RESEARCH MILESTONES

Electrical and Computer Engineering • Spring 2021

THE FUTURE

IS WHAT WE DO

Letter from the Chair

Dear Colleagues,

Please join me in congratulating Professor Wilton for his election to the National Academy of Engineering, Professor Shih on his election to SPIE Fellow, and Professor Contreras-Vidal on his election to AIMBE Fellow. The department's public ECE Lunch and Learn webinar series has been a success. Our online graduate programs are accepting applications!

I am delighted to share more of our department's recent highlights with you, including some exciting research breakthroughs and newly-funded projects.

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**

TOP 1%
OF HIGHLY CITED RESEARCHERS

10 NSF
CAREER AWARDEES

2 NAE MEMBERS

2 NAI FELLOWS

5 NAI SENIOR MEMBERS

7 IEEE FELLOWS

2 AIMBE FELLOWS

1 SAE FELLOW

1 AAAS FELLOW

1 FELLOW OF THE ROYAL SOCIETY (UK)

1 1 SPIE FELLOW

2 CPRIT SCHOLARS

1 OSA FELLOW

1 APS FELLOW

DR. DONALD R. WILTON

A PROFESSOR EMERITUS OF THE
ELECTRICAL AND COMPUTER ENGINEERING DEPARTMENT
AT THE UNIVERSITY OF HOUSTON'S
CULLEN COLLEGE OF ENGINEERING

— ELECTED TO THE —

2021
NATIONAL ACADEMY
OF ENGINEERING
(NAE)

Dr. Donald R. Wilton, a professor emeritus of the Electrical and Computer Engineering Department at the University of Houston's Cullen College of Engineering, has added another impressive honor to his career of distinction with his election to the 2021 Class of the National Academy of Engineering. Wilton's primary research interest is on the application of mathematical and numerical methods for solutions of antenna, guided wave and electromagnetic scattering problems. Regarded as one of the leading authorities in the field of computational electromagnetics, he is perhaps best known for establishing a framework for using computer modeling to study electromagnetic scattering by irregular surfaces, such as the curved wing of an airplane. A 1982 paper on the subject has been cited more than 3,700 times.

Election to the academy is one of the highest marks of distinction in the field. The total United States membership for the academy is 2,355, with another 298 international members. Wilton was elected "for contributions to computational electromagnetics of highly complex structures," according to the organization. Wilton is the 20th faculty member or University of Houston graduate to be honored with membership in the NAE. ⚙
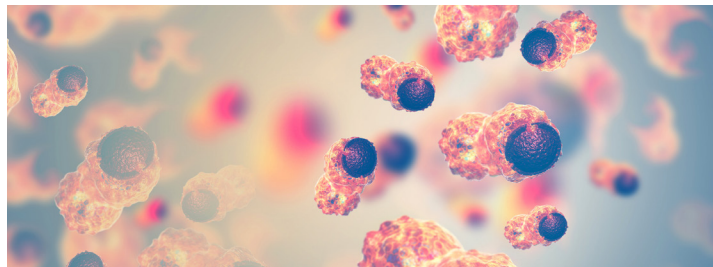
UH, HOUSTON METHODIST **USING AI TO IDENTIFY BREAST CANCER**

Dr. Hien Van Nguyen, an assistant professor of electrical and computer engineering at the University of Houston's Cullen College of Engineering, received an R01 sub-award of $319,285 for his grant, "Convergent AI for Precise Breast Cancer Risk Assessment," from the National Cancer Institute, National Institutes of Health. Ideally, Nguyen hopes to develop a predictive model that would use artificial intelligence technology to examine Breast Imaging Reporting & Data System (BI-RADS) reports and imaging metrics, to provide more accurate cancer risk assessments, which would hopefully cut down on the need for unnecessary biopsies. ⚙

TAPPING THE BRAIN TO **BOOST STROKE REHABILITATION**

Stroke survivors who had ceased to benefit from conventional rehabilitation gained clinically significant arm movement and control by using an external robotic device powered by the patients' own brains. The results of the clinical trial were described in the journal *Neuro-Image: Clinical*. **Dr. Jose Luis Contreras-Vidal**, director of the Non-Invasive Brain Machine Interface Systems Laboratory at the University of Houston, said testing showed most patients retained the benefits for at least two months after the therapy sessions ended, suggesting the potential for long-lasting gains. He is also Hugh Roy and Lillie Cranz Cullen Distinguished Professor of electrical and computer engineering. ⚙

