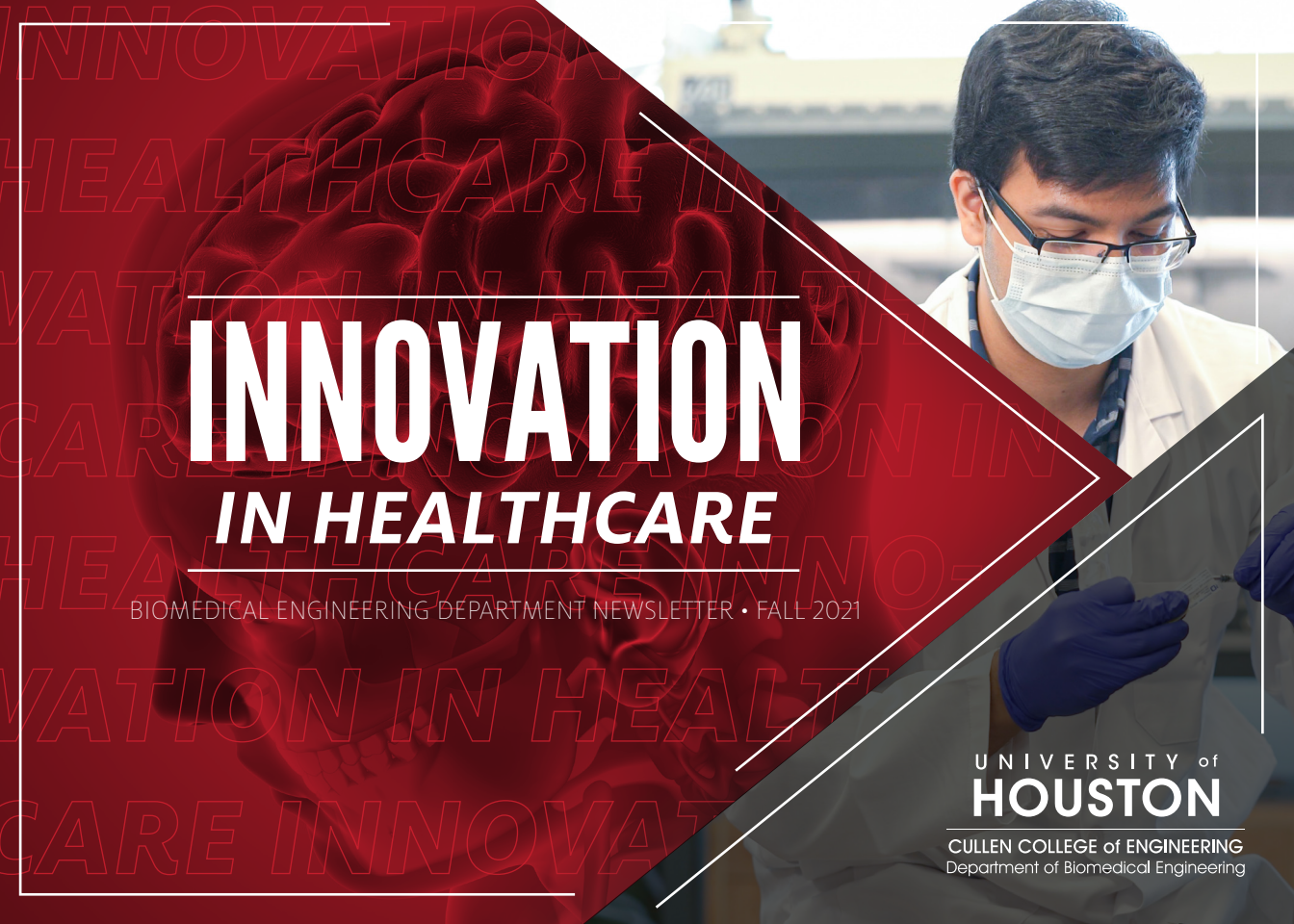


INNOVATION
IN HEALTHCARE

BIOMEDICAL ENGINEERING DEPARTMENT NEWSLETTER • FALL 2021

UNIVERSITY of
HOUSTON
CULLEN COLLEGE of ENGINEERING
Department of Biomedical Engineering

