



THE FUTURE IS WHAT WE DO

ELECTRICAL AND COMPUTER ENGINEERING
DEPARTMENT NEWSLETTER • FALL 2021

UNIVERSITY of
HOUSTON

CULLEN COLLEGE of ENGINEERING
Department of Electrical & Computer 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 electrical and computer 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,

Badri Roysam, Ph.D

Hugh Roy and Lillie Cranz Cullen University Professor Chair
Electrical & Computer Engineering Department
Cullen College of Engineering
University of Houston

UH ECE BY THE NUMBERS



1 MIT

30 UNDER 30 RECIPIENT



10 NSF

CAREER AWARDEES



3 NAE MEMBERS



3 SAE FELLOWS

OSA **1** OSA FELLOW



2 NAI FELLOWS



1 AAAS FELLOW



1 APS FELLOW



5 NAI SENIOR MEMBERS



1 FELLOW OF THE ROYAL SOCIETY (UK)



8 IEEE FELLOWS



1 SPIE FELLOW



1 ECS FELLOW



2 AIMBE FELLOWS

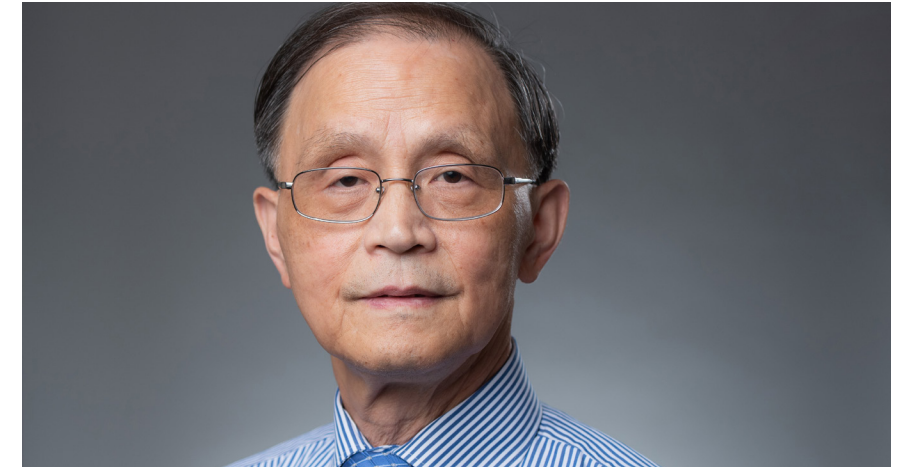



2 CPRIT SCHOLARS

HUANG'S INDUSTRIAL EXPERTISE JOINS CULLEN COLLEGE OF ENGINEERING

An aviation industry veteran with more than 30 years of experience at General Electric and 80 patents to his name has joined the Cullen College of Engineering's Computer and Electrical Engineering Department as a Distinguished Adjunct Professor, to teach a new generation of students.

Hao Huang, Ph.D., started at the University of Houston in July. He retired from the position of Technology Chief of G.E. Aviation – Electrical Power in 2020 after 33 years serving in the aviation and land vehicle electrification industries. He was responsible for generating technical directions, innovation strategies and multi-generation product roadmaps, and contributing innovations and inventions of aircraft electrical power technologies to that industry.



In February of this year, he was elected as a member of the National Academy of Engineering (NAE) with citation 'for contributions to advances in electric machines and power electronics technologies for aerospace electrical systems.' Election to the NAE is one of the highest professional honors accorded to an engineer. In addition to NAE membership, Huang is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) as of 2013, and a Fellow of the Society of Automotive and Aerospace Engineers (SAE) as of 2014. He was also the winner of 2019 IEEE Transportation Technologies Award. 

