Biomedical Engineering
Newsletter Fall 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 fall 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 Engieering 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
Cullen College of Engineering
Univeristy of Houston

UH BME **BY THE NUMBERS**

100% PH.D. POST-GRADUDATE JOB PLACEMENT

**NUMBERS BASED ON FALL 2021*

DEGREES AWARDED *(FALL 2021)*

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

ENROLLMENT *(FALL 2021)*

270 UNDERGRADUATE STUDENTS

122 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**

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

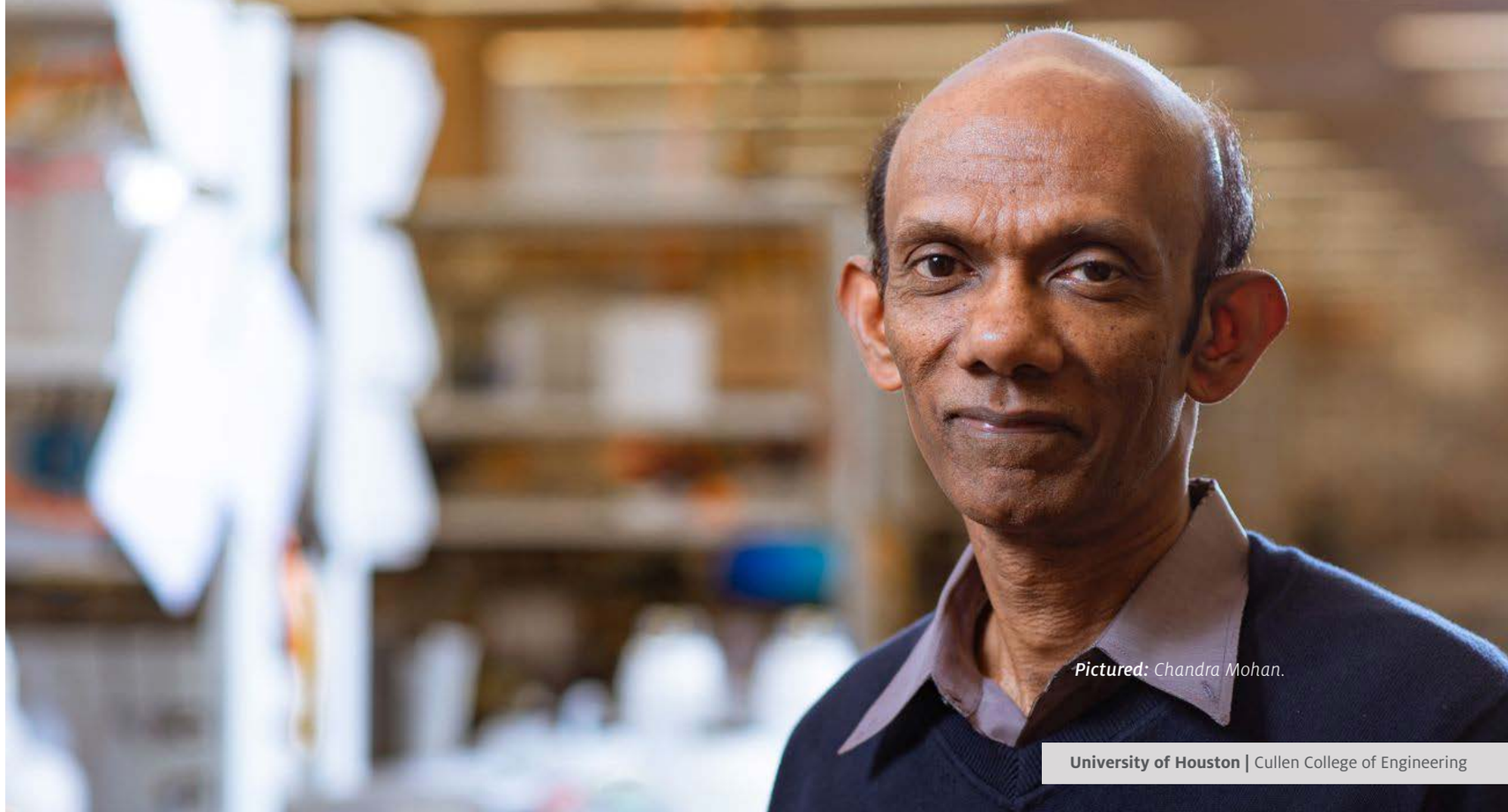
Lu Wang, joined the Department as an assistant professor, starting Sept. 2023. Wang earned her doctorate degrees in Industrial Engineering from the University of Toronto in 2023 and Computer Science from Wayne State University in 2019, respectively. Since 2022, she has served as an assistant professor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