Letter from the Chair

Dear Colleagues,

While we continue to closely monitor the effects of COVID-19 in the greater Houston area and beyond, we have now resumed full-in person functionality at the University of Houston campus. Despite the challenges from the last year, the University of Houston has continued to excel, including enrollment levels reaching record numbers and an increase of 40% in research grants. This publication highlights some of the specific achievements of the Cullen College's biomedical engineering department from the last six months. If you would like to know more about any of these projects, or wish to collaborate, I invite you to contact me directly.

Warm Regards,

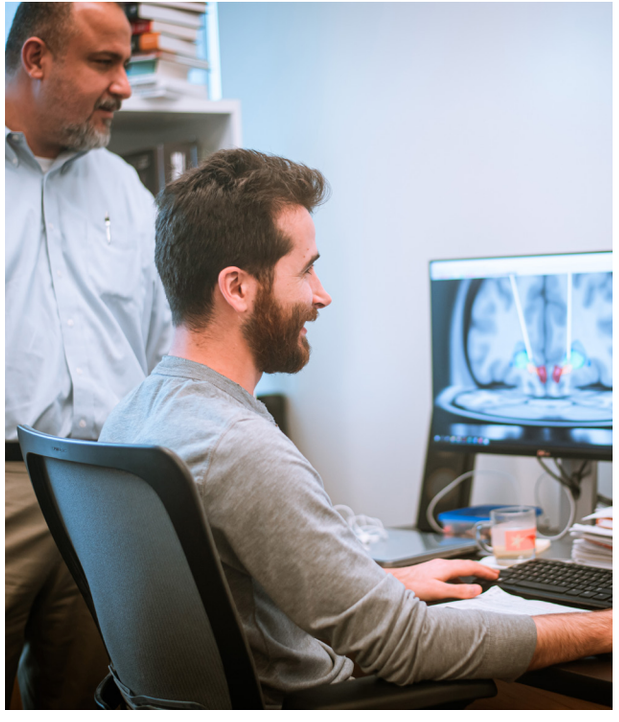
Metin Akay, Ph.D.
Founding Chair, John S Dunn Endowed Chair Professor
Department of Biomedical Engineering
Cullen College of Engineering
Univeristy of Houston

INCE EARNS NSF GRANT TO **CONTINUE RESEARCH ON NEURAL HAND NETWORKING**

Simple, everyday activities that people seldom put thought into – opening a door, cradling an egg, picking up a coffee cup – actually rely on complex interactions between your brain and the nerves of your hand and fingers, all of which are difficult to account for when it comes to creating prosthetic or programming AIs.

It's a challenge that **Nuri Firat Ince**, an Associate Professor in the Biomedical Engineering Department at the Cullen College of Engineering, is tackling in his research. One of his recent proposals, "Characterization and Decoding of Cortical Oscillatory Dynamics of Complex Hand Function," has been approved for a National Science Foundation grant.

In this proposal, the researchers will investigate brain oscillations recorded from motor and somatosensory cortex of human subjects. The outcome of the project will provide essential bases for advancing neuroengineering and brain-inspired concepts and designs, and contributing to the development of next generation hand neuroprosthetics. Research on the $983,513 project started on Sept. 1, 2021, with an estimated end date of August 2025. The Cullen College of Engineering portion of the grant is about $709,000. Ince's co-PIs on the project are Dr. Sujit Prabhu, a Professor in the Department of Neurosurgery at the UT MD Anderson Cancer Center (MDACC), and Giuseppe Pellizzer, Ph.D., an Associate Professor in the Department of Neuroscience at the University of Minnesota.



