INNOVATION IN HEALTHCARE

RESEARCH MILESTONES IN BIOMEDICAL ENGINEERING

UNIVERSITY of HOUSTON

CULLEN COLLEGE of ENGINEERING

Department of Biomedical Engineering

Letter from the Chair

Dear Alumni and Friends of the UH BME Department,

I am proud to highlight the many exciting accomplishments of the UH BME community. Established in 2010, the Cullen College's BME department is home to one of the most highly-regarded biomedical engineering programs in the state of Texas and beyond. Our department is still young, but is developing rapidly. At the Cullen College of Engineering, we are determined to build a unique culture among BME students, to strengthen bonds between our students and to cultivate collegial engagement with our graduates.

To meet the demands of the ever-changing global economy, we offer our students an innovative, entrepreneurial environment and an academic curriculum focused on healthcare technology, management and delivery. Graduates of our programs are prepared to take on leadership positions in the areas of academia, government and industry both nationally and globally.

As a department on the cutting edge of the biomedical industry, our academic and research programs are centered on three emerging academic and research fields: neural and rehabilitation engineering; biomedical imaging; and genomics, proteomics and bionano engineering and science. By promoting unique collaborations between the Texas Medical Center, the world's largest medical center, and other institutions across the state and the nation, our undergraduate and graduate programs bring new ideas and novel dynamics to the existing biomedical and biotechnology industries.

Please don't hesitate to contact me at **makay@uh.edu** for more information on our department and programs or if you are interested in joining or supporting the BME department at the UH Cullen College of Engineering. Thank you for being a friend of the UH BME Depart. ment. I look forward to hearing from you and seeing you at upcoming departmental, college and University events!

Warm regards,

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

UH BME BY THE NUMBERS

#80

Best Biomedical Engineering Program in the U.S.

(Source: U.S. News and World Report)

BEST GRAD SCHOOLS U.S.News & WORLD REPORT ENGINEERING

82 Graduate Students + **272** Undergraduate Students = **354** Total Students

The Best Engineering Program of **2020**

BME FOCUS AREAS: Neural Engineering and Rehabilitation, Bionanoscience and Biomedical Imaging

22:1 University-Wide Student to Faculty Ratio

80%

of UH Engineering Undergrads are Employed Within

1

Year of Graduation

UH BME Department Welcomes **A NEW FACULTY MEMBER**

Mario Romero-Ortega, an award-winning researcher in the field of neuroscience, will join the Cullen College of Engineering on January 1, 2020 as the Cullen Endowed Professor of biomedical engineering.

He is the founder and chief scientific officer of NerveSolutions Inc., a company that commercializes the biosynthetic nerve implant and NeuroBlock devices developed in his laboratory.

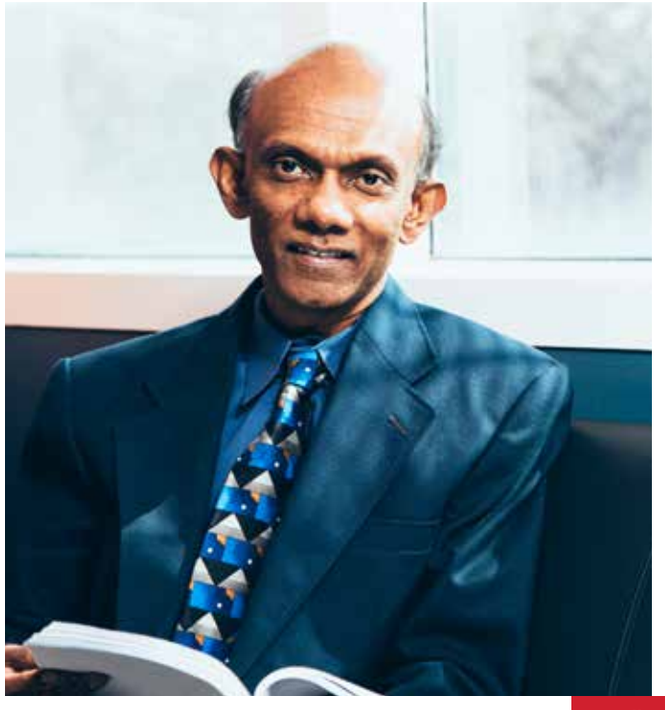
His research centers on the molecular basis of axon guidance and target recognition during development and after injury and how to generate novel nerve repair strategies. Specific interests include: spinal cord injury and neuroprotection, peripheral nerve gap repair, neuroma pain prevention and regenerative peripheral neurointerfaces for the control and feel of robotic prosthetic limbs.

