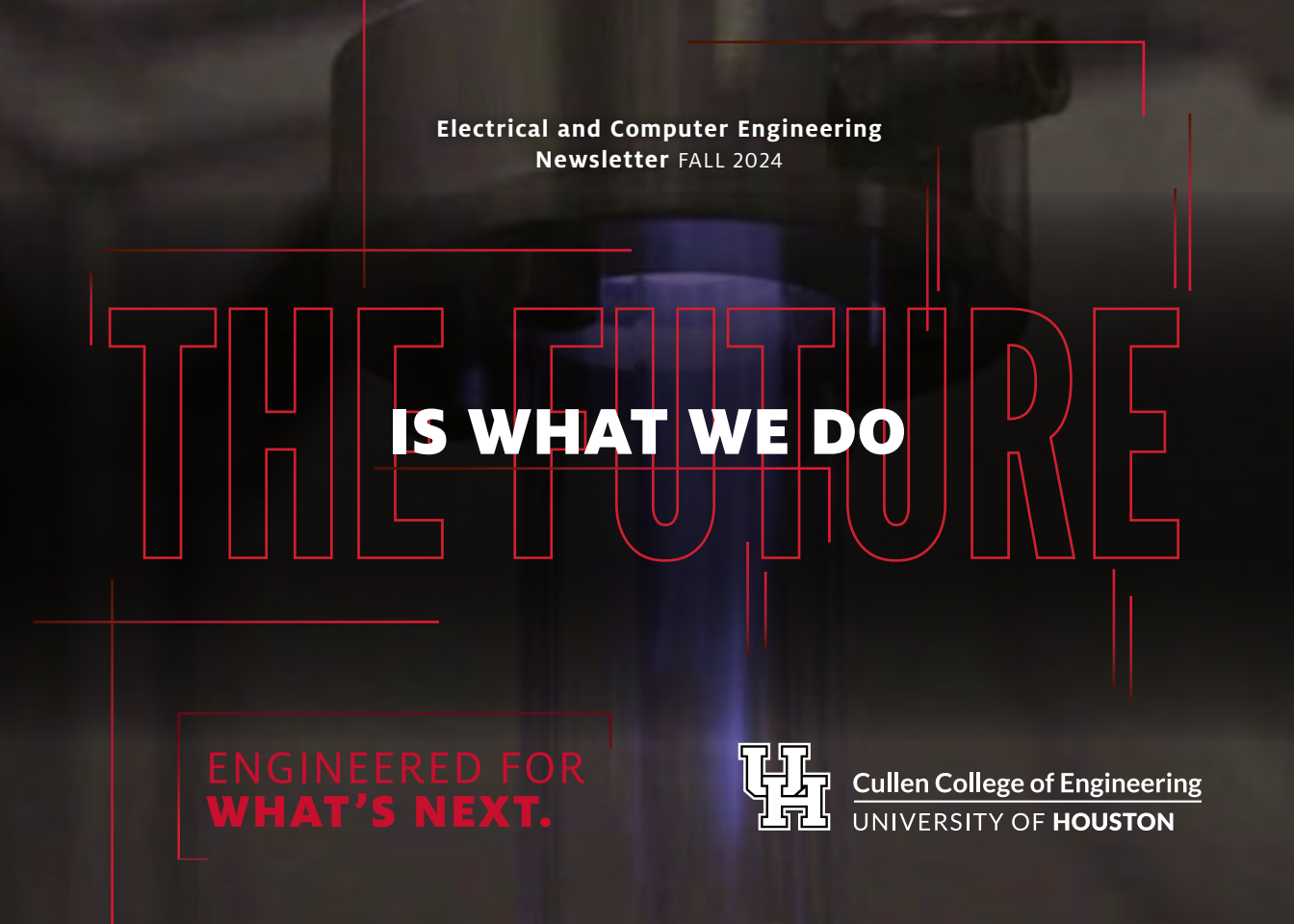

Electrical and Computer Engineering
Newsletter FALL 2024
THE FUTURE
IS WHAT WE DO
ENGINEERED FOR
WHAT'S NEXT.
Cullen College of Engineering
UNIVERSITY OF HOUSTON

Letter from the Chair

Dear Colleagues,

Salutations from Houston!

It is a privilege to serve as the Interim Chair of the Department of Electrical and Computer Engineering at the University of Houston. Our department has a long-standing tradition of excellence in education, research, and innovation, and I am deeply committed to upholding and advancing this legacy during our transitional period.

Our faculty, staff, and students are the driving force behind our department's success, leading groundbreaking research and delivering an education that prepares our students to excel in a rapidly changing technological landscape. Whether through pioneering research in areas such as renewable energy and healthcare or through strong collaborations with industry leaders, our department continues to push the boundaries of knowledge and innovation.

