

Biomedical Engineering  
Newsletter Spring 2023

# 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, including advancements in the medical field. I am delighted to share some of the 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 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  
Cullen College of Engineering  
University of Houston

## UH BME BY THE NUMBERS



**100%**

PH.D. POST-GRADUATE JOB PLACEMENT

\*NUMBERS BASED ON FALL 2022

**DEGREES AWARDED** (FALL 2022)



**50** B.S.



**26** M.S.



**11** Ph.D.



**ENROLLMENT** (FALL 2022)

**272** UNDERGRADUATE STUDENTS

**125** GRADUATE STUDENTS



**FACULTY:**

NAE: **1**

IEEE FELLOW: **1**

SPIE FELLOW: **1**

AIMBE FELLOWS: **3**

AAAS FELLOWS: **2**

NSF CAREER: **2**

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**



*Pictured: Ran An*

## UH BME WELCOMES NEW ASSISTANT PROFESSOR **DR. RAN AN**

**Ran An** is an assistant professor in the Department of Biomedical Engineering at the University of Houston Cullen College of Engineering. Dr. An has worked as a Research Engineer in the biotechnology industry. His current research focuses on the development, clinical translation, and potential commercialization of electrokinetic- and electrochemical-driven microfluidic biosensors for rapid and affordable point-of-care disease diagnostics and monitoring; 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.

Dr. An has authored more than 20 peer-reviewed articles and 10 issued patents, some of which have been licensed and commercialized by leading biotechnology companies with products in the global market. Dr. An has received multiple research and training grants from the National Heart, Lung, and Blood Institute, the National Institute of Diabetes and Digestive and Kidney Diseases, the Center for Advancing Point of Care Technologies, and the Air Force Research Laboratory. Dr. An has won the NIH K25 Career Development Award, NIH Technology Accelerator Challenge Award for Global Disease Diagnostics, NIH T32 Postdoc Fellowship Award, and CAPCaT Point-of-Care Technology Development Award. ⚙️

### PIONEERING IMAGING TECHNIQUES OF FETAL BRAIN AND CORNEA

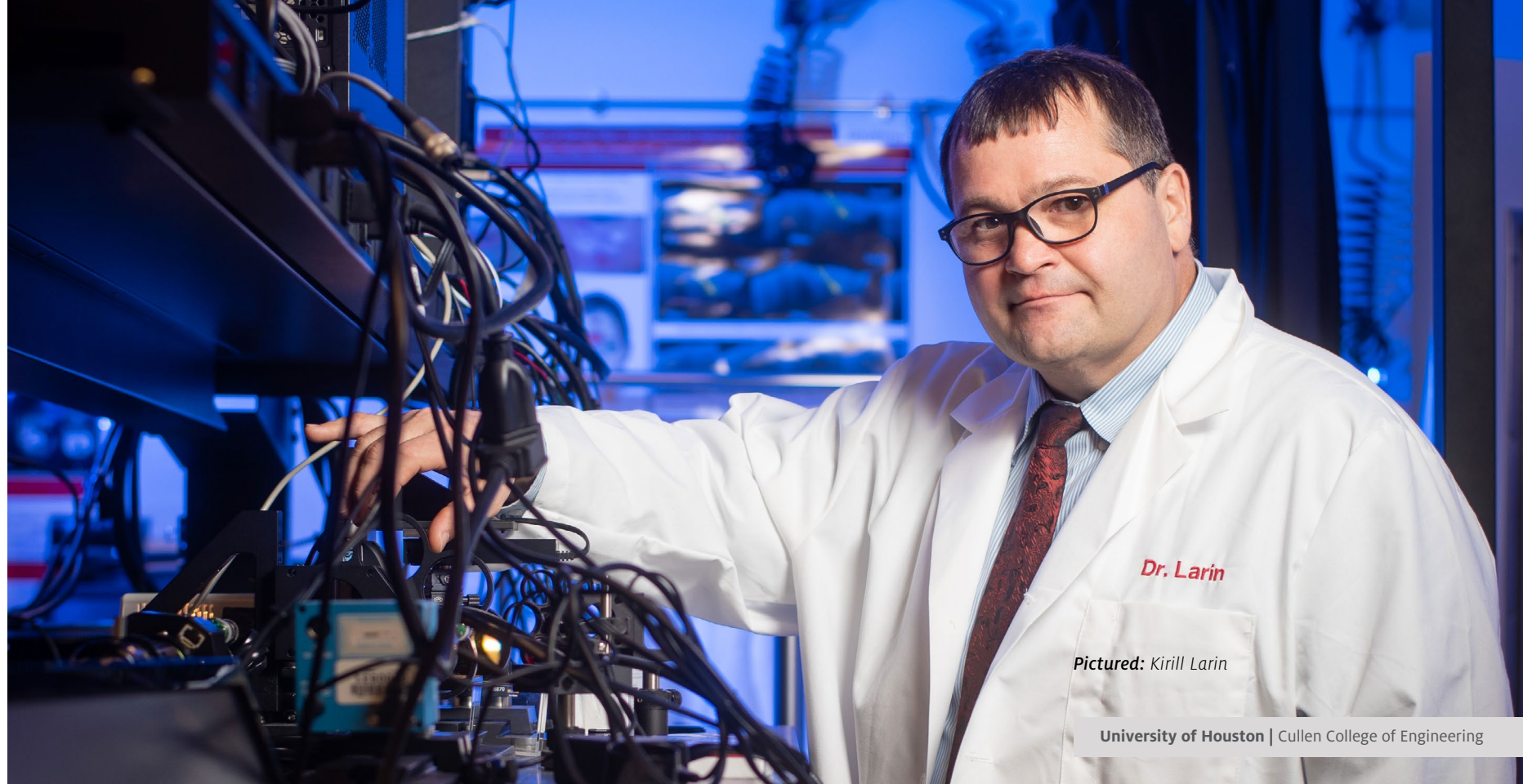
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Under the direction of **Kirill Larin**, high resolution optical coherence tomography (OCT) is having an extended moment. During the past 20 years, the University of Houston professor of Biomedical Engineering has masterminded its growth from a tool that examines only the retina to one that can measure an incredibly large variety of internal organs, ranging from fetal hearts to neural tubes.

