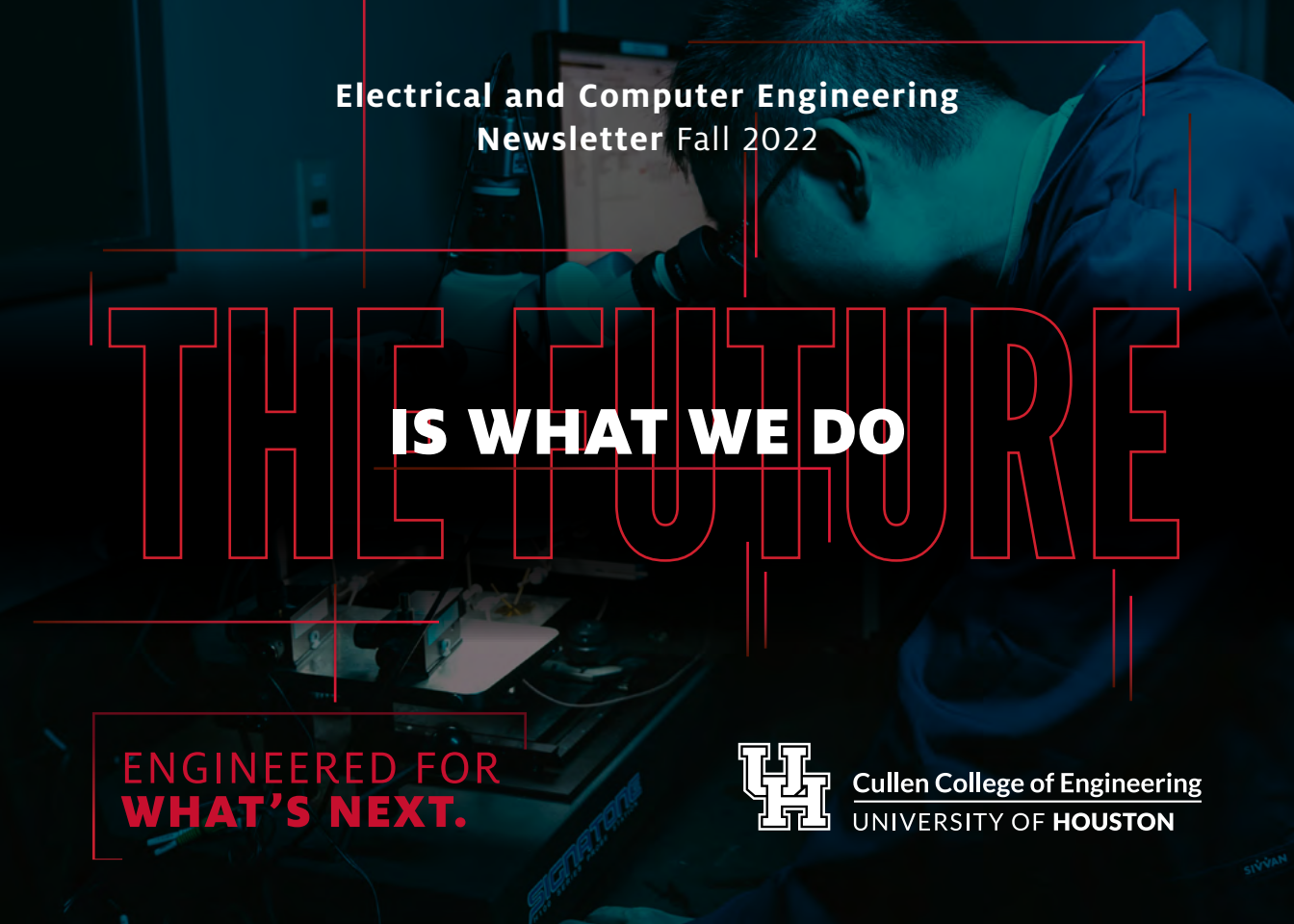

Electrical and Computer Engineering
Newsletter Fall 2022
THE FUTURE
IS WHAT WE DO
ENGINEERED FOR
WHAT'S NEXT.
Cullen College of Engineering
UNIVERSITY OF HOUSTON

Letter from the Chair

Dear Colleagues,

I hope that you are well. I invite you to explore this newsletter and our department's website (ece.uh.edu) at your leisure to see all of the exciting things we are working on. Our excellent faculty continue to see national and global recognition — one such individual recently was named a Global Energy Prize Laureate — and we are actively producing top-quality research intiaitives, such as the development of clean energy technologies, next-gen power sources, advanced cancer treatments and more.

