that couldn't be easily measured before."

Libby believes that one way to develop new antibiotic treatments lies in understanding how cells change their physiology and behavior to adapt to a hostile environment. How do they receive and interpret the signals that tell them when to shut down, when to grow, and when to adapt their processes to a new threat?

If scientists understand what determines adaptive behavior at the cellular level, they can use that knowledge to devise a way to block that adaptation.

Think of the harmful bacteria as a bully about to attack his victim. A bystander steps in and tries to land a punch, but when the bully senses this threat, he puts up his hand and blocks the blow. But what would happen if the rescuer had figured out a way to block the bully's sensing system so he doesn't raise his hands? Wham—easy knockout. That's what Libby is trying to do—determine how the bacterial cell learns that it's about to be punched by a powerful antibiotic, and turn off that signal so the attack can be successful.

To do this, she is combining elements of well-studied proteins to build a new protein that will help her track and control the cellular response to its environment.

"This synthetic biology approach is super new," she says. "We are building new proteins to measure what is happening inside the cell."

'Game-changing' Alzheimer's Research of Bioengineering Professor Is Major Beneficiary of \$50M Grant

A new research institute launched by Nikolai Slavov, associate professor of bioengineering, is the principal beneficiary of a \$50 million grant from two investors, Schmidt Futures and Citadel founder and CEO Ken Griffin, that aim to support big breakthroughs in science. The institute, Parallel Squared Technology Institute (PTI), intends to use new techniques to significantly ramp up single-cell protein analysis of Alzheimer's disease, which researchers suspect is caused by a buildup of abnormal proteins in and around brain cells. The work the institute is undertaking is built on technology Slavov developed at Northeastern. This technology platform will increase the scale of protein analysis by as much as a thousandfold, which will significantly decrease the cost of Alzheimer's research, Slavov says.

"It's going to make this kind of analysis much more accessible, much more powerful," he says, calling it a "Manhattan Project" for the poorly understood brain disorder that afflicts more than 55 million worldwide.

Often protein pathologies and disorders are studied by sequencing RNA, because that is the tool most readily available, Slavov says. "It's a bit like looking for keys under the lamp post, because that is where the light is, rather than where we are going to find things. We are trying to make a very powerful lamp post that can shine a light where people have not yet explored, where we think there is a lot to discover," he says.

Schmidt Futures is a philanthropic initiative of former Google CEO Eric Schmidt and Wendy Schmidt, while Griffin is founder and CEO of the multinational hedge fund Citadel. Together, they announced this week a \$50 million commitment to Convergent Research, which will distribute the funds to PTI and to EvE Bio.

A press release from Schmidt Futures calls PTI and EvE Bio the type of focused research organizations (FROs) that accelerate major breakthroughs to meet challenges associated with human health and climate change.

PTI, which Slavov co-founded with his former PhD students **Aleksandra Petelski** and **Harrison Specht**, expects to grow to 40 to 50 scientists within the first five years with a state-of-the-art research lab. While PTI will operate as an independent not-for-profit research organization, it will be led by Slavov who plans to develop experiential learning programs with the university, including co-op positions for Northeastern students.

Slavov credits the Allen Frontiers Group for supporting his use of mass spectrometry to scale up single-cell protein analysis.

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We are trying to make a very powerful lamp post that can shine a light where people have not yet explored, where we think there is a lot to discover."

Nikolai Slavov

Associate Professor of Bioengineering, and Founder and Director of Parallel Squared Technology Institute

Proteins are the workhorses of the cell, serving as "catalysts for virtually every biochemical reaction that occurs in living things," according to the journal *Nature.* Ramping up the pace of proteomics, the large-scale study of proteins, is expected to yield solutions to problems of drug resistance, help pinpoint biomechanisms associated with the genetic propensity for diseases and enhance immune cells to target diseased cells.

"We will be in a position to understand mechanisms for disease much more accurately and discover new and fundamental biological principles of how a cell functions," according to Slavov, who with Bogdan Budnik won the 2022 Human Proteome Organization's award for discovery in proteomic sciences.

Researchers at PTI expect to soon receive cadaver tissue samples from Massachusetts General Hospital to analyze for Alzheimer's disease. Slavov says he expects the scale of protein analysis to be increased tenfold in the next two years and up to a thousandfold in five years.