STOPPING EPILEPTIC SEIZURES BEFORE THEY BEGIN

University of Houston associate professor of biomedical engineering, **Nuri Firat Ince**, who pioneered a dramatic decrease in the time it takes to detect the seizure onset zone (SOZ) in the brain, has received a $3.7 million BRAIN Initiative grant from the National Institute of Neurological Disorders and Stroke to translate his work into creating a next-generation device that can stop epileptic seizures before they begin.

Ince reduced the time – by weeks – of locating the SOZ, the actual part of the brain that causes seizures in patients with epilepsy, by detecting high frequency oscillations (HFO), which form repetitive waveform patterns that identify their location in the SOZ. Now he plans to use those HFOs to close the loop, translating them into seizure control applications, a method never before explored.

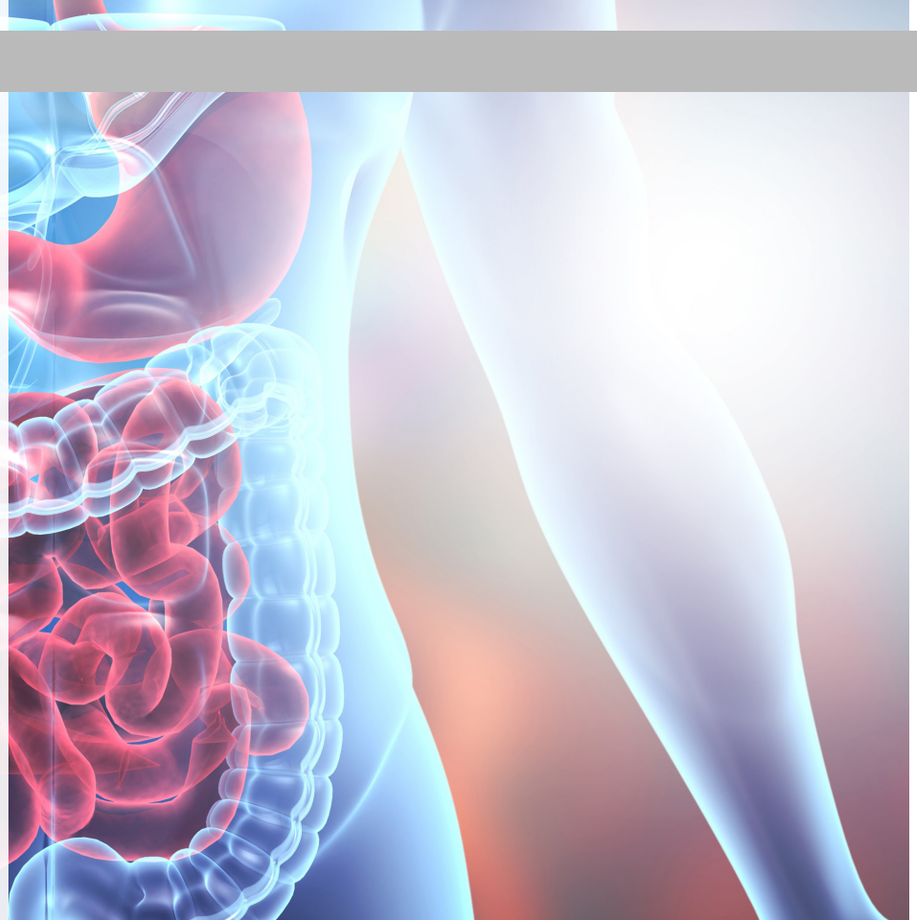
MORE EFFICIENT TESTS MAY ONE DAY

REPLACE ENDOSCOPY

In two journal articles, a University of Houston biomedical researcher reports a step forward in diagnosing intestinal diseases, including colorectal cancer, ulcerative colitis and Crohn's disease using stool proteins. The current gold standard for colon cancer testing measures blood (hemoglobin) present in stool, and tests for inflammatory bowel disease (IBD) measure levels of calprotectin, a protein that detects inflammation in the intestines.