The past several years have no doubt been challenging for us all, but when we come together and collaborate, we are capable of astounding advances sure to better our world for all. I look forward to partnering with you all, my esteemed colleagues.

Warm Regards,

Badri Roysam, Ph.D
Member, ECEDHA Board of Directors
Hugh Roy and Lillie Cranz Cullen University Professor & Chair
Electrical & Computer Engineering Department
University of Houston

UH ECE **BY THE NUMBERS**

DEGREES AWARDED *(FALL 2021)*

131 B.S.

57 M.S.

19 Ph.D.

ENROLLMENT *(FALL 2021)*

664 UNDERGRADUATE STUDENTS

266 GRADUATE STUDENTS

3 NATIONAL ACADEMY OF ENGINEERING **MEMBERS**

2 SOCIETY FOR AUTOMOTIVE ENGINEERING **FELLOWS**

1 OPTICAL SOCIETY OF AMERICA **FELLOW**

2 NATIONAL ACADEMY OF INVENTORS **FELLOWS**

1 AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE **FELLOW**

1 AMERICAN PHYSICS SOCIETY **FELLOW**

1 CHINESE ACADEMY OF ENGINEERING **MEMBER**

10 NATIONAL SCIENCE FOUNDATION **CAREER AWARDEES**

7 INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS **FELLOWS**

1 ROYAL SOCIETY OF CHEMISTRY (UK) **FELLOW**

1 ELECTROCHEMICAL SOCIETY **FELLOW**

3 American Institute for Medical and Biological Engineers **FELLOWS**

1 INTERNATIONAL SOCIETY FOR OPTICS AND PHOTONICS **FELLOW**

KAUSHIK RAJASHEKARA NAMED

GLOBAL ENERGY PRIZE LAUREATE

The most coveted prize in the field of international energy – the Global Energy Prize bestowed by the Global Energy Association – has been awarded to University of Houston Distinguished Professor of Engineering **Kaushik Rajashekara**. This is rarified air, indeed. Only three people in the world were selected for the honor this year out of a record 119 nominations from 43 countries. Think Nobel Prize for science or Academy Award for film. That's the level of award Rajashekara, an Electrical and Computer Engineering Department member who humbly likes to be called "Raja," has taken home.

As the former lead propulsion system engineer for General Motors' IMPACT electric vehicle, Raja may be better known as the man who helped advance the technologies that led to the first commercially produced electric vehicle, the GM EV1 in 1995.

He calls himself a "futurist" because he is always working on futuristic projects. After ushering in the era of electric and hybrid cars from 1989-2006 by advancing the technologies including the EV1, he left his position at GM/Delphi for his next revolutionary project. At Rolls Royce, he worked on advanced architectures for more electric and hybrid electric aircrafts bringing to life his notions of converting ancillary equipment used on aircrafts (like air conditioning and cooking devices) to electricity, leading to next generation aircrafts beyond the 787 Dreamliner-types.

With those futuristic projects in the past, he says the next big thing will be flying cars – and he's all in. If his track record is proof, it may be time to look skyward for a parking spot.

Pictured: *Kaushik Rajashekara pictured in the lab, with his research group, and outside of the Cullen College of Engineering.*

UH ECE WELCOMES

NEW FACULTY MEMBER FOR FALL 2022

Biresh Joarder has joined the department as an assistant professor for fall 2022. For the past two years, he has been an NSF Computing Innovation Postdoctoral Fellow at Duke University.

BRAIN-CONTROLLED EXOSKELETON

IN CLINICAL TRIALS

When 66-year-old Oswald Reedus had a stroke in 2014, he became one of 795,000 people in the United States who annually suffer the same fate. This year he also became the first stroke patient in the world to use a robotic arm controlled by his brainwaves - at home - to recover the use of a limb.

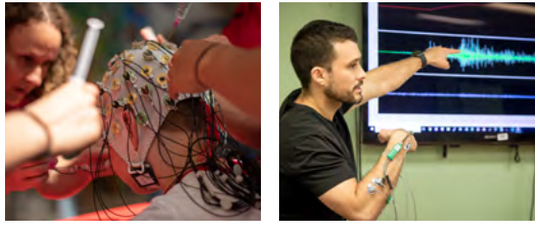
Reedus was lucky to live in Houston and have access to this futuristic-looking, portable device - an invention of Cullen College of Engineering professor **Jose Luis Contreras-Vidal**, an international pioneer in noninvasive brain-machine interfaces and robotic device inventions. His team developed the portable brain-computer interface (BCI) exoskeleton to restore upper limb function. Most neuro technologies are limited to the lab or clinic and are very expensive and hard to operate. This brain-controlled robotic arm requires no surgery and is accessible to robotically guide stroke rehabilitation both in clinic and at home. Reedus' use of it in his Houston home follows clinical trials at TIRR Memorial Hermann.

