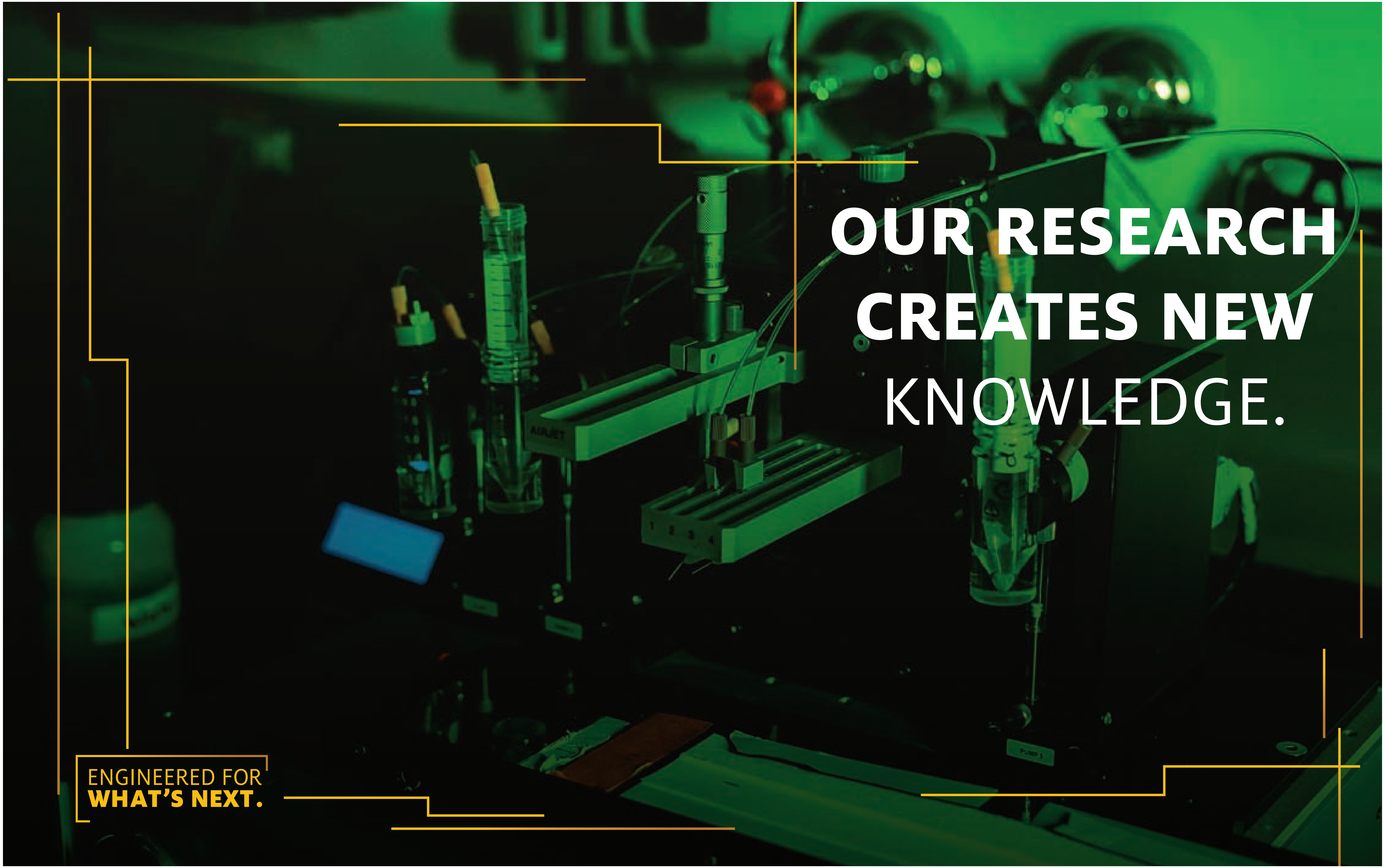
Cullen College of Engineering
UNIVERSITY OF HOUSTON

PARAMETERS

Cullen College of Engineering Magazine •Spring 2025

The Humans
BEHIND THE AI


OUR RESEARCH
CREATES NEW
KNOWLEDGE.
ENGINEERED FOR
WHAT'S NEXT.

