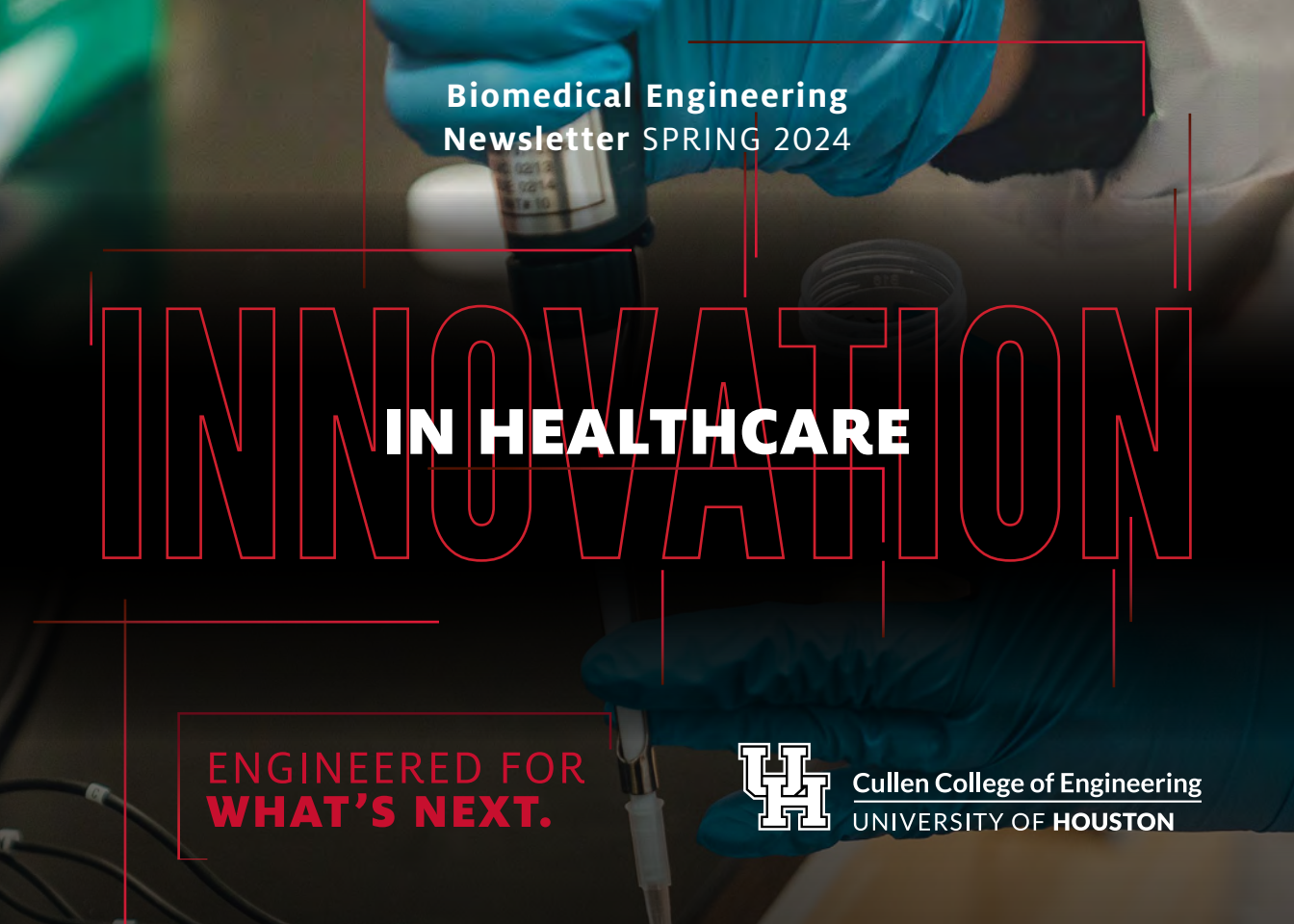


Biomedical Engineering
Newsletter SPRING 2024

INNOVATION

IN HEALTHCARE

ENGINEERED FOR
WHAT'S NEXT.