UH ECE RECEIVES $768K NIH GRANT TO DEVELOP

EXTENSIVE NEUROMOTOR TRAINING

The UH College of Liberal Arts and Social Sciences Department of Health and Human Performance Associate Professor Pranav J. Parikh and Cullen College of Engineering Professor **Jose Luis Contreras-Vidal** have been awarded the NIH R25 Research Education grant, "Neuromotor Skill Advancement for Post-baccalaureates (NSAP)."

Their project, worth $768,000 for the next five years, is based on the National Science Foundation's Industry-University Cooperative Research Center for Building Reliable Advances and Innovations in Neurotechnology (IUCRC BRAIN) at the University of Houston. Its overall goal is to provide didactic and hands-on activities focusing on the development of highly specialized and highly sought-after technical skills to study the brain.



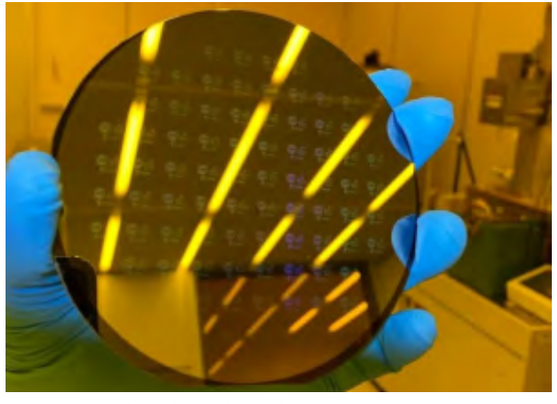
Pictured: *Research images from experiments conducted by the BRAIN Center.*

The NSAP program hopes to complement and enhance the training of therapists, clinical and research fellows, and orthotists and prosthetists from a diverse community for neurorehabilitation and neuroengineering research with the goals of improving health and well-being of children and adults and meeting the nation's biomedical, behavioral and clinical research needs using emergent technologies.

NAMES OF ARTEMIS I TEAM MEMBERS

HEADED TO SPACE ON MICROCHIPS

On July 20th, 53 years after Neil Armstrong took one small step for man and one giant leap for mankind, NASA announced target launch dates for the Artemis I mission, the agency's long-awaited first step to returning astronauts to the moon and eventually Mars. Even though there won't be people onboard the Orion spacecraft when it blasts off later this year, it will carry dozens of tiny tributes created at the University of Houston, to the Artemis team. **Long Chang**, a Research Associate Professor in the Electrical and Computer Engineering Department at the Cullen College of Engineering and expert at the UH nanofabrication facility, answered the call when NASA was looking for a way to honor the thousands of people contributing to the Artemis I mission. Long combined electron beam lithography and reactive ion etching and engraved the nearly 30,000 names onto each of the 80 microchips.



Pictured: *80 identical microchips*

NEW JOURNAL PUBLICATIONS

ELECTRICAL AND COMPUTER ENGINEERING

DISRUPTING THE ENERGY AND HEALTH CARE INDUSTRIES WITH A

MINIATURE PULSED POWER SYSTEM

Pulsed power systems accumulate and store large amounts of energy for a certain period of time to be released instantaneously later.

The development of these systems is deeply intertwined with the nuclear age. In the mid-20th century, pulsed power systems were also used to create other military weapons, such as radar systems and rail guns.

As the 20th century progressed, pulsed power systems were key to the creation of x-ray machines, then MRI machines and Nuclear Magnetic Resonance (NMR) based tools for fossil fuel production.

Now researchers at the University of Houston, led by Cullen College Assistant Professor of Electrical and Computer Engineering **Harish Krishnamoorthy**, are working to develop the next generation of miniaturized pulsed power systems. In a research paper published in *IEEE Transactions on Industrial Electronics*, they propose creating a mini-pulsed power system that can shrink the system's energy storage components, such as capacitors, and deliver an immediate surge of power. The paper demonstrated that the energy storage elements can be reduced to below one-tenth the size of conventional pulsed power systems used on critical applications such as radar.

The architecture of their new pulsed power system proved so compelling that the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E) recently awarded them a $1 million grant to build their gallium nitride (GaN)-based miniaturized pulsed power system. Krishnamoorthy's team will work with researchers from Harvard University and Schlumberger, who are sub-recipients of the grant.