"Instead of costing millions of dollars to a project, it will cost thousands," Slavov says.



AIMBE Fellows

Associate Professor **Aileen Huang-Saad** and Professor **Guohao Dai**, bioengineering, were named Fellows of the American Institute for Medical and Biological Engineering (AIMBE). Huang-Saad was elected "for outstanding contributions to the development of BME entrepreneurship education microenvironments and studying their impact on the engagement of diverse populations." Dai was elected "for contributions in vascular mechanobiology and 3D bioprinting vascular networks for tissue engineering, regenerative medicine applications."



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.



ASME Y.C. Fung Early Career Award

Associate Professor **Jessica Oakes**, bioengineering, was selected as the Y.C. Fung Early Career Award Medalist for outstanding work in respiratory mechanics that has significantly advanced the understanding of asthma, smoking, and inhalable drug delivery, and for strong advocacy in diversity, equity, and inclusion efforts. The award was established to recognize young investigators who are committed to pursuing research in the field of bioengineering and have demonstrated significant potential to make substantial contributions in the bioengineering.



\$3.8M NIH Grant to Study Cardiovascular and Respiratory Effects of E-cigarettes and Cigarettes

Associate professors of bioengineering **Chiara Bellini** and **Jessica Oakes** received a \$3.8 million National Institutes of Health grant for "Cardiopulmonary Outcomes of Dual Cigarette and E-cigarette Use in Animal Models of Chronic Exposure." The project will provide scientific evidence in support of data-driven e-cigarette regulation under The Family Smoking Prevention and Tobacco Control Act, specifically concerning the health risks of dual combustible and electronic cigarette use.



Cellular and Molecular Bioengineering Rising Star Award

Assistant Professor **Sara Rouhanifard**, bioengineering, was selected to receive a 2023 Cellular and Molecular Bioengineering Rising Star Award for her outstanding impact on the field of cellular and molecular bioengineering.

\$3.4M NIH Grant to Discover RNA Modification Sites Using Pseudouridine Modified mRNA

Assistant Professor **Sara Rouhanifard**, bioengineering, was awarded a \$3.4 million National Institutes of Health RO1 grant for "Synthetic mRNA Control Set for Nanopore-Based Pseudouridine Modification Profiling in Human Transcriptomes." The research has the potential to vastly increase insight into the epitranscriptome–changes in chemical modifications of RNA that can affect gene expression within cells–which could help identify new therapeutic targets and lead to new classes of drugs.

\$2M NIH Award for Single-Molecule Protein Sequencer

Professor **Meni Wanunu**, physics and bioengineering, received a \$2 million R01 grant from the NIH/National Human Genome Research Institute for "Asymmetric Single-Chain MspA Nanopores for Electroosmotic Stretching and Sequencing Proteins." Protein identification and single-molecule protein sequencing could revolutionize the understanding of health by providing a picture of the molecular state of the cell at the level of its most functional molecules. **Faculty Honors and Awards**

\$2.1M NIH Award to Understand the Molecular Mechanisms Underlying Alzheimer's Disease

Lee Makowski, professor and chair of the Department of Bioengineering, in collaboration with Massachusetts General Hospital, received a \$2.1 million National Institutes of Health grant for "Fibrillar Polymorphs in Human Brain Tissue." His research group will use x-ray scanning microscopy to observe changes in the molecular structure of amyloid plaques and neurofibrillary tangles during disease with the goal of better understanding the molecular mechanisms underlying the disease, which should provide clues to aid in the design of therapeutics to slow or halt disease progression.

\$1.2M NSF Award to Understand Cell-Fate Transitions for Tumor Development

Herbert Levine, University Distinguished Professor, jointly appointed in physics and bioengineering, is collaborating with Brown University and MD Anderson Cancer Center to lead a \$1.2 million National Science Foundation grant for determining the "Regulation of Cellular Stemness during the Epithelial-Mesenchymal Transition." State-of-the-art single-cell measurement technology will be used together with advanced mathematical modeling frameworks to understand how cells choose specific fates and to quantitatively unravel the genetic and epigenetic dynamics that lead these cells along their trajectories.