Cullen College of Engineering
UNIVERSITY OF **HOUSTON**

Letter from the Chair

Dear Colleagues,

I hope that you are well and that the spring semester has treated you well so far. There are many exciting things happening within our department. I am extremely proud of the work being done by our students and faculty, much of which has received national recognition, such as the NSF CAREER Award received by one of our faculty members for his work using electrolyte migration to alternate current (AC) electric fields. I am delighted to share many more highlights and accomplishments of the UH Biomedical Engineering Department's esteemed faculty and industrious students.

I hope you enjoy reading through this email sampling of our work, and if you any of these projects strike your interest, do not hesitate to reach out. We are always looking for collaborator to further our research.

Warm Regards,

Metin Akay, Ph.D.
Founding Chair, John S Dunn Endowed Chair Professor
International Academy of Medical and Biological Engineering (IAMBE
Chair-Elect IEEE BRAIN Technical Community
Department of Biomedical Engineering

UH BME **BY THE NUMBERS**

100% PH.D. POST-GRADUATE JOB PLACEMENT

**NUMBERS BASED ON FALL 2021*

DEGREES AWARDED *(FY 2023)*

42 B.S. **22** M.S. **12** Ph.D.

ENROLLMENT *(FY 2023)*

270 UNDERGRADUATE STUDENTS

122 GRADUATE STUDENTS

FACULTY:

NAE: **1**
IEEE FELLOW: **1**
SPIE FELLOW: **1**
AIMBE FELLOWS: **3**
AAAS FELLOWS: **2**
NSF CAREER: **4**
BMES FELLOW: **1**
IOP FELLOW: **1**
IAMBE FELLOW: **1**
ACS FELLOW: **1**
TOP 1% HIGHLY CITED RESEARCHERS: **2**
HONORIS CAUSA DOCTORATE: **3**
OSA FELLOW: **1**
AICE FELLOW: **1**
AAIA FELLOW: **1**