FOCUSING ON THE UNHEALTHY BRAIN TO SPEED DRUG DISCOVERY

Though 40 million concussions are recorded annually, no effective treatment exists for them or for many other brain-related illnesses. In collaboration with Dragan Maric of the National Institutes of Health, **Badri Roysam**, Hugh Roy and Lillie Cranz Cullen University Professor and Chair of Electrical and Computer Engineering, and his team are working to speed up drug development to treat brain diseases and injuries like concussion by developing new tools. At the National Institute of Neurological Disorders and Stroke, Maric developed the innovative imaging technique that can be readily implemented for widespread use with the potential to transform brain studies requiring comprehensive cellular profiling from single and serial slices of brain tissue. Roysam's lab developed the computational image analysis methods based on deep neural networks. Roysam's system analyzes the images on the UH supercomputer automatically and can reveal multiple processes at once – the brain injury, effects of the drug being tested and the potential side effects of the drug.

The open-source toolkit approach is also adaptable to other tissues. Its development can accelerate systems-oriented studies by providing quantitative profiles of all the molecular and cellular players at once, in their detailed spatial context. The team's work is supported by a \$3.19 million grant from the NIH. ⚙️

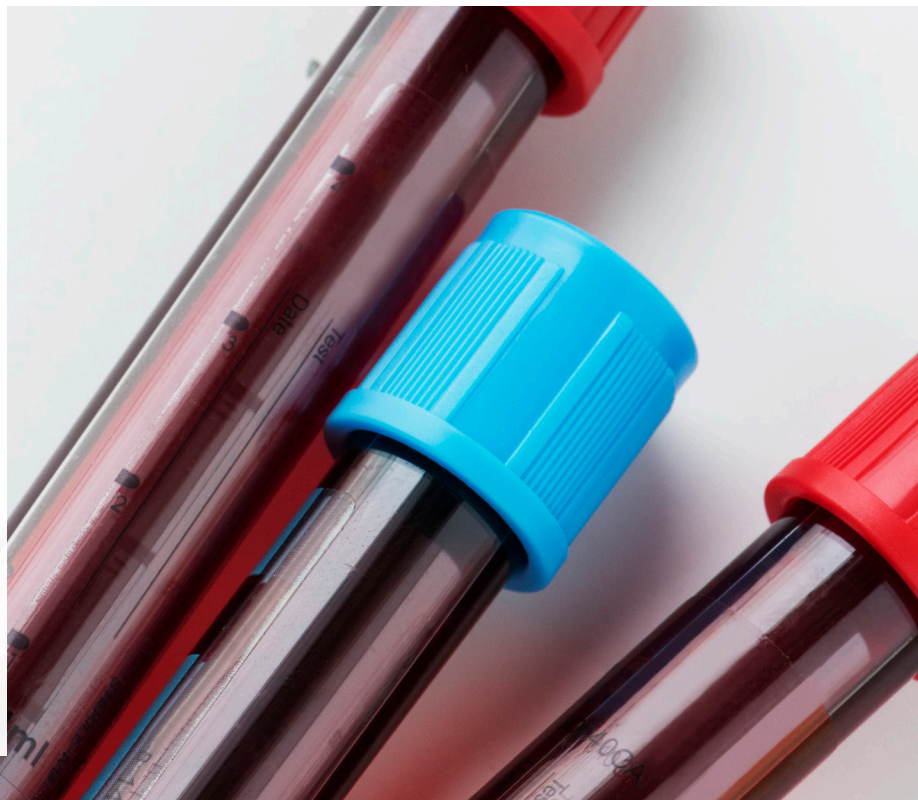


SHIH RECEIVES \$2.7M TO DEVELOP CANCER TEST WITH ‘UNPRECEDENTED EARLY DETECTION POWER’

University of Houston engineering researcher **Wei-Chuan Shih** has been awarded \$2.7 million from the National Institute of Biomedical Imaging and Bioengineering to detect cancer biomarkers in blood by counting exosomes.