With OCT, no biopsies are needed; no invasive measures are taken. Instead, the imaging technique uses light waves to take cross-section pictures and deliver 3D images.

And though Larin has been pushing the limits of OCT's capabilities for more than two decades, he is just getting started.

More than \$5 million in new investments in his work set him up to develop OCT to peer into the fetal brain to assess how it is impacted by maternal drinking and smoking. He is also bringing the technology into clinical settings to diagnose and prevent eye disease. ⚙️



*Dr. Larin*

*Pictured: Kirill Larin*



# EXPANDED GENE THERAPY RESEARCH FOR RARE BLINDNESS DISEASE

A University of Houston researcher is expanding a method of gene therapy with the hopes it will restore vision loss in Usher Syndrome Type 2A (USH2A), a rare genetic disease.

The National Eye Institute has awarded **Muna Naash**, John S. Dunn Endowed Professor of biomedical engineering, \$1.6 million to support her work.

Usher Syndrome Type 2A, caused by mutations of 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 cells in the retina which causes blindness. Currently no treatment exists for USH2A.

"Our goal is to advance our current intravitreal gene therapy platform consisting of DNA nanoparticles/hyaluronic acid nanospheres to deliver large genes in order to develop safe and effective therapies for visual loss in Usher Syndrome Type 2A," Naash said. Gene therapy is the introduction of a normal gene into cells to correct genetic disorders. Intravitreal treatment consists of injections directly into the vitreal chamber of the eye.

"Developing an effective treatment for USH2A has been challenging due to its large coding sequence (15.8 kb) that has precluded its delivery using standard approaches and the presence of multiple isoforms with functions that are not fully understood," said Naash, who will also evaluate the long-term efficacy of the best therapeutic platform for future translation to the clinic.

To rescue vision loss, Naash's non-viral therapy targets the mutation in usherin, the protein product that causes Usher Syndrome Type 2A. Naash has already cloned two usherin isoforms to be tested with her innovative platform to safely advance gene therapy for USH2A.

"Understanding which isoforms of usherin are expressed in the retina and the cochlea and what role they play (in contrast to mutant pathogenic forms) is essential in developing an effective gene therapy construct," Naash said.