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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.

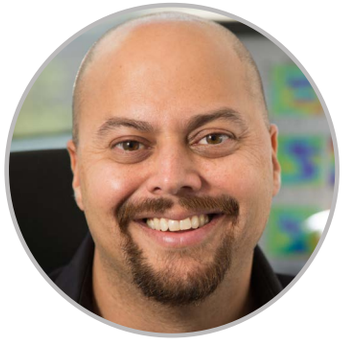
UH Project Lead: Kirill Larin, *Cullen College of Engineering Professor*

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.

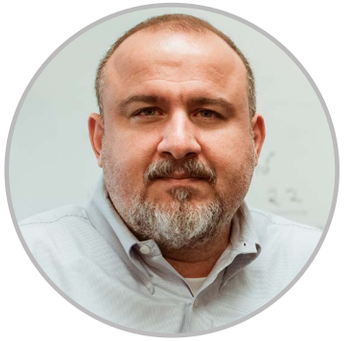
UH Project Lead and PI: Joe Francis, *Professor*

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*



R01NS12465

Electrophysiological footprints of PD motor phenotypes

Project goal: Deep brain stimulation (DBS) of subthalamic nucleus (STN) and globus pallidus internus (GPi) has largely replaced ablative techniques in the surgical treatment of Parkinson Disease (PD) but very limited data exists regarding the electrophysiological abnormalities within these structures for subtypes of PD. The project will show initial evidence of electrophysiological footprints of PD motor phenotypes within the territories of STN. Based on these key preliminary observations, together with clinical experts from BCM, the prroject will investigate dynamics of oscillatory neural activity recorded from the territories of STN and GPi with high resolution electrodes during wake DBS surgery for the personalization and optimization of DBS in PD.

UH Project Lead and PI: Nuri Ince, *Cullen College of Engineering Professor*

R01DK133800

"High-Density Surface Electromyography Guided Precision Botulinum Neurotoxin Injections to Manage Chronic Pelvic Floor Pain"

Project goal: Develop a personalized approach for botulinum neurotoxin injection into pelvic floor muscles guided by intra-vaginal high-density surface EMG to optimize the treatment outcome in treating Interstitial cystitis/ bladder pain syndrome, which negatively impacts the quality of life and sexual activities in 2.7% to 6.5% of women in the U.S.