Warm Regards,

Ji Chen, Ph.D., Fellow IEEE, Fellow AIMBE
Interim Chair and Professor
Electrical & Computer Engineering Department
Cullen College of Engineering
University of Houston

UH ECE **BY THE NUMBERS**

DEGREES AWARDED *(FY2023)*

121 B.S.

180 M.S.

24 Ph.D.

ENROLLMENT *(FALL 2023)*

923 UNDERGRADUATE STUDENTS

327 GRADUATE STUDENTS

3 NATIONAL ACADEMY OF ENGINEERING **MEMBERS**

2 SOCIETY FOR AUTOMOTIVE ENGINEERING **FELLOWS**

1 OPTICAL SOCIETY OF AMERICA **FELLOW**

3 NATIONAL ACADEMY OF INVENTORS **FELLOWS**

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

1 AMERICAN PHYSICS SOCIETY **FELLOW**

2 CANCER PREVENTION AND RESEARCH INSTITUTE OF TEXAS **MEMBER**

13 NATIONAL SCIENCE FOUNDATION **CAREER AWARDEES**

9 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**

Pictured: *Yan Yao,is the deputy lead of the soft matter scientific thrust and the principal investigator for UH's portion of the project.*

UH JOINS DOE'S NEW ENERGY INNOVATION HUB TO ADVANCE BATTERY TECHNOLOGY

The U.S. Department of Energy recently announced $125 million for the creation of two Energy Innovation Hubs to provide the scientific foundation needed to address the nation's most pressing battery challenges and encourage next generation technological developments, including safety, high-energy density and long-duration batteries made from inexpensive, abundant materials. University of Houston — The Energy University — is part of one of the national hubs, the Energy Storage Research Alliance (ESRA).

ESRA brings together nearly 50 world-class researchers from three national laboratories and 12 universities, including UH, to push the boundaries of energy storage science to drive technological innovation and strengthen U.S. economic competitiveness.

Yan Yao, the Hugh Roy and Lillie Cranz Cullen Distinguished Professor at the UH Cullen College of Engineering and principal investigator at the Texas Center for Superconductivity, is the deputy lead of the soft matter scientific thrust and the principal investigator for UH's portion of the project.

"This is a once in a lifetime opportunity," said Yao. "To collaborate with world-class experts to understand and develop new science and make discoveries that will lead to the next generation of batteries and energy storage concepts, and potentially game changing devices is exciting. It's also a great opportunity for our students to learn from and work with top scientists in the country and be part of cutting-edge research."

Yao and his team are globally known for their work to create next-generation batteries using abundant, low-cost organic materials. In the cathode, the team previously used quinones — which can be synthesized from plants and food like maize or soybean — to increase energy density, electrochemical stability and overall safety. They were the first to make solid-state sodium batteries using multi-electron conformal organic cathodes with a demonstrated record of recharging stability of 500 charging cycles.

Pictured: *Image of a microwave plasma in the UH lab of Dr. Shan.*

Pictured: Xiaonan Shan, Jiefu Chen, Lars Grabow, and Xuquing Wu

$1M GRANT AIMED AT BOOSTING CLEAN ENERGY WITH AI-POWERED CATALYSTS AND MICROWAVE PLASMA TECHNOLOGIES

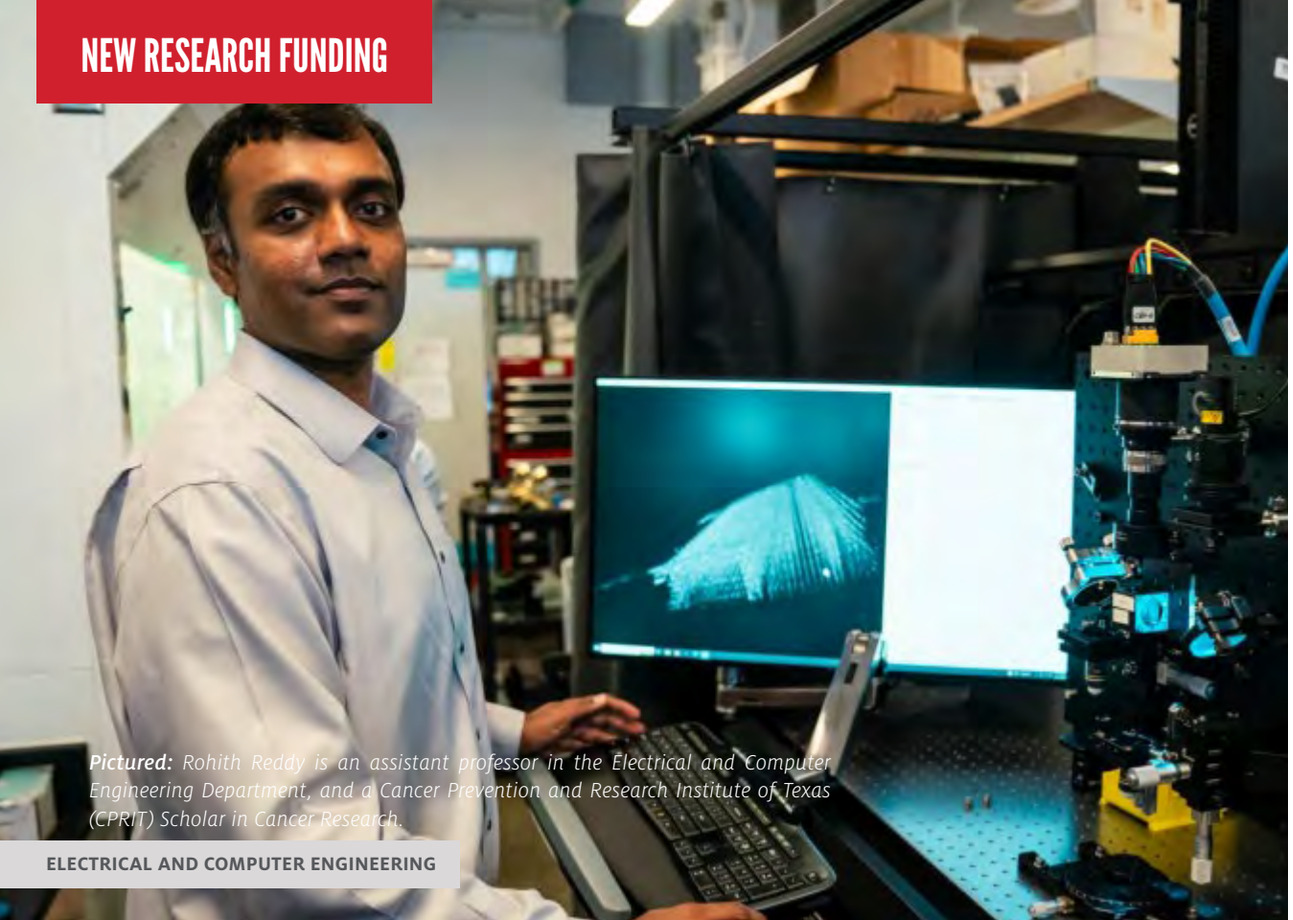
As the world races to combat environmental degradation and climate challenges, transitioning to renewable energy has become a top priority. However, the inconsistent nature of wind, solar and other renewable sources poses a significant challenge to maintaining a stable energy supply, which has slowed the transition.