"The unique aspect of both research reports is that we are looking at stool samples comprehensively, and not just at one or two favorite molecules," said **Chandra Mohan**, Ph.D., Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering in the UH Cullen College of Engineering. "We are casting a wide net, and this has never been done before." The work was reported in both *Nature Communications* and the *Journal of Gastroenterology*.

Mohan's hope is to replace the invasive endoscopy test by finding stool markers that can predict what is happening in the intestine without having to do endoscopy. Stool test for proteins can be done at home and through the mail.



IMPROVED NEURAL INTERFACES FOR LIMB AMPUTEES

Mario Ignacio Romero-Ortega, the Cullen Endowed Professor of Biomedical Engineering, has been awarded $2.79 million from the National Institute of Neurological Disorders and Stroke (NIH) for his project titled "Regenerative Ultramicroelectrode Arrays For Sensory-Motor Specific Interfacing." According to the project summary, there are "approximately 4 million amputees globally, a number estimated to grow 200,000 annually. Upper limb amputees traditionally use passive, body powered, or electrically powered prostheses that use surface Electromyographic (EMG) signals from intact muscles in the residual limb for movement, despite the motion artifacts, variability and need of visual and/or surrogate sensory control by the user." Current neural interfaces suffer from numerous common challenges, including electrode failure and signal deterioration. Romero-Ortega will study two novel strategies designed to increase the selectivity of recording/stimulation at the peripheral nervous system (PNS) interface, through use of a newly developed ultra-thin multielectrode array and molecular guidance cues. Advancing these interfaces has the potential to improve the lives of robotics prosthetics users through better control and decreasing uncomfortable sensations, such as "stings or tingles."