Prior to his UH appointment, he worked in several key roles – associate professor of bioengineering at The University of Texas at Dallas (UTD); as adjunct faculty in the surgery department at The University of Texas Southwestern Medical Center (UTSW); The University of Texas at Arlington Research Institute (UTARI); and as a partner researcher with the University of Wollongong in Australia.

Romero-Ortega has also served as director for the Regenerative Neurobiology Division at the Texas Scottish Rite Hospital and as assistant professor of neurology and plastic surgery at UTSW.

His accolades include the 2014 UTA College of Engineering Excellence in Research Award, the 2013 TechFortWorth Impact Award, and the 2013 Tech Titans Award in Technology Innovation.

He received his doctorate in neuroscience from Tulane University and his postdoctoral training from UTSW as associate member of the Christopher Reeve Paralysis Foundation Research Consortium on Spinal Cord Injury. His bachelor's degree in biology is from Guadalajara University in Mexico.



Blood Clotting **PROTEINS DISCOVERED** as Biomarkers of Lupus Nephritis

Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering **Chandra Mohan** recently reported in *Arthritis Research and Therapy* that clotting proteins, both those that promote blood clots (prothrombotic) and those that work to dissipate them (thrombolytic), are elevated in the urine of patients who suffer from lupus nephritis (LN).

According to Mohan, among the proteins examined, urine plasmin emerged as the strongest independent predictor of kidney function and renal disease status. Urine biomarkers represent promising candidates for the early diagnosis as well as the monitoring of disease activity and therapeutic responses in lupus nephritis. The discovery of the new biomarker for active LN opens the door for clinical monitoring of the disease.

Testing New Treatment for EPILEPSY PATIENTS

University of Houston associate professor of biomedical engineering **Nuri Ince**, who pioneered a dramatic decrease in the time it takes to detect the seizure onset zone (SOZ) in the brain, has been awarded $2.3 million by the National Institutes of Health to expand his testing in a large number of adult and pediatric epilepsy cases. Current treatment protocols for detecting the actual part of the brain that causes seizures, the SOZ, require prolonged monitoring of intracranial EEGs (iEEG) for days or weeks following surgical insertion of electrodes. Using his newly created machine learning algorithms, Ince observed that high frequency oscillations (HFO) in the seizure onset zone form repetitive waveform patterns that identify their location. Ince's method not only saves weeks of hospitalization, but reduces side effects and costs associated with what has traditionally been an arduous, and often painful, procedure.

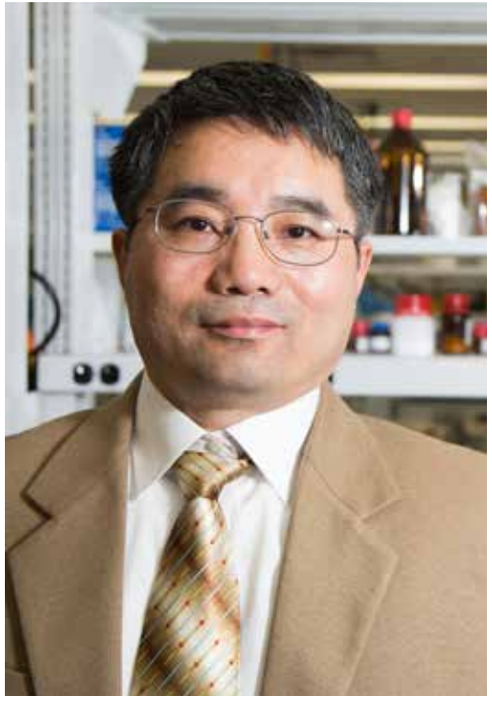
NSF CAREER Winner Sheereen Majd to IMPROVE DRUG DELIVERY

Decades ago it might have seemed like science fiction, but today the delivery of drug nanoparticles to specific sites in the body holds great promise for curing disease and healing patients. The National Science Foundation has awarded UH biomedical engineer **Sheereen Majd** the CAREER Award and $500,000 to improve nanoparticle drug delivery. Majd's research is focused on tailoring nanoparticle drug carriers to target a selected group of cells affected in different diseases while sparing other cells. The nanoparticles work as vehicles that can carry drugs through the body to the general location of tumors or other areas of illness. If tagged with appropriate recognition molecules, as Majd intends, these vehicles can deliver the drug only to tumor or diseased cells.

Researchers Developing Early Detection, Home Monitoring Tests for **LUPUS NEPHRITIS**

With $5 million in grants from the National Institutes of Health (NIH), two University of Houston **Cullen College of Engineering** biomedical researchers are moving the needle on early detection and monitoring of kidney nephritis, or inflammation, in patients who have systemic lupus erythematosus, known simply as lupus.

Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering, **Chandra Mohan**, one of the nation's leading lupus researchers, is working on disease diagnostics with his $3 million portion. **Tianfu Wu**, assistant professor of biomedical engineering, is leading a $2 million project, developing a system that tests multiple samples for multiple biomarkers at once and a smartphone-based analysis and reporting system for disease monitoring and home care. The app-based program would allow patients to read their own diagnosis, which could be particularly helpful for elderly patients who often cannot be transported to an office for a test. The home tests may not only be able to predict flares but to guide individualized treatment.



Isolating T-cells to **BOOST CELLULAR THERAPIES**

The Cancer Prevention & Research Institute of Texas has awarded $200,000 to **Sergey Shevkoplyas**, associate professor of biomedical engineering, for his project titled "Novel High-Throughput Microfluidic Device for Isolating T-cells Directly from Whole Blood to Simplify Manufacturing of Cellular Therapies." The project proposes that by addressing current limitations, researchers will develop and validate a novel high-throughput microfluidic device for extracting T lymphocytes with high efficiency, minimal cell damage, and in numbers sufficient for manufacturing a therapeutic dose of CAR T-cell therapy directly from whole blood.

The project's proposed device would allow most cancer patients receiving CAR T-cell therapies to avoid leukapheresis by giving blood samples instead. Because of the equipment-free, scalable, closed-system design, the proposed high-throughput microfluidic device could be integrated into exiting workflow to replace some of the most laborious steps in the CAR T-cell manufacturing process. Reduced complexity and lower cost of manufacturing will ultimately lead to making novel CAR T-cell therapies accessible to more cancer patients.

Smart Brain Stimulators: Next-Gen
PARKINSON'S DISEASE THERAPY

Researchers at the University of Houston have found neuro biomarkers for Parkinson's disease that can help create the next generation of "smart" deep brain stimulators, able to respond to specific needs of Parkinson's disease patients. Those with the disease often undergo the high-frequency brain stimulation, a well-established therapy for the progressive nervous system disorder that affects movement, but the therapy has been imprecise. Currently, stimulators can only be programmed clinically and are not adaptable to the fluctuating symptoms of the disease which can include tremors, slowness, or an inability to walk. The biomarkers are key to improving the technology to make it responsive or smart.

According to **Nuri Ince**, associate professor of biomedical engineering, a closed-loop stimulator adaptive to sensing a patient's symptoms is now possible. The stimulator can make the adjustments to the fluctuations in real time, and the patient no longer has to wait for weeks or months until the doctor can adjust the device. Ince and doctoral student **Musa Ozturk**, lead author of the paper, published their findings in *Movement Disorders* journal.

Research Moves Closer to Brain-Machine
INTERFACE AUTONOMY

Joe Francis, professor of biomedical engineering, recently reported in *eNeuro* that an autonomous brain-computer interface, a form of artificial intelligence, can sense when its user is expecting a reward by examining the interactions between single-neuron activities and the information flowing to these neurons, called the local field potential.

His team's findings allow for the development of an autonomously updating brain-computer interface (BCI) that improves on its own, learning about its subject without having to be programed. The findings potentially have applications for robotic prosthetics, which would sense what a user wants to do (pick up a glass, for example) and do it. The work represents a significant step forward for prosthetics that perform more naturally.

Multi-Modal Optical Imaging Will Offer New Clues to **EMBRYONIC DEVELOPMENT**

Kirill Larin, professor of biomedical engineering at UH, is a co-investigator on a $3.7 million project funded by the National Heart, Lung and Blood Institute, with the goal of developing a new technology to allow simultaneous imaging of both embryonic structural development and the molecular underpinnings that occur in the developing circulatory system. The project is in collaboration with David Mayerich, assistant professor of electrical and computer engineering at UH, and Baylor College of Medicine.

The overall objective of this work is to develop a multi-modality imaging platform that can provide time-resolved three-dimensional images of tissue development, with high temporal and spatial resolutions at a molecular level. The ability to correlate between large-scale developmental milestones and micro-scale cellular and protein-specific changes is a significant unmet need in the study of developmental biology. This will be accomplished by designing and developing a novel microscopic imaging system that provides spatially and temporally aligned OCT and light sheet microscopy (LSM) images. Simultaneous images will be collected through OCT scanning and fluorescent light sheet excitation of the same sample plane.

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 $30 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.

UNIVERSITY of HOUSTON | ENGINEERING

UH Cullen College of Engineering
Department of Biomedical Engineering
Science & Engineering Research Center
3517 Cullen Blvd, Room 2027
Houston, TX 77204-5060
@UHEngineering

Research MILESTONES