The National Science Foundation awarded a $1 million grant to this project, titled "Multidisciplinary High-Performance Computing and Artificial Intelligence Enabled Catalyst Design for Micro-Plasma Technologies in Clean Energy Transition."

TThis project aims to leverage machine learning for catalyst discovery and develop new characterization methods for studying chemical reactions under extreme conditions such as plasma, one of the four states of matter, which is an ionized state consisting of positively charged ions and negatively charged electrons. The goal is to improve the efficiency of catalysts in hydrogen generation, carbon capture and energy storage.

The University of Houston team includes **Jiefu Chen**, associate professor of electrical and computer engineering, **Lars Grabow**, professor of chemical and biomolecular engineering, **Xiaonan Shan**, associate professor electrical and computing engineering and **Xuquing Wu**, associate professor of information science technology. They are collaborating with Su Yan, an associate professor of electrical engineering and computer science at Howard University.

"By enhancing the efficiency of catalytic reactions in key areas such as hydrogen generation, carbon capture and energy storage, this research directly contributes to these global challenges," said Chen, the principal investigator of the project. "This interdisciplinary effort ensures comprehensive and innovative solutions to complex problems."



Pictured: Rohith Reddy is an assistant professor in the Electrical and Computer Engineering Department, and a Cancer Prevention and Research Institute of Texas (CPRIT) Scholar in Cancer Research.

UH ECE'S REDDY LANDS RENEWABLE $629K GRANT FOR KIDNEY DISEASE RESEARCH

A researcher at the Cullen College of Engineering has received a renewable grant with a total potential value of about $3.2 million from the National Institutes of Health to expand his research into improving the accuracy of diagnosis for forms of kidney disease.

Rohith Reddy is an assistant professor in the Electrical and Computer Engineering Department, and a Cancer Prevention and Research Institute of Texas (CPRIT) Scholar in Cancer Research. The NIH's National Institute of Diabetes and Digestive and Kidney Diseases chose his proposal, "Improving the Accuracy of Lupus Nephritis Diagnosis using Biomarkers Derived from Ultraviolet and Mid-infrared Spectroscopic Imaging," for funding.

The grant is $629,842 for its first year. If the research shows promise, it is renewable for up to five years, for a total value of about $3.2 million.

Reddy explained that his research's goal is to improve the accuracy of the diagnosis of lupus nephritis, which is a kidney disease where the immune system of the body attacks parts of its own kidney.

According to Reddy, the idea for the research came out of prior work to improve the accuracy of gynecologic ovarian cancer diagnoses. He also noted that his proposal was refined thanks to collaboration with his Cullen peers **David Mayerich** — an associate professor in the Electrical and Computer Engineering Department, and another CPRIT Scholar — and **Chandra Mohan**, Hugh Roy and Lillie Cranz Cullen Endowed Professor of Biomedical Engineering.

Reddy also identified two others with outside affiliations that would be involved in the project — Kyung Hyun Lee, an assistant professor of Biostatistics at UT Health's Center for Clinical Research and Evidence-Based Medicine; and Anthony Chang, a Professor of Pathology at the University of Chicago.

FACULTY ACCOLADES

STUART LONG

EARNS ANTENNAS AND PROPAGATION SOCIETY (AP-S) DISTINGUISHED ACHIEVEMENT AWARD

Stuart Long, Moores Professor of Electrical and Computer Engineering and Associate Dean of Undergraduate Research and the Honors College, was recently awarded the Institute of Electrical and Electronics Engineers (IEEE) Antennas and Propagation Society (AP-S) Distinguished Achievement Award for the introduction and development of the dielectric resonator antenna and the early development of the microstrip patch antenna.