Studying AxolotIs to Understand How Limbs Develop and Regrow

Professor **Sandra Shefelbine**, mechanical and industrial engineering, and bioengineering, in collaboration with Biology Professor James Monaghan, was awarded a \$625,000 grant from the National Science Foundation for "In Vivo Mechanotransduction During Limb Growth" to understand the mechanical signaling involved in limb growth. The researchers will use axolotls, a type of salamander that can regrow limbs, to study how cells sense and respond to mechanical forces. They believe that this research could lead to new insights into how limbs develop and regenerate.



Single-Cell Proteomics Research Published in Nature

Nikolai Slavov, associate professor, bioengineering, published research on "Initial Recommendations for Performing, Benchmarking, and Reporting Single-Cell Proteomics Experiments" as well as "Prioritized Mass Spectrometry Increases

the Depth, Sensitivity and Data Completeness of Single-Cell Proteomics" in *Nature Methods*. The papers focus on ways to improve single-cell proteomics workflows and protein quantification.



Nonspherical Ultrasound Microbubbles for Drug Delivery Published in PNAS

Assistant Professor **Tao Sun**, bioengineering, published research on "Nonspherical Ultrasound Microbubbles" in *Proceedings of the National Academy of Sciences*. Spherical microbubbles

(MB) are widely used for ultrasound imaging and ultrasound-mediated drug delivery. Sun's research shows that it is possible to generate nonspherical MB. Nonspherical MB outperformed spherical MB in temporarily permeabilizing the blood-brain barrier, opening new avenues for drug delivery.



Parameswaran Named ATS Rising Star

Associate Professor **Harikrishnan Parameswaran**, bioengineering, received the Rising Star Award from the American Thoracic Society's Science and Innovation Center (SIC) for his research in the area of respiratory structure and function. The SIC is a collaboration of basic and translational scientists focused on new technologies advancing research in respiratory, critical care, and sleep medicine.



Learn more about our accomplished faculty

Student Successes

SELECTED HIGHLIGHTS





Sears B. Condit Award for Outstanding Scholastic Achievement

Zachary Hoglund, E'24, bioengineering and biochemistry, won the Sears B. Condit Award, which provides scholarships for outstanding scholastic achievement. Hoglund is co-

president of student organization Innovators for Global Health and served as a neurology research co-op in the Hyman Research Lab at Harvard Medical School.

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. **Ashley Herrick**, PhD'25, bioengineering, received the award in 2023, and **Amanda Dee**, E'23, bioengineering, received an honorable mention.







Outstanding Graduate Student Award for Research

Ryan Jamieson, PhD'23, bioengineering, received Northeastern's 2023 Outstanding Graduate Student Award for Research, which recognizes those that have shown

an exceptional ability to conduct high-level research and make contributions to the scholarly literature in their fields.



Bioengineering Capstone Team Featured in National Security Innovation Newsletter

The National Security Innovation Network (NSIN) featured Northeastern's **Bioengineering Capstone Team** in their national newsletter. The capstone project "Drone-Aided Forest Health Monitoring for Sustainable, Regulation-Conscious Harvest of Wood Biomass," sponsored by the NSIN and Space Force, was selected out of all their sponsored projects across the country.



Scholarship for Promising Graduate Students from Ghana

Subodh Chanrai (pictured above, second from the left), a member of Northeastern's Board of Trustees, and his brothers in the family business, Chanrai Summit Group, believe education opens the door to opportunity. In that spirit, the family established the Chanrai Family Graduate Scholarship to provide educational opportunities to young Ghanaians. The first recipient of the scholarship is Kelvin Amakye (above, third from the left) who will pursue a master's degree in bioengineering at Northeastern. At the University of Ghana, the county's foremost institution of higher learning, Amakye was honored as one of the outstanding students in his class by the dean of the School of Engineering Sciences. The provost of the College of Basic and Applied Sciences recognized Amakye as one of the very best students of the entire college in the final year of his studies as a result of his hard work. sheer merit, and continued grit. Amakye says that there is this mindset that bioengineers or biomedical engineers in Ghana are incapable of coming out with their own innovations with respect to medical devices and bioimaging devices. He hopes that after his graduate studies at Northeastern and some co-ops or internships with American companies he will be able to return to Ghana and change this harmful mindset by contributing to the local design of medical devices. Amakye also wants to establish a foundation in the future that would contribute to innovations in bioengineering and medical equipment in Ghana.

Alternative Spring Break in Ghana

Innovators for Global Health, a student organization consisting of undergraduate engineering students, traveled to Ghana during spring break to help build relationships with local medical facilities to determine medical device needs. The group's mission is to improve global health challenges through innovative medical device designs and global partnerships.