NEW TECHNOLOGY ALLOWS MORE PRECISE VIEW OF THE SMALLEST NANOPARTICLES

Current state-of-the-art techniques have clear limitations when it comes to imaging the smallest nanoparticles, making it difficult for researchers to study viruses and other structures at the molecular level. **Dr. Wei-Chuan Shih**, professor of electrical and computer engineering, and other scientists from the University of Houston and the University of Texas M.D. Anderson Cancer Center have reported in *Nature Communications* a new optical imaging technology for nanoscale objects, relying upon unscattered light to detect nanoparticles as small as 25 nanometers in diameter. The technology, known as PANORAMA, uses a glass slide covered with gold nanodiscs, allowing scientists to monitor changes in the transmission of light and determine the target's characteristics. PANORAMA takes its name from Plasmonic Nano-aperture Label-free Imaging (PlAsmonic NanO-apeRture lAbel-free iMAging), signifying the key characteristics of the technology. PANORAMA can be used to detect, count and determine the size of individual dielectric nanoparticles. ✿

A SAFER, LESS EXPENSIVE AND FAST CHARGING AQUEOUS BATTERY

Lithium-ion batteries are critical for modern life, from powering our laptops and cell phones to those new holiday toys. But there is a safety risk – the batteries can catch fire. Zinc-based aqueous batteries avoid the fire hazard by using a water-based electrolyte instead of the conventional chemical solvent. However, uncontrolled dendrite growth limits their ability to provide the high performance and long life needed for practical applications. Now researchers have reported in *Nature Communications* that a new 3D zinc-manganese nano-alloy anode has overcome the limitations, resulting in a stable, high-performance, dendrite-free aqueous battery using seawater as the electrolyte. **Dr. Xiaonan Shan**, co-corresponding author for the work and an assistant professor of Electrical and Computer Engineering at the University of Houston, said the discovery offers promise for energy storage and other applications, including electric vehicles. ✿

DISCOVERIES HIGHLIGHT NEW POSSIBILITIES FOR **MAGNESIUM BATTERIES**

Magnesium batteries have long been considered a potentially safer and less expensive alternative to lithium-ion batteries, but previous versions have been severely limited in the power they delivered.

Researchers from the University of Houston and the Toyota Research Institute of North America (TRINA) reported in Nature Energy that they have developed a new cathode and electrolyte – previously the limiting factors for a high-energy magnesium battery – to demonstrate a magnesium battery capable of operating at room temperature and delivering a power density comparable to that offered by lithium-ion batteries.