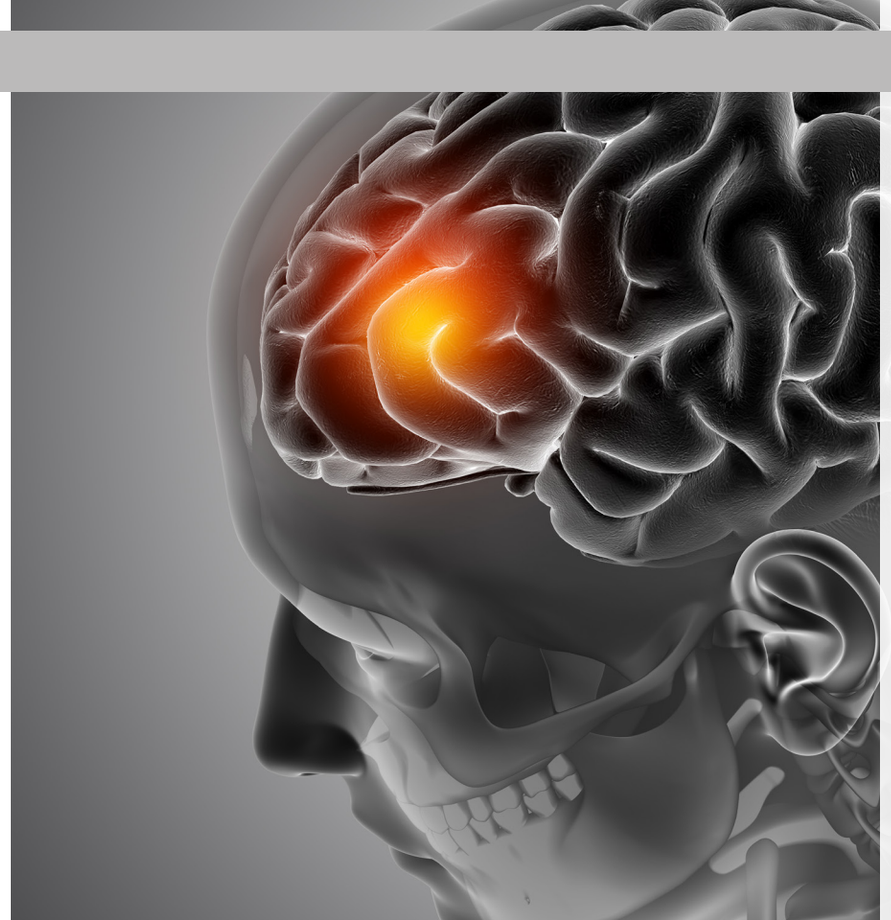
ACTUATOR DISCOVERY OUTPERFORMS EXISTING TECHNOLOGY

University of Houston researchers are reporting a breakthrough in the field of materials science and engineering with the development of an electrochemical actuator that uses specialized organic semiconductor nanotubes (OSNTs).

Currently in the early stages of development, the actuator will become a key part of research contributing to the future of robotic, bioelectronic and biomedical science.

"Electrochemical devices that transform electrical energy to mechanical energy have potential use in numerous applications, ranging from soft robotics and micropumps to autofocus microlenses and bioelectronics," said **Mohammad Reza Abidian**, associate professor of biomedical engineering in the UH Cullen College of Engineering. He's the corresponding author of the article "Organic Semiconductor Nanotubes for Electrochemical Devices," published in the journal *Advanced Function Materials*, which details the discovery. Joining Abidian on the project were **Mohammadjavad Eslamian**, **Fereshtehsadat Mirab**, **Vijay Krishna Raghunathan** and **Sheereen Majd**, all from the Department of Biomedical Engineering at the UH Cullen College of Engineering.

BIOMEDICAL ENGINEERING



UH RESEARCHER DEVELOPS, TESTS NANO-CARRIER AS POTENTIAL **TREATMENT FOR BRAIN TUMORS**

With a survival rate of only five years, the most common and aggressive form of a primary brain tumor, glioblastoma multiforme, is notoriously hard to treat using current regimens that rely on surgery, radiation, chemotherapy and their combinations.

"Two of the major challenges in the treatment of gliomas include poor transport of chemotherapeutics across the blood brain barrier and undesired side effects of these therapeutics on healthy tissues," said **Sheereen Majd**, assistant professor of biomedical engineering at the University of Houston. "To get enough medicine across the blood brain barrier, a high dosage of medication is required, but that introduces more toxicity into the body and can cause more problems."

In an article published and featured on the cover of a January issue of *Advanced Healthcare Materials*, Majd reports a new glioma-targeted nano-therapeutic that will only address tumor cells offering increased effectiveness and reduced side effects. Majd's study, which tested the nano-therapeutic both in vivo and in vitro, is the first report on targeted delivery of Dp44mT to malignant tumors.

SCREENING FOR SKIN DISEASE ON YOUR LAPTOP

The founding chair of the Biomedical Engineering Department at the University of Houston is reporting a new deep neural network architecture that provides early diagnosis of systemic sclerosis (SSc), a rare autoimmune disease marked by hardened or fibrous skin and internal organs. The proposed network, implemented using a standard laptop computer (2.5 GHz Intel Core i7), can immediately differentiate between images of healthy skin and skin with systemic sclerosis.

"Our preliminary study, intended to show the efficacy of the proposed network architecture, holds promise in the characterization of SSc," reports **Metin Akay**, John S. Dunn Endowed Chair Professor of biomedical engineering. The work is published in the *IEEE Open Journal of Engineering in Medicine and Biology*.