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PARAMETERS

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ChBE's Henderson earns teaching award from EDIIE
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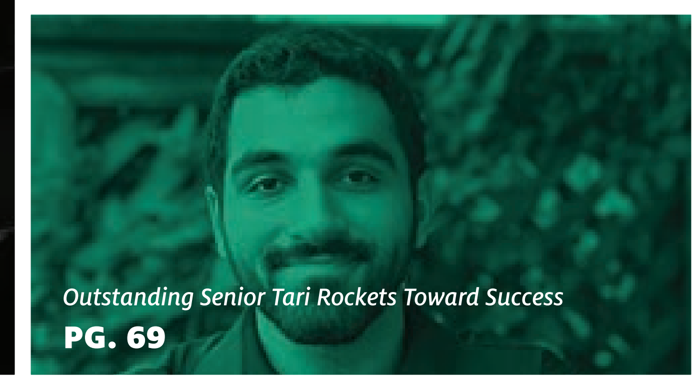

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IN EVERY ISSUE

Cullen College of Engineering
UNIVERSITY OF HOUSTON

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DEAN'S LETTER

Dear Friends of the Cullen College of Engineering,

We stand at a pivotal moment in the evolution of engineering—where the intersection of technology, creativity, and responsibility shapes the path forward. At the Cullen College of Engineering, we embrace this challenge with purpose and pride.

Artificial intelligence has captured the world's attention, and rightly so. However, behind every breakthrough in AI and every leap forward in engineering are the dedicated individuals driving change. In this issue's feature package, "The Humans Behind the AI," we highlight some of the remarkable work our faculty, students, and collaborators are doing to harness AI for good—from predicting pandemic patterns and fighting cancer to innovating in structural engineering and tracking climate change through glacier monitoring.

These stories transcend mere headlines; they serve as testaments to our core mission: addressing real-world challenges through interdisciplinary research, impactful education, and an unwavering commitment to innovation.

We take pride in recognizing our exceptional community. Faculty members Ben Xu and Gül Zerze have received the prestigious NSF CAREER Awards—which is one of the highest honors an early-career faculty can receive. A large number of our senior faculty have been recognized with national and international honors. As always, in our spring issue, we are proud to highlight two students who will be honored at the Spring Commencement—Outstanding Senior Parsa Tari and Outstanding Junior Jonathan Gaucin, who embody the excellence and potential of the next generation of engineers.

As we look ahead to the future of clean energy, biomedical breakthroughs, advanced materials, and smarter infrastructure, I am confident that the Cullen College will continue to lead. We are not just preparing students to succeed—we are preparing them to shape what comes next.

Thank you for being part of our journey.

Sincerely,

P. Sharma

Pradeep Sharma
Dean of the Cullen College of Engineering
Hugh Roy and Lillie Cranz Cullen Distinguished University Professor

PARAMETERS ON THE FIVES

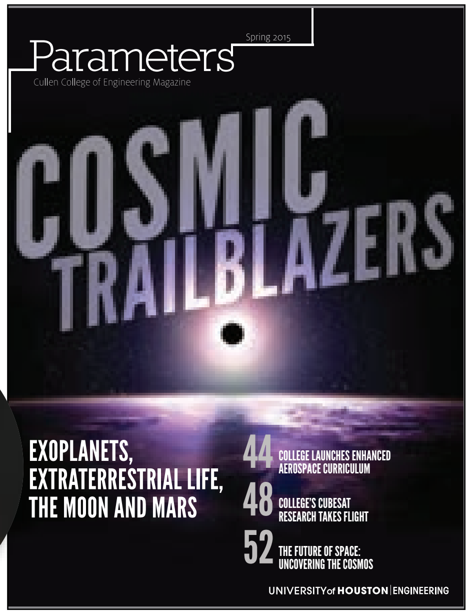
BY STEPHEN GREENWELL

A look back at past **PARAMETERS** stories and interview subjects, and what those Cougars are up to now...

5 YEARS BACK...

The cover story was a profile on **Faith Malton**, a civil engineering undergraduate. Malton was born without her right arm and shoulder, which challenged her to “engineer” her way through life. An extensive world traveler, Malton also rappelled 21 stories down Hotel Alessandra in downtown Houston for a charity event.

Malton started as a civil engineering intern for Walter P. Moore in May 2019, and after graduating in Spring 2020 from Cullen, she became a graduate civil engineer for the firm in August 2020. After five and a half years with WPM, she changed course and started as a full-time regulatory engineer for Aris Water Solutions.



10 YEARS BACK...

“Cosmic Trailblazers” was the theme of the issue, highlighting the role that Cullen College of Engineering graduates had played in space exploration and the efforts of the college to beef up this aspect of the curriculum. Six different UH graduates have been to space, with the most recent being **Akihiko Hoshide** on a SpaceX mission in 2021 for five months.

The aerospace industry – which includes outer space as well – remains a vital part of Cullen. The Department of Mechanical Engineering added Aerospace to its name to reflect its importance in 2024. **Olga Bannova** remains the director of the Space Architecture Graduate Program, which continues to produce important research and garners recognition among the field. See page 66 for a feature story about their recent efforts.