NATIONAL RECOGNITION

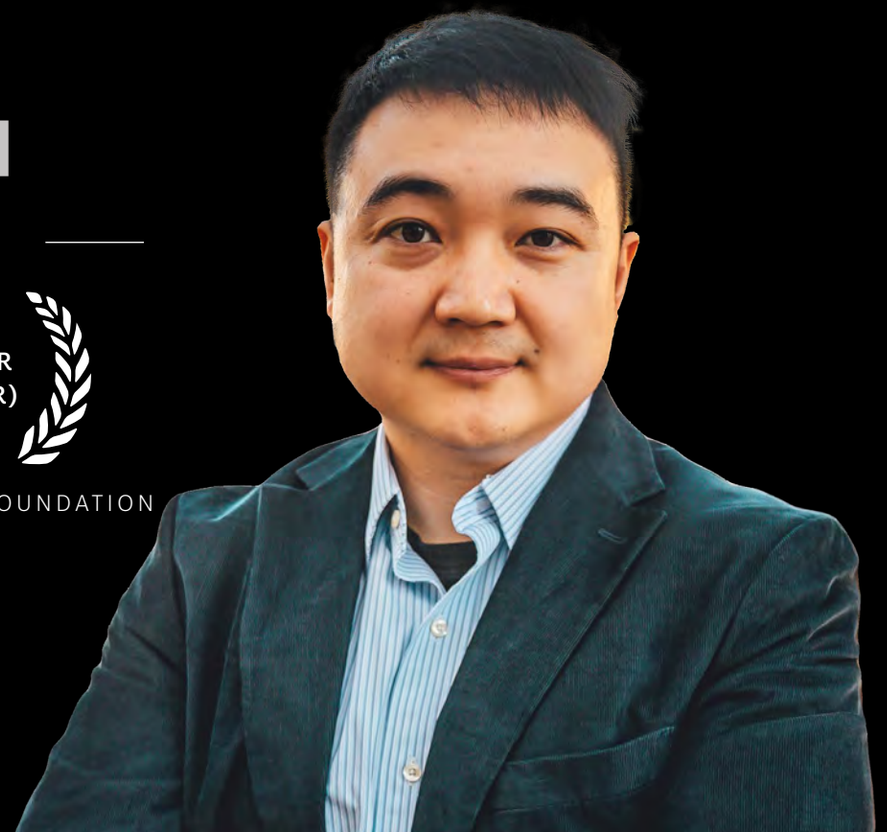
RAN AN

WINNER OF THE

2024
FACULTY EARLY CAREER DEVELOPMENT (CAREER) AWARD

FROM THE NATIONAL SCIENCE FOUNDATION

NSF



A University of Houston professor in the Department of Biomedical Engineering has earned the prestigious National Science Foundation CAREER Award.

Ran An is an assistant professor in the Biomedical Engineering Department with a joint faculty appointment in the Department of Biomedical Sciences at the UH Tilman J. Fertitta Family College of Medicine. His proposal, "Alternating Current Electrophoresis in Spatially Non-Uniform Electric Fields," was chosen for funding by the NSF. An's research will examine a curiosity in recent research on electrolyte migration using alternating current (AC) electric fields.

According to his proposal, "Scientists have assumed that applying AC voltages to an electrolyte solution encourages the electrolytes to migrate in a way that does not affect the overall bulk solution properties. However, recent research studies revealed that electrolyte bulk solution properties change when a spatially non-uniform AC electric field is applied. Effects such as flow reversal, pH shifts, solution osmotic pressure change, and the generation of ion concentration gradients were observed."

The grant is for $515,501, with an estimated end date of June 2029. Beyond this grant, An's current research focuses on the development, clinical translation and potentially commercialization of: 1) electrokinetic- and electrochemical-driven microfluidic biosensors for rapid and affordable point-of-care disease diagnostics and monitoring; 2) organ-on-chip functional assays to facilitate fundamental understanding of disease pathophysiology, drug testing, and personalized healthcare, with a specific interest in human microcirculatory health.

BME'S METIN AKAY FEATURED IN STUDY

HIGHLIGHTING SCIENTISTS' CONTRIBUTIONS TO ENGINEERING ADVANCEMENTS

Metin Akay, founding chair of the Biomedical Engineering Department at the University of Houston and John S. Dunn Professor, is one of 50 top scientists from 34 elite universities to publish a roadmap for groundbreaking research to transform the landscape of medicine in the coming decade.

"This paper represents a valuable guideline in the advancement of engineering innovations in healthcare, so that we can improve the quality of healthcare, reduce costs, ultimately, improve lives of people worldwide," said consortium member Akay. "We have a shared commitment to advancing patient-centric technologies, and healthcare efficacy and accessibility, especially for major healthcare challenges such as chronic conditions, substance abuse and mental disorders."

Pictured: *A research student in Dr. Akay's lab.*

NEW

FACULTY

YUNCHENG DU

Yuncheng Du, has joined the Department as an associate professor. Du earned his doctorate from the University of Waterloo in Ontario, Canada, in 2016. The same year, he was hired as an assistant professor at Clarkson University in New York. He earned a NSF CAREER Award in 2022.

NEW

FACULTY

LU WANG

Lu Wang, joined the Department as an assistant professor, starting Sept. 2023. Wang earned her doctorate degrees in Industrial Engineering from the University of Toronto in 2023 and Computer Science from Wayne State University in 2019, respectively. Since 2022, she has served as an assistant professor in the Computer Science Department at Texas State University.

CHANDRA MOHAN AWARDED $3 MILLION GRANT TO DEVELOP AI SYSTEM TO ANALYZE BIOPSY RESULTS

Chandra Mohan, M.D., Ph.D., Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering in the UH Cullen College of Engineering, will use a $3 million grant from the National Institute of Diabetes and Digestive and Kidney Diseases to bring AI into the diagnostic picture.

The goal of using AI to classify lupus nephritis in an automated fashion with high accuracy will translate to better treatment for lupus nephritis, according to researchers.