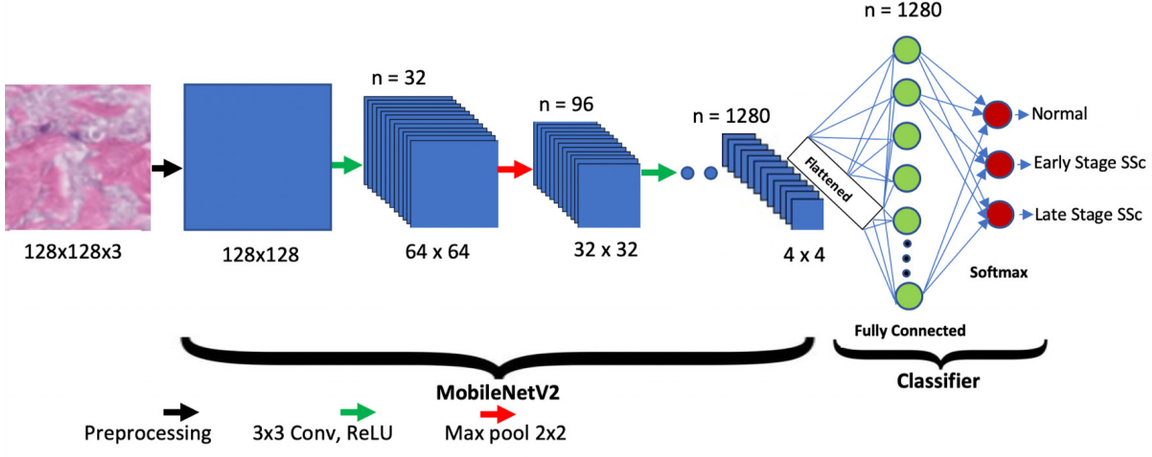
Among several deep learning networks, Convolutional Neural Networks (CNNs) are most commonly used in engineering, medicine and biology, but their success in biomedical applications has been limited due to the size of the available training sets and networks.

To overcome these difficulties, Akay and partner **Yasemin Akay** combined the UNet, a modified CNN architecture, with added layers, and they developed a mobile training module. The results showed that the proposed deep learning architecture is superior and better than CNNs for classification of SSc images.

The training time was less than five hours.

Joining Metin Akay and Yasemin Akay, the paper was co-authored by **Yong Du**, **Cheryl Shersen**, **Ting Chen** and C**handra Mohan**, all of University of Houston; and Minghua Wu and Shervin Assassi of the University of Texas Health Science Center (UT Health).

Figure shown below: *The proposed network architecture incorporates the MobileNetV2 model and classifier unit with a mobile training module.*



BIOMEDICAL ENGINEERING

RENITA HORTON, PH.D

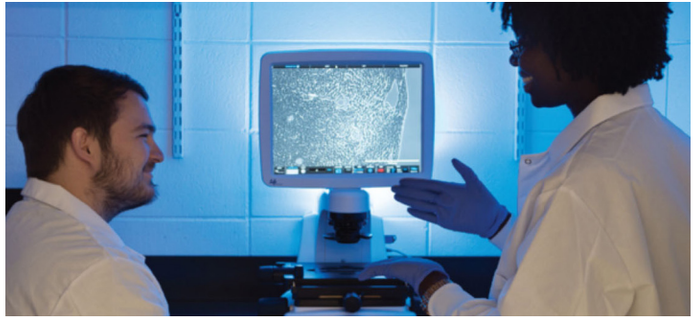
ASSISTANT PROFESSOR IN THE BIOMEDICAL ENGINEERING
DEPARTMENT OF THE COLLEGE OF ENGINEERING

RECIPIENT OF THE

2021
RALPH E. POWE JUNIOR FACULTY ENHANCEMENT AWARD

FROM THE OAK RIDGE ASSOCIATED UNIVERSITIES CONSORTIUM

ORAU



Renita Horton, Ph.D., an Assistant Professor in the Biomedical Engineering Department of the College of Engineering, has been selected as one of the 2021-22 recipients of the Ralph E. Powe Junior Faculty Enhancement Award from the Oak Ridge Associated Universities consortium.

Named in honor of Powe, who served as the ORAU councilor from Mississippi State University and was elected chair of ORAU's Council of Sponsoring Institutions, the competitive research award provides seed money for junior faculty members that often result in additional funding from other sources. The one-year grant of $5,000 must be matched by the applicant's institution.

Horton was one of 35 honorees this year, from an applicant pool of 156. She plans to use the award to pursue a new artery of research.