NEW JOURNAL PUBLICATIONS

MAJOR ADVANCE IN SEMICONDUCTOR MATERIALS

Researchers have for the first time experimentally discovered that a cubic boron arsenide crystal offers high carrier mobility for both electrons and holes – the two ways in which a charge is carried in a semiconducting material – suggesting a major advance for next-generation electronics. While earlier predictions had theorized that the crystal could exhibit simultaneously high electron and hole mobility, one of two papers published July 22 in the journal *Science* shows that researchers were able to experimentally validate the high carrier mobility at room temperature, expanding its potential use in commercial applications. Researchers from across the United States, including the University of Houston, the Massachusetts Institute of Technology, the University of Texas at Austin and Boston College, were involved in the work. One of the principal investigators for this work is **Jiming Bao**, a professor of electrical and computer engineering at UH.

Pictured: *Zhifeng Ren and Jiming Bao, principal investigators at the Texas Center for Superconductivity at UH, have for the first time experimentally discovered that a cubic boron arsenide crystal offers high carrier mobility for both electrons and holes, suggesting a major advance for next-generation electronics.*

IDENTIFYING AN ALTERNATIVE TO LITHIUM-BASED BATTERY TECHNOLOGY

As governments and industries all over the world are eager to find energy storage options to power the clean energy transition, new research conducted at the University of Houston and published in Nature Communications suggests ambient temperature solid-state sodium-sulfur battery technology as a viable alternative to lithium-based battery technology for grid-level energy storage systems.

Yan Yao, Cullen Professor of Electrical and Computer Engineering, and his colleagues developed a homogeneous glassy electrolyte that enables reversible sodium plating and stripping at a greater current density than previously possible. The researchers found a novel form of oxysulfide glass electrolyte that has the potential to satisfy all of these requirements at the same time. A high-energy ball milling process was used to create the electrolytes at room temperature. This research was funded by the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E).

FIRST UH RECIPIENT OF NOTED

POWER ELECTRONICS FELLOWSHIP

In another first for the University of Houston, doctoral student **Hussain Sayed** became the institution's inaugural recipient of the Joseph John Suozzi INTELEC® Fellowship Award in Power Electronics for 2022.

Sayed, a Ph.D. candidate in the Cullen College of Engineering, is UH's first student to earn this noted prize presented by the Institute of Electrical and Electronic Engineers (IEEE) Power Electronics Society. He received this honor for his proposed study examining the underlying elements to enable monitoring of the health status and reliability of individual power converters used in data centers.

The award carries a $15,000 grant, and according to Sayed, it will certainly assist his academic and professional journeys at the University of Houston.

"This fellowship will significantly contribute to my upcoming Ph.D. research work as well as to my long-term academic career pathway," he said.

This prize also complements Sayed's commitment to success as a researcher exploring real-world applications for the principles learned at UH and at the Cullen College of Engineering.

Earlier this year, Sayed also received recognition from IEEE as he earned the Technical Session Best Presentation Award at the institute's Applied Power Electronics Conference.

Pictured: *Hussain Sayed*

FACULTY ACCOLADES

ZHU HAN

CHOSEN AS ACM DISTINGUISHED SPEAKER

Zhu Han, Moores professor in the Electrical and Computer Engineering Department at the Cullen College of Engineering, has been selected for a three-year term as a Distinguished Speaker by the Association for Computing Machinery.

Han is the first two professors from the University of Houston to receive this honor, together with Dr. Albert Cheng, a computer science professor in the College of Natural Sciences and Mathematics.

According to the ACM, their speakers come from a wide range of disciplines – academic sources like Stanford University and McGill, but also, vastly different industries, like IBM, Microsoft, Sony Pictures and Raytheon. The organization is affiliated with about 140 speakers currently.

Han has been a Distinguished Member of the ACM since 2019. He sees it as an opportunity to more widely disseminate the research he and his team are doing at the Cullen College of Engineering, as well as being positively influenced by other speakers of the ACM.