"By leveraging the power of computer vision and deep learning, a branch of machine learning, we will build classifiers that rival the best renal pathologists in making a diagnosis using current criteria. This could dramatically improve patient management and long-term renal and patient outcome," said Mohan.

Pictured: *Chandra Mohan.*

University of Houston | Cullen College of Engineering

WEARABLE SENSORS TO **DETECT COLORECTAL CANCER**

Through a HEALTH-RCMI Pilot Program Award, University of Houston's **Zhengwei Li** will develop a wearable biosensor that promises to detect colorectal cancer and provide real-time health monitoring through your smartphone.

Through support from HEALTH-RCMI, Li has spearheaded a new study, "Development of Ultrasensitve Smart Bioelectronic Sensors for Colorectal Cancer Prevention and Health Disparities Reducing among Black Americans." This initiative was funded $50,000 by NIMHD and HEALTH-RCMI [PI: Dr. Ezemenari Obasi].

"Colorectal cancer is the third cause of cancer related deaths in the U.S., according to the American Cancer Society," Li said. "They estimate more than 150,000 cases this year in the U.S. Black Americans and minorities are more likely to be impacted by colorectal cancer."

Li's vision about a cancer-free world is an ambitious one. He is determined to reduce cancer disparities by creating devices that can remotely sense the biophysical signals of certain cancers.

Pictured: *Zhengwei Li*

NEW RESEARCH GRANTS

RESEARCH

PORTFOLIO ADDITIONS

R01EY033978

"No-Touch High Resolution Optical Coherence Elastography of the Cornea using a Heartbeat"

Project goal: Develop new clinical technology and method capable of precise noninvasive and "no-touch" quantitative measurements of the corneal mechanical properties. This will be achieved by the development of a novel fast Optical Coherence Elastography (OCE) system utilizing a human heartbeat as the loading source.

UH Project Lead and PI: Kirill Larin, *Cullen College of Engineering Professor*

R01HD086765

"Multimodal Optical Imaging on the Effect of Maternal Polysubstance Exposure on Fetal Brain Microvessel Function"

Project goal: Understand the etiology of congenital brain growth anomalies due to prenatal alcohol/ethanol and nicotine exposure. This will be achieved by developing a new imaging platform based on multiphoton light-sheet microscopy combined with Optical Coherence Tomography.

UH Project Lead and PI: Kirill Larin, *Cullen College of Engineering Professor*

R01EY034114

"Regulation of tissue repair and scar formation by the stromal niche"

Project goal: Corneal scarring is a public health problem and a very common indication of corneal transplantation. We aim to address the innovative concept that re-establishing a unique environment or stromal niche with its unique mechanical and chemical cues is critical after injury to ameliorate scarring -- a potential target for therapeutic interventions.

UH Project Lead: Kirill Larin, *Cullen College of Engineering Professor*

PI: Espana from USF

NEW RESEARCH GRANTS

RESEARCH

PORTFOLIO ADDITIONS

R01NS125435

“Regenerative Micro-Electrode Peripheral Nerve Interface for Optimized Proprioceptive and Cutaneous specific interfacing"

Project goal: Generate a somatosensory neuroprosthesis by optimizing microstimulation within peripheral nerve conduits that use molecular guidance cues to separate cutaneous and proprioceptive sensory modalities.

UH Project Lead and PI: Joe Francis, *Professor*

R01EB032416

“Visual-search ideal observers for modeling reader variability"

Project goal: Multireader clinical imaging trials are a burdensome standard for assessing and comparing diagnostic medical imaging technology. Work will develop an adaptive computer model that can provide quantitative multireader performance estimates at clinically relevant tasks. This will improve the statistical rigor of in silico imaging trials, ultimately benefitting patient care through faster, less costly adoption of imaging advances.