SURF SCHOLARS



Three BME undergraduate students were selected for the University of Houston's Summer Undergraduate Research Fellowship (SURF), according to the Honors College. The program provides funding for rising UH sophomores, juniors and seniors to participate in a focused, full-time, 10-week research experience from June through August under the direction of a faculty member. SURF is only open to undergraduates, and students who previously participated in SURF are not allowed to apply again, as the focus is on providing opportunities for first-time research.

SURF provides a $4,000 scholarship to participating students. Participating students also attend the weekly Brown Bag Lecture series, and present a research poster at Undergraduate Research Day, currently scheduled for April 2022.

Participating students included:

- **Anaga Ajoy**, studying Biomedical Engineering with Pranav Parikh.
- **Dorothy Mwakina**, studying Biomedical Engineering with Yingchun Zhang.
- **Nivriti Sabhnani**, studying Biomedical Engineering with Jose Contreras-Vidal.

SCRIP SCHOLAR

BME undergraduate student, **Esperanza Vazquez**, recently participated in Rice University's Summer Cardiovascular Research Internship Program (SCRIP) during the summer of 2021.

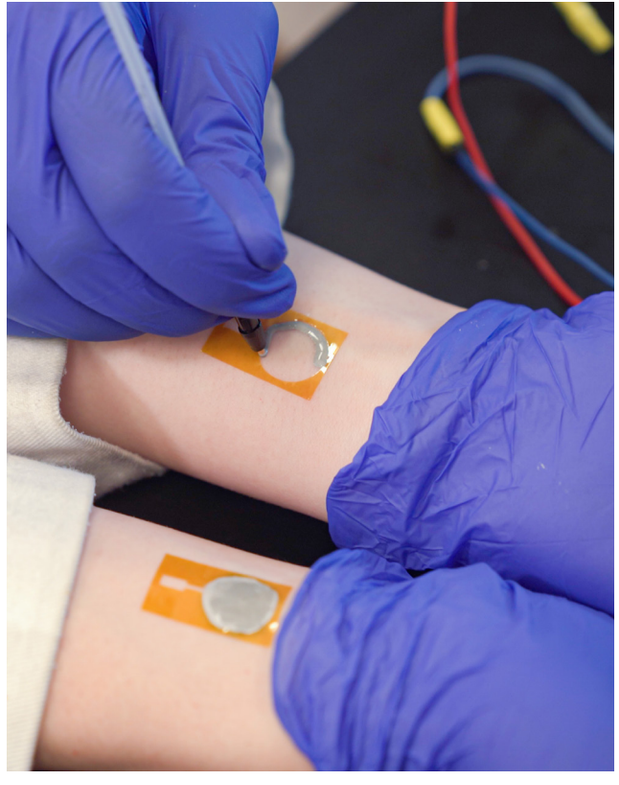
According to the Institute of Biosciences and Bioengineering (IBB) at Rice, the purpose of the program is to provide students with the opportunity to perform research in the departments of Bioengineering, Biosciences, Chemical and Biomolecular Engineering, Chemistry, Computational and Applied Mathematics, Psychology, Sociology, and Statistics.

TCSUH SCHOLAR

A BME graduate student received a scholarship from the Texas Center for Superconductivity at the University of Houston (TcSUH), as recognition for work inside and outside of the classroom.

Faheem Ershad received a Cora Hawley Scholarship. According to the TcSUH, Hawley established the scholarships to further the careers of exceptional students aligned with TcSUH research programs.

Ershad joined the Ph.D. program in biomedical engineering in 2018 after completing a B.S. in biomedical engineering with a minor in nanoengineering. In recognition of his undergraduate excellence, Faheem received the prestigious NSF Graduate Research Fellowship. His advisor is Cunjiang Yu, Bill D. Cook Associate Professor of Mechanical Engineering. Ershad has been investigating drawn-on-skin electronics for motion artifact-less sensing and point-of-care treatment in one of his research projects. He has published 13 papers, with two in *Nature Electronics*, one in *Nature Communications*, and three in *Science Advances*.