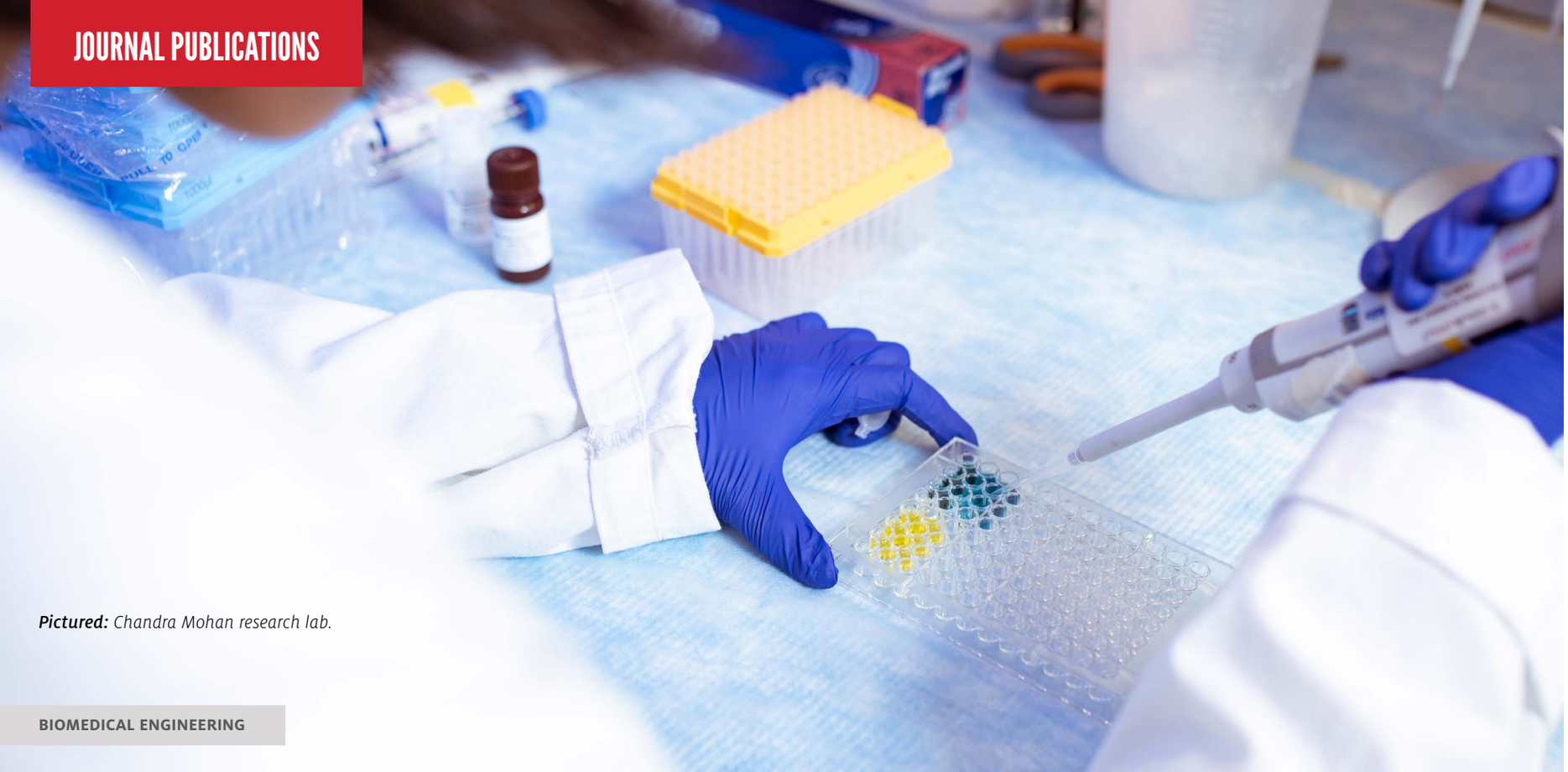
UH Project Lead and PI: Yingchun Zhang, *Associate Professor*

R21NR020379

"Assessing multifactorial etiology of IC/ BPS using a novel PFM-Hip-Trunk muscle network analysis"

Project goal: Distinguish pelvic floor muscle (PFM) phenotypic subtypes in Interstitial cystitis/ bladder pain syndrome for personalized and precision treatment by comprehensively assessing the PFM overactivity, hip/trunk muscle activity alteration, PFM-to-Hip/Trunk inter-muscular connectivity.

UH Project Lead and PI: Yingchun Zhang, *Associate Professor*



Pictured: *Chandra Mohan research lab.*

POWERFUL IMAGING TECHNOLOGY USED TO INVESTIGATE RENAL DISEASE

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.