UH Project Lead and PI: Howard Gifford, *Associate Professor*

Pictured: *Chandra Mohan research lab.*

CLINICAL IMMUNOLOGY

JOURNAL FEATURES UH RESEARCHER'S POWERFUL IMAGING TECHNOLOGY

Theres been a recent finding by a University of Houston nationally recognized expert in systemic lupus erythematosus (SLE or lupus), a chronic autoimmune disease that affects multiple organs including the kidneys, skin, joints and heart, that has been reported in the journal *Clinical Immunology.*

Chandra Mohan, M.D., Ph.D., Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering in the UH Cullen College of Engineering, is reporting the first use of the powerful imaging mass cytometry (IMC) to examine the kidneys of patients with lupus (systemic lupus erythematosus), an autoimmune disease that can affect multiple organs and become fatal, and to diagnose lupus nephritis (LN) in those patients.

NEW MODEL TO EXAMINE USHER SYNDROME

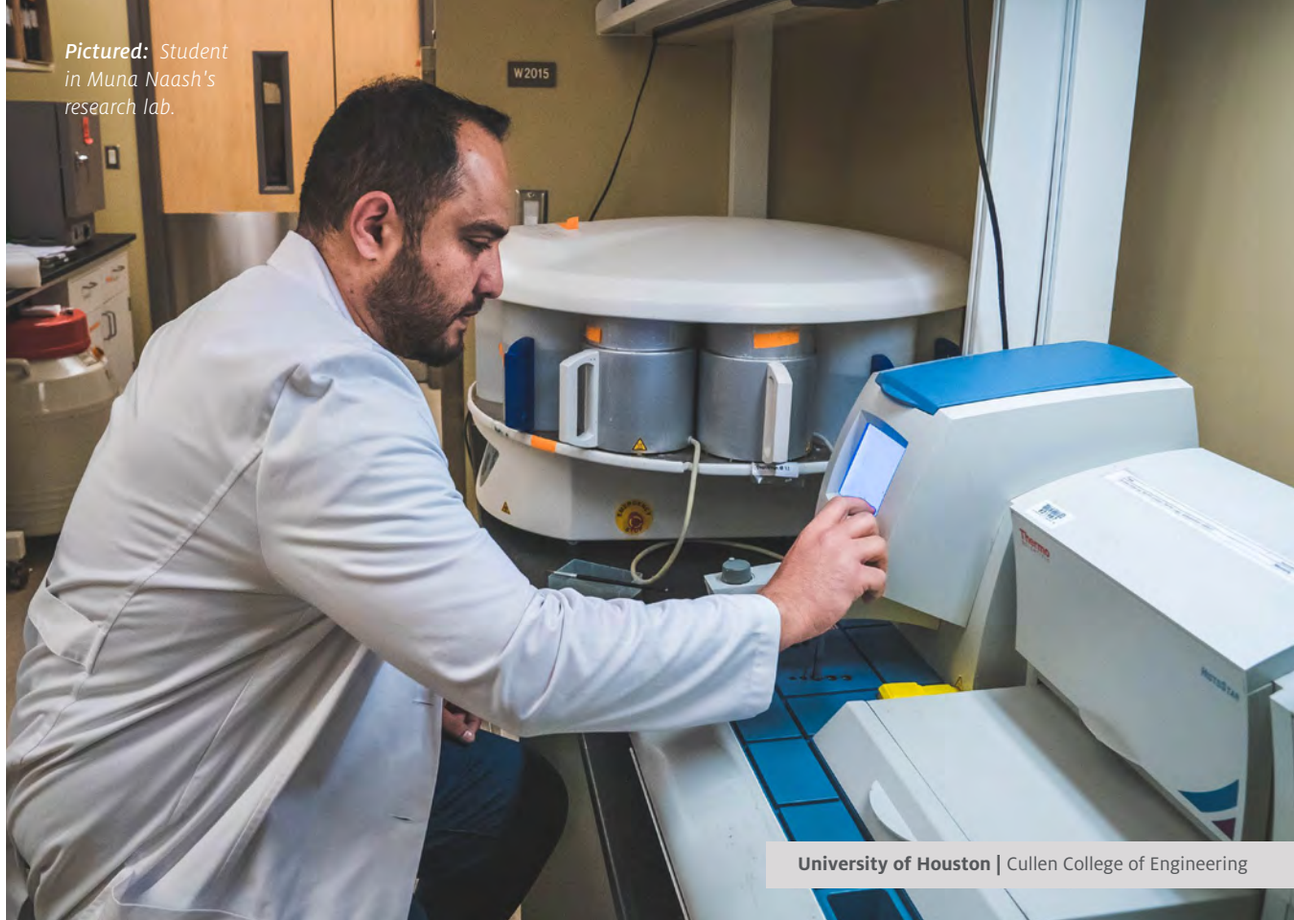
FEATURED IN NATURE COMMUNICATIONS JOURNAL