Known as “liquid biopsy,” the process, which requires only a simple blood draw, can improve the accuracy of measuring nearly invisible minimal residual disease (MRD) in cancer tumors. Circulating tumor exosomes (CTE) are excreted by cells and contain surface proteins and genetic materials (DNA and RNA) that reflect the characteristics and make-up of the parental cell. Cancerous tumors send them off into the bloodstream in mass quantities.

Shih’s immediate goal is to obtain a high-resolution, digital exosome map with both multiplex surface protein and cargo D/RNA biomarker profiles. His team includes Steven Lin, M.D., a physician-scientist and radiation oncologist at University of Texas M.D. Anderson Cancer Center. ⚙️



ALTERED MICROSTRUCTURE IMPROVES ORGANIC-BASED, **SOLID STATE LITHIUM EV BATTERY**

Only 2 percent of vehicles are electrified to date, but that is projected to reach 30 percent by 2030. A key toward improving the commercialization of electric vehicles (EVs) is to heighten their gravimetric energy density – measured in watt hours per kilogram – using safer, easily recyclable materials that are abundant. Lithium-metal in anodes are considered the “holy grail” for improving energy density in EV batteries compared to incumbent options like graphite at 240 Wh/kg in the race to reach more competitive energy density at 500 Wh/kg.

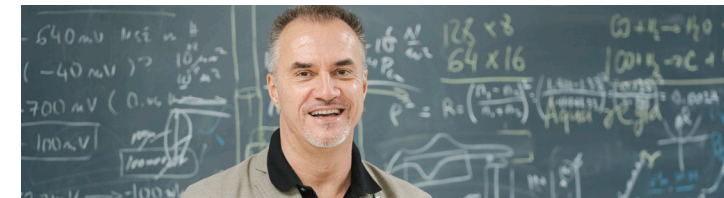
Yan Yao, Ph.D., professor of Electrical and Computer Engineering at the Cullen College of Engineering at the University of Houston, and UH post doctorate Jibo Zhang are taking on this challenge with Rice University colleagues. In a paper published June 17 in *Joule*, Zhang, Yao and team demonstrate a two-fold improvement in energy density for organic-based, solid state lithium batteries by using a solvent-assisted process to alter the electrode microstructure. Zhaoyang Chen, Fang Hao, Yanliang Liang of UH, Qing Ai, Tanguy Terlier, Hua Guo and Jun Lou of Rice University co-authored the paper. This research was funded by the U.S. Department of Energy’s Office of Energy Efficiency and Renewable Energy (EERE), as part of the Battery 500 Consortium. ⚙️

NERVOUS SYSTEM ACTIVATION

FROM SKIN CONDUCTANCE

A new paper from **Rose Faghiih**, Ph.D., Assistant Professor of Electrical and Computer Engineering and the Director of the Computational Medicine Laboratory, and her doctoral student Raful Amin describes how they have developed a novel inference engine to obtain brain information from raw electrodermal activity (EDA) recordings, eradicating previous challenges from earlier methods. *IEEE Transactions on Biomedical Engineering* published "Identification of Sympathetic Nervous System Activation From Skin Conductance: A Sparse Decomposition Approach With Physiological Priors" in its May 2021 issue.

"We utilize physiological knowledge about the system for reliable identification of the solution," Amin said. "We address some of the vital challenges for rigorous analysis; by implementing our algorithm on data collected from 109 healthy participants, we establish that our approach can infer brain information with high reliability. Our novel inference engine will eventually help clinicians and researchers with accurate quantification of brain information for health tracking and other clinical/non-clinical applications." ⚙️



MULTI-DEPARTMENT RESEARCH INTO SYNTHESIS VIA SLRR REACTION

Cullen College of Engineering professor **Stanko R. Brankovic**, Ph.D., of the Electrical and Computer Engineering Department, is the corresponding author for a new, multi-department perspective paper on potential advancements in catalyst synthesis. The paper, "Electroless Pb Monolayer Deposition – Prelude for Further Advances in Catalyst Monolayer Synthesis via Surface Limited Redox Replacement Reaction," was published in April 2021 in *ACS Catalysis*, a journal with an impact factor 14.