Dr. Yan Yao, Cullen Professor of Electrical and Computer Engineering at the University of Houston and co-corresponding author for the paper, said the groundbreaking results came from combining both an organic quinone cathode and a new tailored boron cluster-based electrolyte solution. ⚙
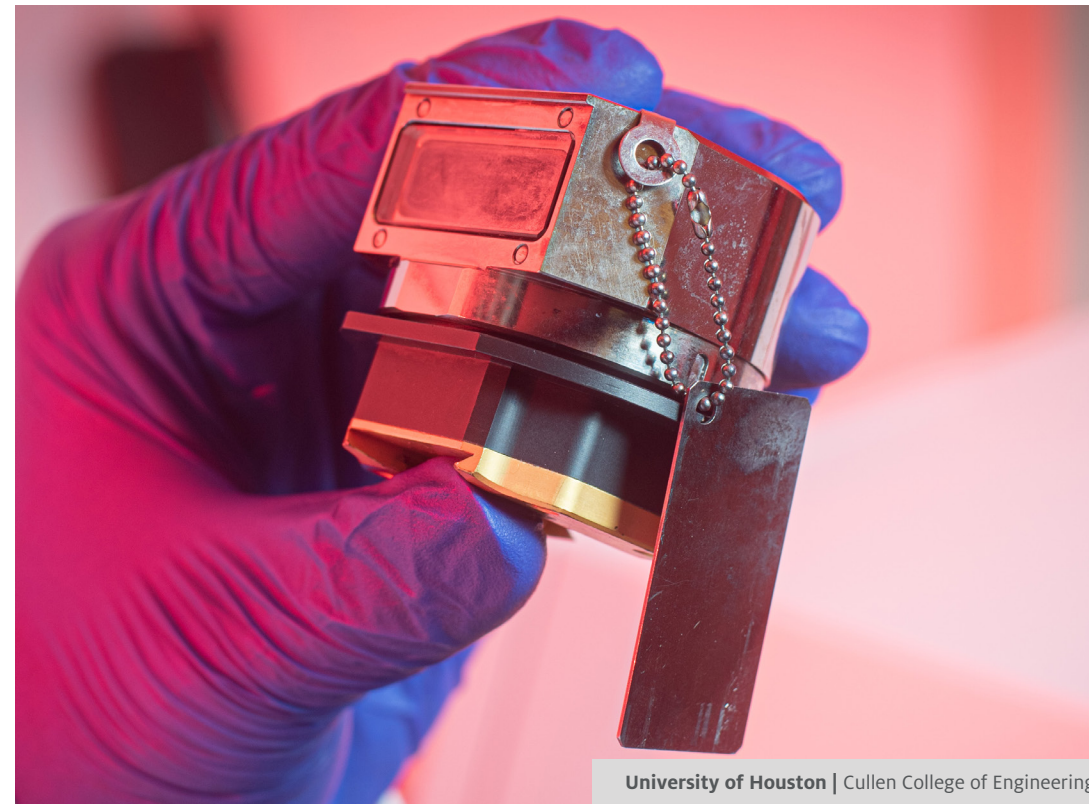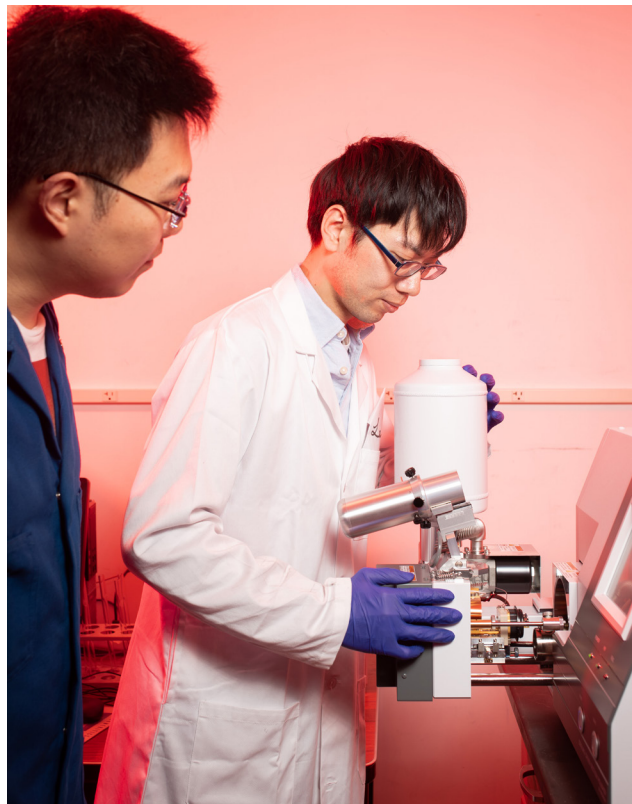
FACULTY

ACCOLADES
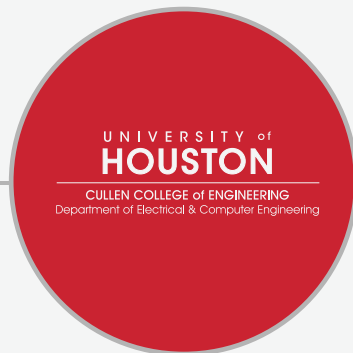
Dr. Hien Nguyen, assistant professor of electrical and computer engineering, was elected to the NAI Senior Member Class of 2021. He is among 61 academic inventors from around the country chosen for the prestigious honor for their remarkable innovation-producing technologies and growing success in patents, licensing and commercialization.

Dr. Wei-Chuan Shih, a professor of electrical and computer engineering at the University of Houston's Cullen College of Engineering, has been promoted to a Fellow by SPIE for his contributions in novel imaging methods, spectroscopic techniques and plasmonic nanostructures with various applications in chemical and biosensing.

FACULTY

ACCOLADES

Dr. Jose Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen Distinguished Professor of electrical and computer engineering at UH, has been elected as a Fellow by AIMBE, for pioneering contributions to development of brain-machine interfaces for controlling wearable exoskeletons for rehabilitation, and for mapping art-evoked brain activity.

Dr. Kaushik "Raja" Rajashekara, Cullen College of Engineering professor in the Electrical and Computer Engineering Department, was recognized by the Institute of Electrical and Electronics Engineers with the 2021 IEEE Medal for Environmental and Safety Technologies.

Dr. Rose Faghih, an assistant professor in the Electrical and Computer Engineering Department and the director of the Computational Medicine Lab, was selected to participate in the 2020-21 Interstellar Initiative. ✿

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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