Usher syndrome, a rare inherited genetic disease, is a leading cause of combined deafness and blindness with type 2A (USH2A) being the most common form. USH2A, caused by mutations in the USH2A gene, can include hearing loss from birth and progressive loss of vision, prompting retinitis pigmentosa (RP). RP affects the retina, the eye's light-sensitive layer, leading to a breakdown of the light-sensitive cells in the retina which initially leads to night blindness followed by progressive loss of daily vision. Currently no treatment exists for USH2A.

A University of Houston biomedical engineer has reported to *Nature Communications*, her team's design and generated a model expressing c.2299delG, the most common human disease mutation in USH2A. **Muna Naash**, John S. Dunn Endowed Professor of Biomedical Engineering reported that "the model exhibits retinal degeneration and expresses a truncated, glycosylated protein which is mislocalized to the photoreceptor inner segment. The degeneration is associated with a decline in retinal function, structural abnormalities in connecting cilium and outer segment and mislocalization of the usherin interacting partners - very long G-protein receptor 1 (VLGR1) and whirlin (WHRN)."

These results prove that expression of the actual mutant protein is beneficial in reproducing USH2A retinal phenotype and offers insight into strategies for designing therapeutic interventions. An in-depth analysis of the retina in the model revealed structural anomalies in the photoreceptors ultimately leading to the death of the photoreceptor cells causing vision loss.

Naash who was recently funded by the National Eye Institute, shared that this model exhibits retinal degeneration associated with a decline in retinal function and continues to support the development of an effective gene therapy platform to treat USH2A associated visual defects.



Pictured: *Student in Muna Naash's research lab.*

UH BME DOCTORAL STUDENT EARNS NASA SILVER ACHIEVEMENT MEDAL

Kimia Seyedmadani, a biomedical engineering student pursuing her doctorate, received NASA Silver Achievement Medal, for outstanding leadership and innovation of the biomedical and countermeasure hardware selection and flight certification processes. Her advisors are Metin Akay, Founding Chair and John S. Dunn Endowed Chair, and Yasemin Akay, Instructional Associate Professor. Together, they lead the Neural Engineering and Informatics Laboratory in the Biomedical Engineering Department.

The award caught her totally by surprise.

"I was happy and stunned," she said. "I am an Iranian immigrant with a diverse engineering background, and here I was, receiving one of the highest honor governmental medals, for impact to the field of Bioastronautics. Many people had to nominate me, from my management and above, for me to be recognized. I was very humbled by the support of my family, mentors and, most of all, my team, and I remembered them all, even those who were no longer with us."

Seyedmadani earned her B.S. followed by her M.S. in Bioengineering and Biomedical Engineering from Arizona State under the guidance of Vincent Pizziconi, an associate professor in the School of Biological and Health Systems Engineering. She also earned her M.S. in Aerospace Engineering and Bioastronautics from the University of Colorado at Boulder under the guidance of James Voss, a former NASA astronaut as well as an AIAA Fellow and Smead Aerospace scholar-in-residence.

While Seyedmadani had a diversity of knowledge prior to being hired at NASA, she wanted to continue the journey of higher education to be able to transform her work. She chose UH specifically because of Metin and Yasemin Akay's mentorship and vision.

Pictured: *Kimia Seyedmadani [center], a biomedical engineering student pursuing her doctorate, received the NASA Silver Achievement award during a ceremony in December.*

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 $40 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.

Cullen College of Engineering
UNIVERSITY OF HOUSTON

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