This award honors outstanding career technical achievements in the fields of antennas and propagation and is the highest recognition given by the society.

This is the fourth award Long has received from the IEEE AP-S. Previous awards include the IEEE AP-S Outstanding Service Award for his service on the administrative committee, as vice president and president of the Society, in 2007; the IEEE AP-S John Kraus Antenna Award for the introduction and development of the dielectric resonator antenna in 2014; and the IEEE AP-S Chen-To Tai Distinguished Educator Award for his commitment to electromagnetics education through teaching, research, and the development of programs to attract students to the field in 2018.

KAUSHIK RAJASHEKARA

ELECTED INTERNATIONAL FELLOW OF THE ENGINEERING ACADEMY OF JAPAN

Kaushik Rajashekara, Distinguished Professor of Engineering at the University of Houston Cullen College of Engineering, continues to receive recognition and awards on a global scale. The man who ushered in the era of electric cars, working on the General Motors EV1 in 1995 when he was a Technical Fellow there, has been elected an International Fellow of the Engineering Academy of Japan, recognized for his contributions to power conversion and, of course, electrification of transportation.

According to the academy, Rajashekara's election as an International Fellow specifically honors his "outstanding scientific research and scientific-technical developments in the field of energy which promote greater efficiency and environmental security for energy sources on Earth in the interests of all mankind."

He stands among an elite group of fewer than 10 Fellows from the United States, out of a distinguished group comprising 800 Fellows and 15 International Fellows.

In 2022 Rajashekara received the most coveted prize in the field of international energy — the Global Energy Prize bestowed by the Global Energy Association.

Pictured: *In a collaborative project between the Harris County Office of County Administration's Sustainability Office and the University of Houston, researchers, county staff and the Harris County energy management team within the Sustainability Office are working together to develop*