The work will provide a solid foundation for understanding the function of each usherin isoform and developing an effective gene therapy platform to treat USH2A associated visual defects, she said. ⚙️

*Pictured: Muna Naash*



*Pictured: Chandra Mohan and Richard Willson*

## EARLY DIAGNOSIS AND MONITORING OF LUPUS NEPHRITIS- ON YOUR SMARTPHONE

A team of researchers at the University of Houston is reporting the success of their new method for the early diagnosis and monitoring of lupus nephritis – at home. **Chandra Mohan**, Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering and **Richard Willson**, Huffington-Woestemeyer Professor of chemical and biomolecular engineering and professor of biochemical and biophysical sciences, has pioneered the smartphone-based app and test kit for lupus nephritis based on the technology underlying home pregnancy tests.

The home test – with results read on a smartphone – is meant to eventually replace the gold standard for diagnosis of active lupus nephritis, an invasive kidney biopsy, with its attendant morbidity which cannot be serially repeated. The test assesses the levels of a protein-coding gene known as ALCAM.

According to the Centers for Disease Control and Prevention, about 204,295 Americans have systemic lupus erythematosus, an autoimmune disease leading to chronic inflammation in multiple organs, including the kidneys. Nephritis flares are hard to recognize because their symptoms often masquerade as something else. A sufferer might think they have a cold or the flu or are just tired.

“A point-of-care testing platform’s importance rests on its potential to empower patients to monitor their health status with convenience, thus allowing for early diagnosis and monitoring of disease progression. The LFA represents the most widely used rapid diagnostic POC testing platform,” said Mohan. ⚙️



## NEW RESEARCH GRANTS



*Pictured: The performance of Live-Wire at the Wolf Trap Foundation to use the brain-body technology to listen, map and record dancer's brain activity.*

BIOMEDICAL ENGINEERING

## INVESTING IN BRAIN RESEARCH AND NEUROENGINEERING

The **BRAIN Center** will use a \$768,135 workforce development grant from the National Institutes of Health (NIH) to provide specialized training in innovative neurotech, computational tools and neuroengineering techniques to complement and enhance the training and career of therapists, clinical fellows, orthotics and prosthetics professionals. ⚙️



*Pictured: Brain-body technology recordings*

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*Pictured: Mario Romero-Ortega*



## UH BME PROGRAM HELPS STUDENTS EXPLORE PATHS TO SCIENCE CAREERS

High school senior Zander Harris has always been curious about how scientists make discoveries in laboratories, and how medical professionals prepare for their careers. He wondered what it would be like to slip on a white coat and work shoulder to shoulder with real scientists in a real medical lab.

Wonder no more, young Zander.

He and five schoolmates from Jack Yates High School experienced all of the above during the STEM RISE summer program, which recently concluded a seven-week session at the University of Houston. The research lab experience and hands-on lessons covering the STEM fields of science, technology, engineering and math, immersed students in the work and daily life of UH science laboratories.

The six students, now juniors and seniors at Yates, were the

first high school students to join STEM RISE (the program's full name is Science, Technology, Engineering and Mathematics Research Inquiry Summer Enrichment). The program, from the UH College of Natural Sciences and Mathematics and Tilman J. Fertitta Family College of Medicine, in partnership with Jack Yates High School in Houston's Third Ward, aims to encourage curious young scholars and help improve the racial and ethnic diversity of professionals who enter scientific and medical fields.

In addition to engaging in STEM lessons, the Yates students (under direction of UH faculty, medical students and undergraduate students) participated in one of three UH research projects:

- Studies of either neuromodulation of hypertension or the anatomy and function of the spleen, directed by **Mario Romero-Ortega**, professor of biomedical engineering and

biomedical sciences at the Cullen College of Engineering and Fertitta Family College of Medicine

- Explorations of breast cancer treatments directed by two collaborating professors: Fatima Merchant, engineering technology chair in the College of Technology, and Meghana Trivedi, associate professor of pharmacy practice and translational research in the College of Pharmacy

In their lab work, the students were guided – cheered along, too – by their near-peer STEM RISE mentors. That team comprised UH undergraduates and medical students. The mentors, well on the way to professional roles in their chosen fields, devoted their summer to watching their new, younger colleagues nurture visions of science careers being within reach, while they also furthered their own preparation as future doctors and STEM teachers. ⚙️



FACULTY

ACCOLADES

METIN AKAY



**Metin Akay**, Ph.D., the founding chairman and the John S. Dunn Endowed Professor of Biomedical Engineering, was awarded an honorary doctorate degree by the University of Pécs for his contributions to the University and developing the professional program of the 3D center. ⚙️

# CULLEN

## 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 world-class 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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Innovation in  
**HEALTHCARE**