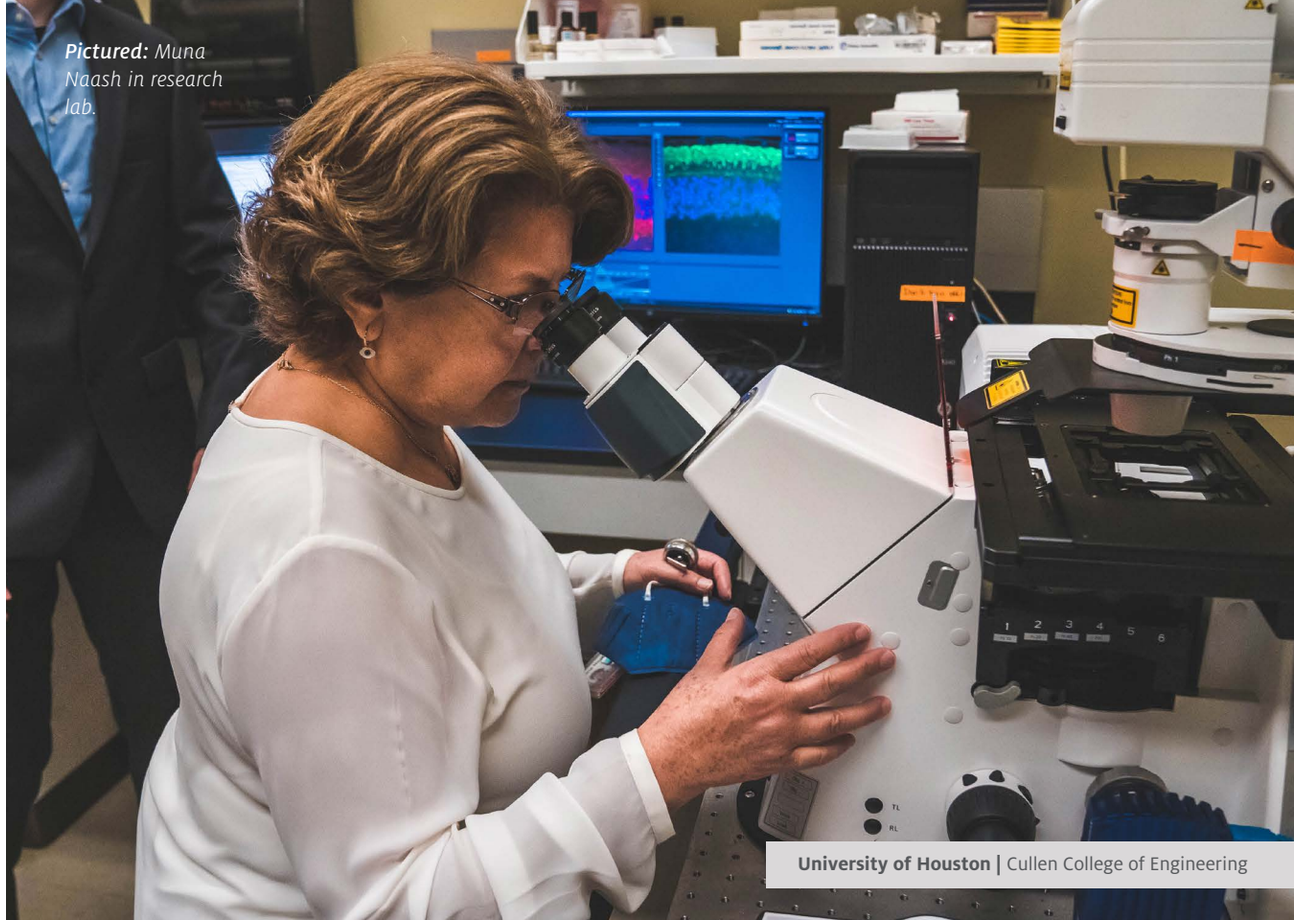
UH BME RESEARCHER REPORTS NEW MODEL TO EXAMINE USHER SYNDROME

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.