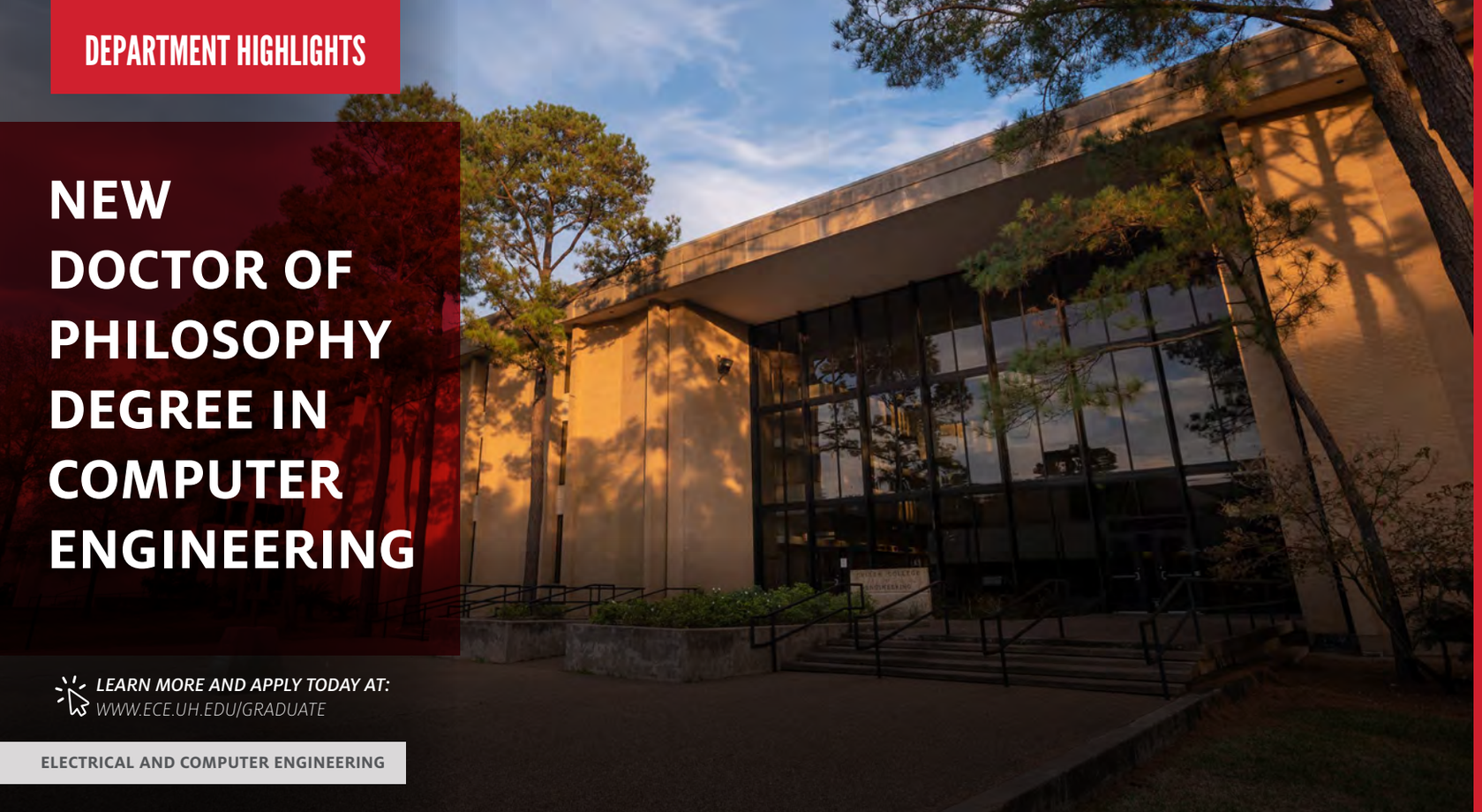
UH ECE PARTNER WITH HARRIS COUNTY ON **VISION FOR SUSTAINABLE ENERGY FUTURE**

In a collaborative project between the Harris County Office of County Administration's Sustainability Office and the University of Houston, researchers, county staff and the Harris County energy management team within the Sustainability Office are working together to develop a comprehensive baseline of energy use and energy use intensity for County assets.

As a first step of this ambitious project, Harris County Sustainability Team and UH research intern Xidan "Delia" Zhang, UH Cullen College of Engineering Assistant Professor of Engineering Technology and Electrical and Computer Engineering **Jian Shi**, and Moores Professor of Electrical and Computer Engineering **Zhu Han** have spent the past year working closely with County energy managers Glen Rhoden and Yas Ahmadi.

Looking ahead to Fall 2024, the team plans to undertake additional building projects, including building automation system (BAS) upgrades, LED lighting installations and the development of solar energy and heat pump initiatives.

NEW DOCTOR OF PHILOSOPHY DEGREE IN COMPUTER ENGINEERING



LEARN MORE AND APPLY TODAY AT:
WWW.ECE.UH.EDU/GRADUATE

ELECTRICAL AND COMPUTER ENGINEERING

The Computer Engineering Ph.D. program will provide students with a doctoral-level education in Computer Engineering in preparation for successful academic, national laboratory, or industrial research and development careers in computer software and hardware.

Students in this progarm will be prepared in these vital areas: advanced software and hardware design, integrated systems, artificial intelligence, networking and cybersecurity and more.

This new Ph.D. program will be administered as a graduate research program within the Cullen College of Engineering's Department of Electrical and Computer Engineering (ECE).

Pictured: *Wei-Chuan Shih, Cullen College of Engineering professor of electrical and computer engineering.*

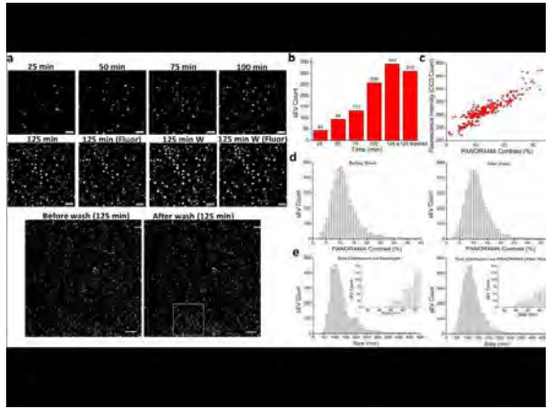
NEW METHOD HAS POTENTIAL TO DETECT CANCER AT EARLIEST STAGES

A University of Houston researcher is reporting a new method to detect cancer which could make cancer detection as simple as taking a blood test. With a 98.7% accuracy rate, the method — which combines PANORAMA imaging with fluorescent imaging — has the potential to detect cancer at the earliest stage and improve treatment efficacy.

The remarkably precise method allows researchers to peer into nanometer-sized membrane sacs, called extracellular vesicles or EVs, that can carry different types of cargos, like proteins, nucleic acids and metabolites, in the bloodstream.

When **Wei-Chuan Shih,** Cullen College of Engineering professor of electrical and computer engineering, and his team examined the number and cargo of small EVs inside patients with cancer and those without, their finding was remarkable.

"We observed differences in small EV numbers and cargo in samples taken from healthy people versus people with cancer and are able to differentiate these two populations based on our analysis of the small EVs," reports Shih, in Nature Communications Medicine. "The findings came from combining two imaging methods — our previously developed method PANORAMA and imaging of fluorescence emitted by small EVs — to visualize and count small EVs, determine their size and analyze their cargo." For this research, supported by the National Institutes of Health, it was a matter of counting the number of small EVs to detect cancer.



Pictured: Digital counting and sizing of sEVs via PANORAMA.

Pictured: Jiming Bao

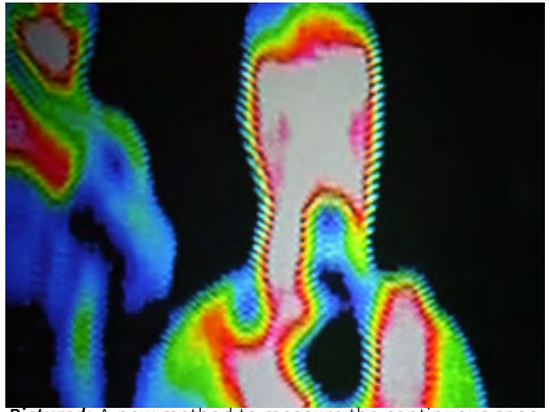
UH ECE PROFESSOR REPORTING NEW METHOD SET TO IMPROVE THERMAL IMAGING AND INFRARED THERMOGRAPHY

A new method to measure the continuous spectrum of light, developed in the lab of University of Houston professor of electrical and computer engineering **Jiming Bao**, is set to improve thermal imaging and infrared thermography, techniques used to measure and visualize temperature distributions without direct contact with the subject being photographed.