Student Spotlights

Jason Derks, PhD'22

BIOENGINEERING Advised by Nikolai Slavov, Associate Professor of Bioengineering

Jason Derks began pursuing his PhD in 2017, eager to lead a synthetic biology project with the skills he developed as a research technician in the years prior. He found an early mentor in Joseph Ayers, affiliated faculty, bioengineering, who generously gave Derks freedom to develop a research project to engineer a strain of baker's yeast for real-time chemical sensing; the proposed research and preliminary results were presented as a poster at RISE:2019.

Two years into the program, Derks' research took a different direction as he joined the laboratory of Associate Professor Nikolai Slavov, bioengineering, who served as his primary advisor and mentor for the remainder of his PhD. In the Slavov laboratory, Derks' research focused on developing new methods for highthroughput proteomics and using them for quantifying the proteomes of single nuclei from macrophage cells responding to bacterial antigens. The aim of this project was to study protein translocation with submolecular resolution and understand its contributions to the innate immune response of macrophages.

To quantify proteins, Derks used liquid chromatography mass spectrometry (LC-MS), an approach which, though powerful, limited the number of samples he could analyze. Thus, his first project on the Slavov team focused on increasing the throughput of LC-MS analysis by multiplexing samples as proposed by Slavov. This side project became Derks' primary dissertation research, and developed into a technology he would call "plexDIA," which he published in *Nature Biotechnology* in 2022. Since then, he has authored a perspective in the *Journal of Proteome Research* about plexDIA and presented his work at the American Society for Mass Spectrometry.

Derks has since continued his work as a postdoctoral researcher, using plexDIA to analyze the proteomes of single nuclei at high throughput to investigate heterogeneity of protein translocalization, and looks forward to applying high-throughput proteomics in industry.



Student Spotlights



Mireia Perera-González, PhD'23 BIOENGINEERING

Advised by Heather Clark, Professor of Bioengineering and James Monaghan, Professor of Biology

Originally from Spain, **Mireia Perera-González** began her PhD program in the fall of 2019 after successfully completing her bachelor's degree in biomedical engineering at Carlos III University of Madrid. Her research has focused on developing and optimizing dynamic magnetic resonance imaging (MRI) methods for evaluating bioresponsive contrast agents.

During her doctoral candidacy, Perera-González participated in multiple interdisciplinary projects ranging from evaluating toxic agents in the cardiovascular system (including wildland fire smoke, doxorubicin chemotherapy drug, and e-cigarette vaping devices) to programming complex sequence methods to accelerate quantitative MRI studies. She has presented her work at international conferences, culminating in three first-author publications, two of which are currently under submission.

In addition to her research efforts and excellent academic performance, Perera-González has made a positive impact on the Northeastern community both as a leader and a teacher's assistant. She was elected to the Bioengineering Graduate Student Council, where she served for several years, first as the social chair, then as the council's vice president, and in her final year leading the council as president. In 2020, Perera-González received the Outstanding Graduate Teaching Award. Since the summer of 2022, she has been working as an imaging scientist for the Institute for Chemical Imaging of Living Systems, focused on preclinical imaging systems such as MRI and ultrasound.

Following graduation, Perera-González's genuine passion for science and enthusiasm for collaborating with people across varying disciplines and backgrounds has led to her new role as technical sales engineer/application scientist at Swabian Instruments USA. Her experience and leadership will help drive Swabian Instruments' scientific, sales, and marketing efforts at their Boston office.

Suzanne Stasiak, PhD'23

BIOENGINEERING Advised by Harikrishnan Parameswaran, Associate Professor of Bioengineering

Suzanne Stasiak began her PhD in bioengineering at Northeastern in 2017 after graduating with a BS in biomedical engineering from Boston University. Her research focuses on airway smooth muscle mechanics and interactions with the extracellular matrix in the context of understanding the development of asthma.