BIOMEDICAL ENGINEERING

LARISSA IKELLE EARNS **NRSA FOR EYE RESEARCH**

Larissa Ikelle, a doctoral student in the Biomedical Engineering Department at the Cullen College of Engineering, has received funding from the National Institutes of Health's Ruth L. Kirschstein National Research Service Award to continue her research into the mechanisms of diseases associated with vision loss, and to develop therapeutic strategies to correct them.

The award comes with funding for Ikelle's research proposal, as well as a stipend for tuition and a small spending allowance for her doctorate studies. Ikelle described her work as studying the biochemistry of retinal diseases, in order to develop therapies that can prevent or delay blindness.

Ikelle earned her Bachelor's of Applied Science in Biochemistry and Cell Biology, as well as a B.A. in French Studies, from Rice University in 2014. After a year as a research assistant at Oxane Materials in Houston, Ikelle became a research assistant for the UH Department of Biomedical Engineering in 2016. She has contributed to research by Muayyad Al-Ubaidi, Ph.D., and Muna Naash, Ph.D., both professors in the Biomedical Engineering Department, and has received authorship credit for several papers with them.

ALUMNI ACHIEVEMENTS

Mohammadjavad Eslamian was honored by the Society for Biomaterials for his abstract titled, "Conducting Polymer Nanofibers for Biorobotics." Eslamian submitted the abstract for the Society for Biomaterials' 2021 Virtual Annual Meeting in April, and received a STAR (Student Travel Achievement Recognition) award for the contribution. As part of the honor, Eslamian was invited to give a talk during the special STAR Award Session.

Gwen Musial received the Ph.D.-ZEISS award at this year's virtual Young Researcher Vision Camp held by the European Vision Institute. Musial received first prize for her talk on novel in-vitro tissue analysis via Optical Coherence Tomography (OCT). The focus of the Europen Vision Institute is to provide better support, coordination and orientation of research in the field of visual sciences.

Megan Goh, a top recent graduate of the UH BME department and the Cullen College's Outstanding Senior for 2018, is currently continuing her studies at Harvard Medical School. Goh previously received a Fulbright Study/Research Grant scholarship in 2018 to travel abroad in Germany, where she studied infantile brain disorders in animal models using photoacoustic imaging.

Maham Gardezi, a recent graduate, received a 2021-2022 Fulbright grant. Her accomplishments include serving in the UH Bonner Leaders Program, working as a project head for the Program Engagement Encouraging Rising Students (PEERS) program, and conducting neuroscience research under Associate Professor Bhavin Sheth from the University of Houston and Ian Mendez under the SMART-MIND program at The University of Texas at El Paso. She is currently serving as an English Teaching Assistant in Latvia.

NEW CAREERS PLACEMENTS

Mohammadjavad Eslamian, PhD
Senior Product Engineer at Medtronic

Sadaf Pustchi, PhD
Post-doctoral fellow at Cedars-Sinai

Richard Su, PhD
Biomedical Engineer at TomoWave Laboratories

Yaxi Li, PhD
Post-doctoral fellow at the University of Houston

Moin Atique, PhD
Post-doctoral fellow at Baylor College of Medicine

Musa Ozturk, PhD
Research Scientist at Cala Health

Kian Torabian, PhD
R&D Engineer at Siemens Healthineers

Nicholas Dias, PhD
Principal Research Scientist at HillMed Inc

Madeleine Lu, PhD
Venture Fellow at GOOSE Capital and Project Manager at Iterion Therapeutics

The University of Houston
Cullen College of Engineering

The University of Houston Cullen College of Engineering addresses key challenges in energy, healthcare, infrastructure, and the environment by conducting cutting-edge research and graduating hundreds of worldclass engineers each year. With research expenditures topping $35 million and increasing each year, we continue to follow our tradition of excellence in spearheading research that has a real, direct impact in the Houston region and beyond.

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Research MILESTONES