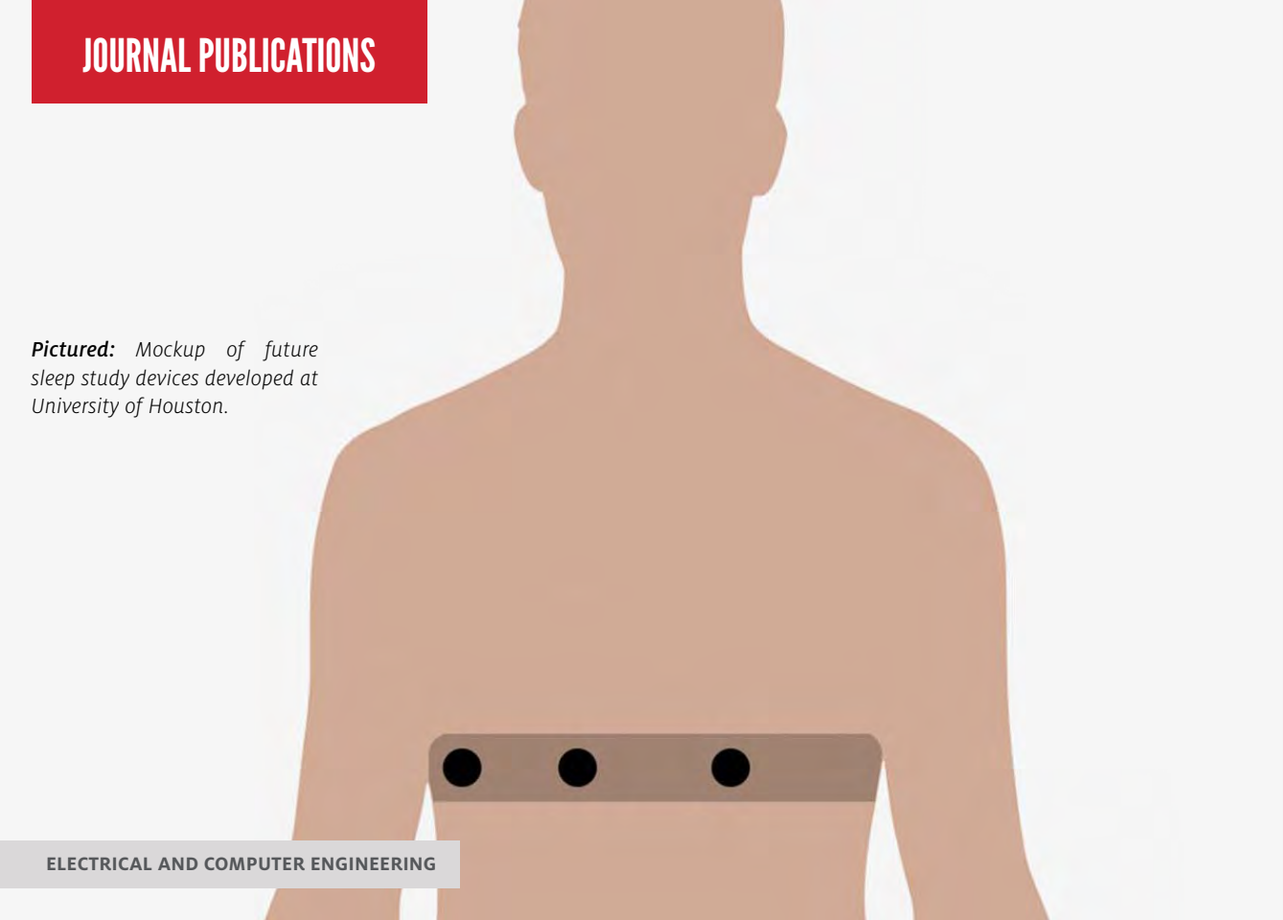
Because they are highly sensitive, thermal cameras and infrared thermometers measure temperature accurately from a distance, making them versatile and valuable tools in many fields from the military to medical diagnostics. They detect infrared radiation, invisible to the human eye, and convert it into visible images. Different colors on the image represent varying temperatures, allowing users to see heat patterns and differences.

"We designed a technique using a near-infrared spectrometer to measure the continuous spectrum and fit it using the ideal blackbody radiation formula," reports Bao, in the journal Device. "This technique includes a simple calibration step to eliminate temperature- and wavelength-dependent emissivity."

Bao demonstrates his technique by measuring the temperature of a heating stage with errors less than 2°C and measuring the surface temperature gradient of a catalyst powder under laser heating. Using the near-infrared spectrometer, thermal radiation from a hot target is collected with an optical fiber and recorded by a computer. The collected spectrum is normalized using a system calibration response and fitted to determine the temperature.