Within her first year of graduate school, she won the university's Alpha Fund Grant to develop a cell and tissue stretcher compatible with an inverted microscope for live imaging, resulting in a patent application. This device is used in the lab to mimic the isotropic, variable stretch waveforms felt by smooth muscle cells in the living airway, while culturing the cells on optically clear elastic substrates of tunable stiffness and protein. Over the course of her doctoral work, she investigated the relationship between extracellular matrix remodeling, such as pathological stiffening, and airway smooth muscle reactivity, such as hyperresponsiveness to a contractile agonist. Stasiak presented her research at numerous conferences at the university, national, and international levels, winning multiple travel and abstract awards, including the Northeastern University Bioengineering Symposium Outstanding Oral Presentation award in 2019. She published a first-author paper in Science Advances in August 2020, detailing efforts to understand how matrix stiffness and cell connectivity alter calcium signaling among smooth muscle cells. In 2021, she was awarded the Northeastern University College of Engineering Outstanding Graduate Student Award for her contributions.

During her time at Northeastern, Stasiak participated in multiple outreach activities for young scientists spanning grades K-12, such as at the MIT Museum where she educated on energy concepts, and at Northeastern's Building Bridges program, where students learned about mechanical elements of cell cytoskeleton. Following graduation, Stasiak moved to California to pursue a career that combines her detail-oriented, problem-solving skills from years of research experience with her passion for hands-on teaching.



Goldwater Scholar Sets Sights on Medical and Doctoral Degrees

Giona Kleinberg, E'23, is curious, ambitious, and passionate about research. Last year, he earned a prestigious Goldwater Scholarship, opening new opportunities for him to apply his aptitude and enthusiasm for data analysis to the world of biomedical research. Having graduated with a combined major in bioengineering and biochemistry, and a minor in data science, he plans to pursue both a medical degree and a PhD.

Starting in his first year, Kleinberg immersed himself in research in the lab of Sandra Shefelbine, professor of mechanical and industrial engineering, jointly appointed in bioengineering. There, he drew on his knowledge of data science to create image processing solutions for bioengineering lab applications. During his time in Shefelbine's lab, he was the first author on a paper comparing novel image processing pipelines created for multiple deep learning algorithms; an image from his analysis appeared on the cover of the journal *Cells & Development*. Since then, he has published three other papers, with five more accepted or under review.

In 2021, Kleinberg held a co-op position as a research assistant at Harvard Medical School's Sabatini Lab, which focuses on the structure and function of brain synapses and the relationship between synapse function and animal behavior. There, he investigated hyperthyroidism and mania using mice, with a potential application for bipolar disorder. He found the experience so rewarding that he continued to work there part-time once the co-op ended, eventually signing on for a second co-op in the lab. Though that job has now ended as well, he has landed a full-time position in the lab, where he plans to work for a year while he applies to MD and PhD programs.

In addition to his research, Kleinberg advances his career aspirations by working as a medical scribe in the emergency department of Massachusetts General Hospital, recording patient symptoms, lab and physical exam results, imaging, differential diagnoses, and medical decision-making. He also shadows physicians to learn more about the profession. Goldwater Scholar Giona Kleinberg, E'23, bioengineering and biochemistry, was first author on a paper comparing novel image processing pipelines created for multiple deep learning algorithms; an image from his analysis appeared on the cover of the journal Cells & Development. Since then, he published three other papers, with five more accepted or under review.

Kleinberg has been recognized repeatedly for his talents, earning PEAK Experience awards from Northeastern's Office of Undergraduate Research and Creative Endeavors in 2021 and 2022, respectively. In 2022, he also received the 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.

"It feels like the culmination of a lot of hard work from myself and my fantastic mentors," he says. "It's really good to be recognized for the long hours I've been putting in the last few years."

Kleinberg notes that achieving a distinction like the Goldwater Scholarship can signify talent in a way that opens more academic and professional opportunities. He offers the example of the Waller Institute, a nonprofit group that enlists pre-med students worldwide to write literature reviews and conduct meta-analyses under the guidance of researchers and physicians from universities across the United States. Since winning the Goldwater award, he has risen from research intern to research team lead, and then he took over as president of the organization.



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Letter from the Chair



COVER IMAGE

The Parallel Squared Technology Institute, launched by **Nikolai Slavov**, associate professor of bioengineering, is the principal beneficiary of a \$50 million grant from two investors, Schmidt Futures and Citadel founder and CEO Ken Griffin. The research intends to use new techniques to significantly ramp up single-cell protein analysis of Alzheimer's disease. The work the institute is undertaking is built on technology Slavov developed at Northeastern. Read the full article on page 6.

Photo by Ruby Wallau/Northeastern University