WEI-CHUAN SHIH

RECOGNIZED FOR WORK ADDRESSING CANCER TREATMENT

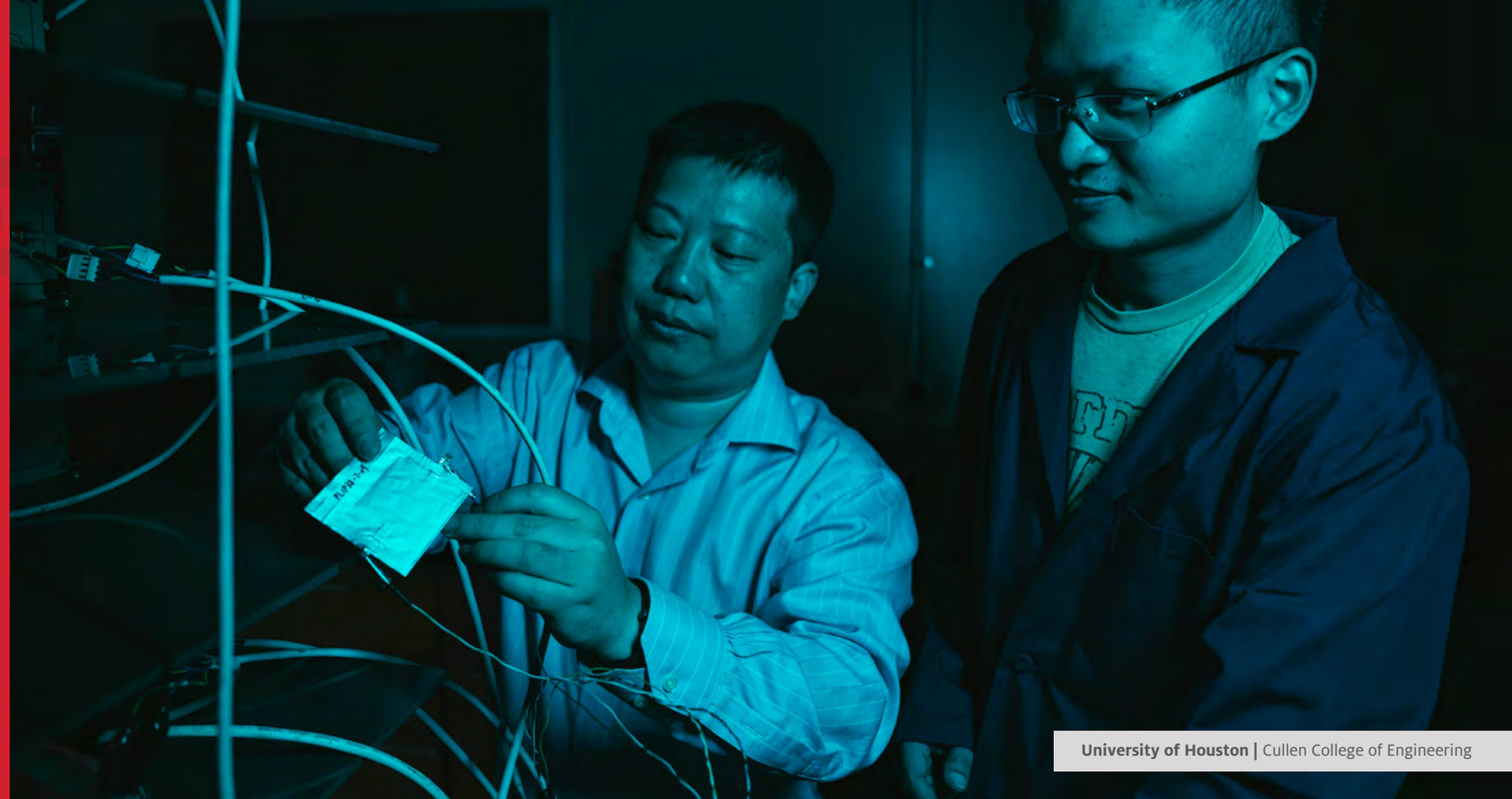
A professor from the Cullen College of Engineering's Department of Electrical and Computer Engineering is part of one of 20 teams or individuals chosen for the 2022 Accelerator for Cancer Therapeutics annual cohort.

According to Texas Medical Center Innovation (TMCi), the effort is comprised of Texas-based startups working to address the world's most significant cancer challenges with novel technologies and treatments. As the innovation hub of the Texas Medical Center, TMCi spearheads the Accelerator for Cancer Therapeutics, funded by the Cancer Prevention and Research Institute of Texas (CPRIT) in association with the Gulf Coast Consortia (GCC) and the University of Texas Medical Branch (UTMB).

Wei-Chuan Shih, Ph.D., along with Dr. Steven Lin of M.D. Anderson Cancer Center, are part of the 2022 cohort. Shih is a Cullen College of Engineering Professor in the Electrical and Computer Engineering Department. They were chosen to further develop Scenexo as part of the nine months of clinical and business development education and advisement they will receive from the accelerator program.

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.



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