Pictured: A new method to measure the continuous spectrum of light.



Pictured: *Mockup of future sleep study devices developed at University of Houston.*

GROUNDBREAKING APPROACH TO SLEEP STUDY EXPANDS POTENTIAL OF SLEEP MEDICINE

University of Houston, associate professor of electrical and computer engineering **Bhavin R. Sheth** and former student Adam Jones, have introduced a groundbreaking approach to sleep stage classification that could replace the current gold standard in sleep testing, the cumbersome polysomnography, which uses a myriad of wires and is performed in a clinic. Their new procedure, which can be performed at home by the user, uses a single-lead electrocardiography-based deep learning neural network.

If you've ever had a problem sleeping, and ended up in a sleep lab, you know the polysomnography test is anything but restful. With a multitude of leads — sensors and wires — dangling from every part of your body, you are asked to sleep, which is a state difficult to reach without such encumbrance, nearly impossible with it.

But what if the number of those electrodes — attached from your scalp to your heart — was reduced to simply two?

"We have successfully demonstrated that our method achieves expert-level agreement with the gold-standard polysomnography without the need for expensive and cumbersome equipment and a clinician to score the test," reports Sheth in Computers in Biology and Medicine. "This advancement challenges the traditional reliance on electroencephalography (or EEG) for reliable sleep staging and paves the way for more accessible, cost-effective sleep studies."

Even more, by enabling access to high-quality sleep analysis outside clinical settings, Adam and Bhavin's research holds the potential to expand the reach of sleep medicine significantly. The electrocardiography-based model was trained on 4000 recordings from subjects 5–90 years old. They showed that the model is robust and performs just as well as a clinician scoring polysomnography.

"Our method significantly outperforms current research and commercial devices that do not use EEG and achieves gold-standard levels of agreement using only a single lead of electrocardiography data," said Sheth, who is also a member of the UH Center for NeuroEngineering and Cognitive Systems.

"It makes less-expensive, higher-quality studies accessible to a broader community, enabling improved sleep research and more personalized, accessible sleep-related healthcare interventions."

AI-FOCUSED STRUCTURED RESEARCH

FEATURED IN THE JOURNAL ADVANCED ENGINEERING INFORMATICS

After natural disasters, many people are understandably worried about the potential for structural damage to their homes. The research work of a Cullen College of Engineering Ph.D. student and his advising professor aims to provide them with another tool for identifying that damage.

Subin R. Varghese, an Electrical and Computer Engineering Department student, is an author of "Unpaired image-to-image translation of structural damage." The paper was published in Advanced Engineering Informatics in April 2023. Varghese is advised by Vedhus Hoskere, assistant professor in the Civil and Environmental Engineering Department.

Varghese notes that by using AI, potential damage following natural disasters and other weather-related events could be detected. This is especially important because of the strain on inspectors and emergency personnel after these events.

Pictured: *Subin R. Varghese*

Pictured: *Yuan Zi is studying in the Electrical and Computer Engineering Department at the Cullen College of Engineering. He was chosen for a 2023 summer internship, and completed it with the industrial AI team at the ABB Corporate Research Center in Germany, under the mentorship of Ralf Gitzel, Ph.D.*