Brankovic is the corresponding author for the paper. The published work is a result of multiyear effort among UH researchers to perfect and understand a new phenomenon for monolayer controlled deposition and present its practical importance to the relevant fields of catalysis and electrocatalysis. ⚙️

BRANKOVIC NAMED **FELLOW OF ELECTROCHEMICAL SOCIETY**

Stanko R. Brankovic, Ph.D., a professor in the Electrical and Computer Engineering, and Chemical and Biomolecular Engineering departments of the University of Houston's Cullen College of Engineering, was selected as a Fellow of the Class of 2021 for the Electrochemical Society (ECS).

The Fellow level of membership for the ECS was established in 1989, for advanced individual technological contributions in the field of electrochemical and solid state science and technology; and active membership and involvement in the affairs of the society. Those selected must receive at least three nominations from members of the ECS. ⚙️



ECE STUDENTS FEKRI AZGOMI, AMIN AMONG 21 STUDENTS **PRESENTING AT NATIONAL MEETING**

A pair of Cullen College of Engineering students were among 21 nationwide that gave live presentations at the National Science Foundation's Cyber-Physical Systems (CPS) Principal Investigators' meetings from June 2 through June 4.

The NSF CPS PI meeting brings together PIs whose research is funded by the CPS program to give presentations on the progress of their grants. This year the CPS PI meeting was held virtually, and for the first time, featured graduate student presentations.

Doctoral students Rafiul Amin and Hamid Fekri Azgomi are both advised by Rose Faghieh, Ph.D., Assistant Professor of Electrical and Computer Engineering and the Director of the Computational Medicine Laboratory (CML). Under the supervision of Dr. Faghieh, the duo prepared a demonstration on CML's MINDWATCH research for the meeting. ⚙️

STUDENT PROJECT TRUESTEP TAKES **1ST AT DESIGN COMPETITION**



A four-person team of students at the University of Houston's Cullen College of Engineering has won a pair of awards for their project – a soft robotics exoskeleton – after presenting at the Excellence in Senior Design competition, held virtually by the University of Texas at Dallas on May 21. **Arnold Emeh** represented the Electrical and

Computer Engineering Department. Competing against 12 other universities and colleges, the TrueStep project took first place in the category of Texas Instrument's Best Engineering Design Award. The group also received the Out of the Box Award.

TrueStep is a soft robotics exoskeleton that provides walking assistance to people suffering from foot drop, a medical condition where an individual cannot lift the front part of their feet due to weakness in dorsiflexion muscles. The condition is usually caused by stroke, spinal cord injuries, or other neuromuscular diseases. ⚙️



P-LEGS TAKES HOME **PEDIATRIC HONOR FROM SWPDC, SXSW**

An invention from University of Houston researchers to help children with walking disabilities won the Southwest National Pediatric Device Innovation Consortium's Pediatric Device Prize at this year's South by Southwest. The award, which comes with \$25,000 in funding, was one of two given by SWPDC in that category at this year's SXSW. The UH device is the Pediatric Lower-Extremity Gait System – P-LEGS – which is a mobility assistant, rehabilitation platform and diagnostic tool designed to help children with motor disabilities. It was chosen from a field of 18 entrants.

Jose Luis Contreras-Vidal, Ph.D., Hugh Roy and Lillie Cullen Distinguished Professor of Electrical and Computer Engineering and the director of UH's BRAIN Center, is the principal investigator for the project. The graduate student lead for the project is **David Eguren**. Other team members include **Alexander Steele, Yang Hu, Krishna Sarvani Desabhotla, Swagat Bhandari, Lujayna Taha, Nivriti Sabhnani** and **Allen Shen**. "We were excited and honored to have been selected by the SWPDC for this award," Eguren said. "The award will be valuable in helping us continue device development and testing." ⚙️

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 \$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