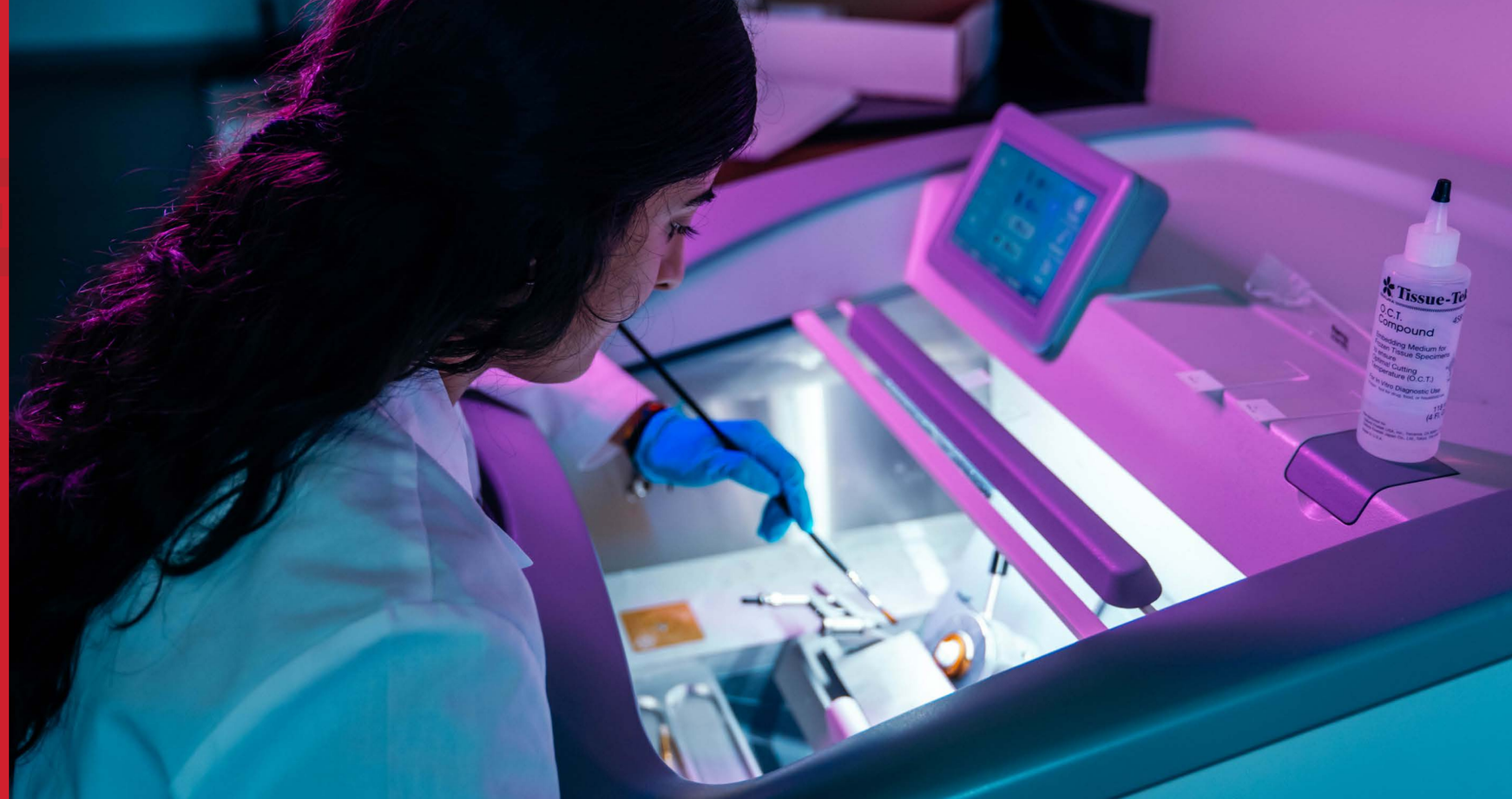
Naash who was recently funded by the National Eye Institute, shared that this model exhibits retinal degeneration associated with a decline in retinal function and continues to support the development of an effective gene therapy platform to treat USH2A associated visual defects.



Pictured: *Muna Naash in research lab.*

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 spear-heading research that has a real, direct impact in the Houston region and beyond.



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