UH ECE PH.D. STUDENT ZI

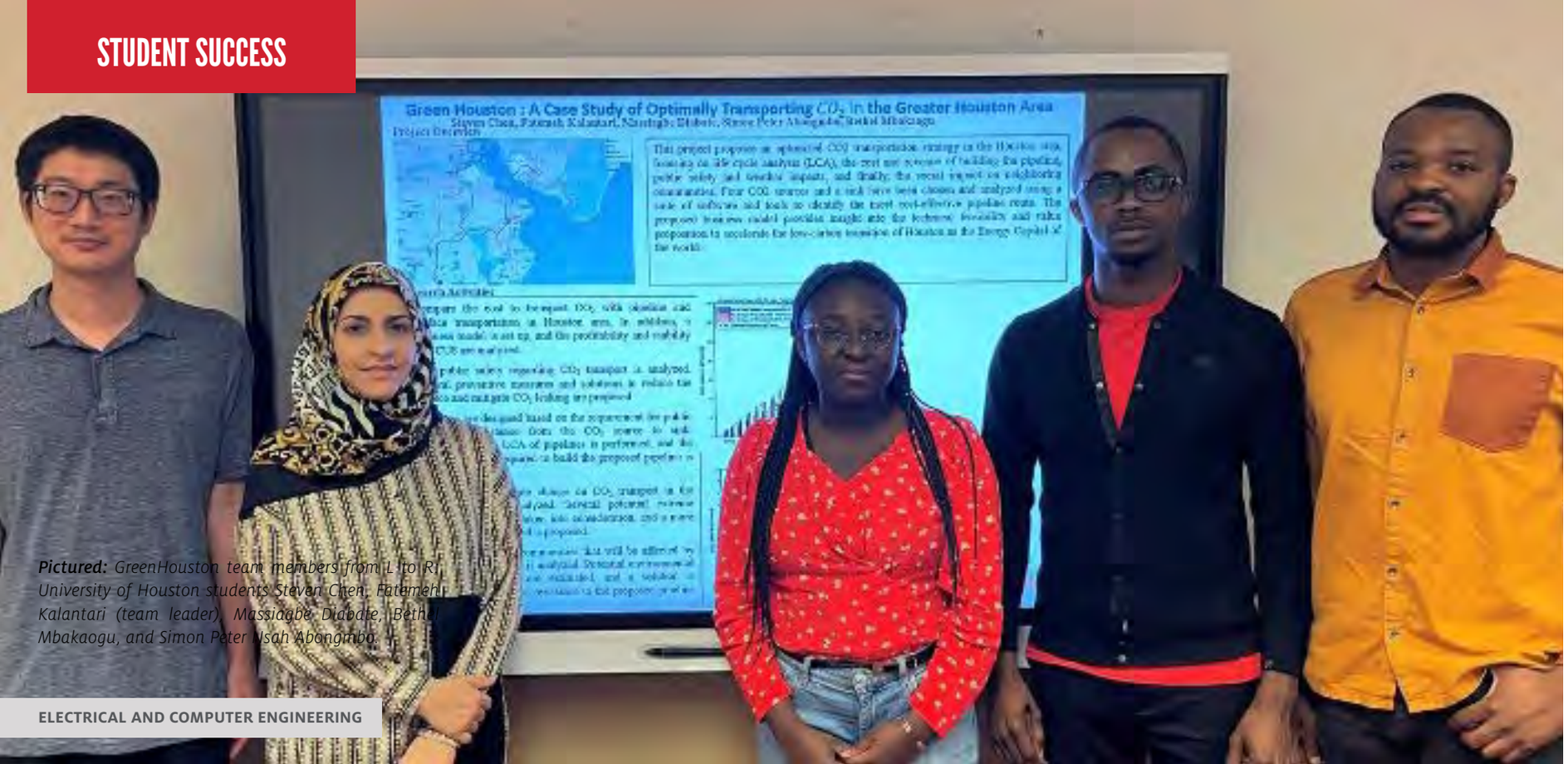
THRIVES DURING RISE INTERNSHIP

An engineering student completing his doctorate at the University of Houston was honored by being selected for a Research Internships in Science and Engineering (RISE) Professional summer research internship in Germany.

Yuan Zi is studying in the Electrical and Computer Engineering Department at the Cullen College of Engineering. He was chosen for a 2023 summer internship, and completed it with the industrial AI team at the ABB Corporate Research Center in Germany, under the mentorship of Ralf Gitzel, Ph.D.

"It was an incredible experience, working alongside domain experts and data scientists who had dedicated years to solving complex problems," he said. "This internship provided me with a multitude of positive experiences that I hold close to my heart."

Zi is scheduled to graduate in 2024. He is looking for work that will allow him to apply his diverse skill set and knowledge base. He also encouraged both graduate and undergraduate students to apply for RISE internship opportunities. It has led to networking opportunities, as well as professional and personal development for him.



Pictured: *GreenHouston team members from L to R, University of Houston students Steven Chen, Fatemeh Kalantari (team leader), Massiagbe Diabate, Bethel Mbakaogu, and Simon Peter Nsah Abongmbo.*

UH ECE STUDENTS SHINE IN **DOE'S AMERICAN-MADE CARBON MANAGEMENT COMPETITION**

GreenHouston, a team of University of Houston students mentored by Assistant Professor **Jian Shi** from the UH Cullen College of Engineering, created a winning proposal for an optimized carbon dioxide transportation pipeline specifically tailored for the Houston area.

The team's strategy, which factored in cost analysis, revenue potential, safety considerations, weather hazards and social impact on neighboring communities, addressed complex challenges surrounding carbon management and won third place in the first American-Made Carbon Management Collegiate Competition.

The team plans to use the cash award to grow their project through additional research, refining existing technologies, addressing remaining challenges and raising awareness of CCUS and its project.

UH ECE DEPARTMENT HOSTS

IEEE-HKN STUDENT LEADERSHIP CONFERENCE

More than 250 people flocked to the Cullen College of Engineering at the University of Houston in early November, as the Electrical and Computer Engineering Department hosted the 2003 IEEE-HKN (Eta Kappa Nu) Student Leadership Conference.

The overarching mission and vision of the IEEE-HKN is to recognize excellence in scholarship, attitude and character. The leadership conference serves as the hallmark event for these goals.

The event focuses on training for Chapter leaders, individual and professional development, technical sessions, and networking to bring together members from around the world and encourage inter-chapter activity and cooperation.

This year's event featured sessions on community service, planning a career path for future job opportunities, and alumni talking about the things overlooked during undergrad and the next steps in grad school.

For more information about IEEE-HKN, visit its website.

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.

ENGINEERED FOR
WHAT'S NEXT.

Cullen College of Engineering
UNIVERSITY OF HOUSTON

UH Cullen College of Engineering
Department of Electrical & Computer Engineering
Engineering Building 1, Room N308
4226 Martin Luther King Boulevard
Houston, TX 77204-4005

@UHEngineering

The Future 

IS WHAT WE DO