15 YEARS BACK...

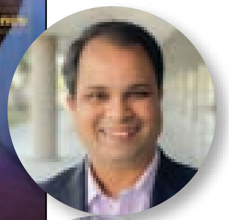
The university continued its push toward securing Tier One status from the Carnegie Foundation for the Advancement of Teaching, with the Cullen College of Engineering at the forefront of that effort. **Ramesh Shrestha**, a Hugh Roy and Lillie Cranz Cullen Distinguished Professor of Civil and Environmental Engineering, brought the National Center for Airborne Laser Mapping (NCALM) to UH from the University of Florida. **Venkat “Selva” Selvamanickam**, then M.D. Anderson Chair Professor of Mechanical Engineering, was spearheading the Texas Center for Superconductivity Applied Research Hub. **Abdeldjelil “DJ” Belarbi**, the new department chairman of Civil and Environmental Engineering, and **Metin Akay**, founding department chairman of Biomedical Engineering, were also featured for their efforts in their respective areas.

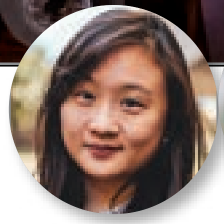
All of these efforts bore fruit, as Carnegie first elevated UH to Tier One status in 2011 and reconfirmed that designation in 2016. UH has been categorized as an “R1” – highest research activity – institution, Carnegie’s top classification.

20 YEARS BACK...

Manmohan Kalsi (1970 MSME, 1975 Ph.D. ME) was the subject of a long profile that explained how his artistic pursuits, especially painting and music, fed into the success of his company, Kalsi Engineering. Reflecting on his career, Kalsi told writer Brian Allen that some of his most successful innovations are the result of the workings of his intuition, of the “undisciplined” part of his brain that allows him to go beyond rigorous analysis and testing.

Kalsi Engineering remains active to this day, with a facility in Sugar Land, and Kalsi frequently gives back to the University of Houston. The Dr. Manmohan Singh Kalsi and Dr. Marie-Luise Schubert Kalsi Endowed Professorship was started in 2014 and honor the memory of Professor **Gabriel Andrews Fazekas**, who taught Kalsi at UH. At a 2015 alumni dinner in honors of the Kalsis, he said Fazekas had a profound influence on him and Kalsi taught with a passion that he hadn’t witnessed with many other professors. Today, the endowment funded by the Kalsis supports three professors in the Mechanical and Aerospace Engineering Department – **Shailendra Joshi**, **Daniel Floryan** and **Kelly Huang**.





IN THE MEDIA **SPOTLIGHT**

GAMERS AREN'T WASTING THEIR LIVES — THEY'RE HELPING THEIR CAREERS

The naysayers and detractors of online gaming and its ill effects on youth might need to stand down. That's what science is telling us in a new report in the journal Human Resource Development International from **Melika Shirmohammad**i, assistant professor in the Cullen College of Engineering's Technology Division.

News of her research was then amplified by stories in The New York Post and The Houston Chronicle, among other smaller newspapers and publications. The research has had a long tail, continuing to be picked up months after its initial publication in November.

READ ONLINE AT:
https://nypost.com/2024/11/19/lifestyle/gamers-arent-wasting-time-theyre-helping-their-careers-study/

HEMP MICROBES STUDY MAY LEAD TO MORE SUSTAINABLE FARMING METHODS

A new study of hemp microbes by Biotechnology's **Abdul Latif Khan** and his Ph.D. student **Waqar Ahmad**, published in *Nature*, may help scientists create special mixtures of helpful microbes to make hemp plants produce more CBD or have better-quality fibers.

"Understanding these microorganisms can also lead to more sustainable farming methods, using nature to boost plant growth instead of relying heavily on chemicals," Ahmad said.

The story was picked up by Phys.org and MSN.com, two of the largest aggregators of news on the web, along with many smaller trade publications focused on the hemp industry.

READ MORE ONLINE AT:
https://phys.org/news/2025-01-hemp-microbes-sustainable-farming-methods.html

AI AT FOREFRONT OF TAILORED CANCER TREATMENTS: UH LEADS INNOVATIONS

Research by **Badri Roysam** of the Electrical and Computer Engineering Department, and Navin Varadarajan of the William A. Brookshire Department of Chemical and Biomolecular Engineering is showing how AI can be used to detect and treat cancer.

This work is featured in our cover stories for this issue – See page 44. But it was also picked up by Houston TV station KHOU 11, with both professors sitting for an interview.

VIEW ONLINE AT:
https://www.khou.com/article/news/health/university-houston-researchers-ai-cancer-treatments/285-6d6a4cda-fa14-4ea3-8c63-44ffcfe60b2e

DOZEN OF COASTAL **SKYSCRAPERS IN MIAMI ARE SINKING**

Urban development is the reason why at least 35 different skyscrapers in Miami have sunk as many as 8 centimeters, or three inches, between 2016 and 2023.

"We attribute the sinking ground primarily to the weight and vibrations from high-rise construction," said **Pietro Milillo**, assistant professor in the Department of Civil and Environmental Engineering.

The research was picked up by The Miami Herald, Earth.com and automobile website Jalopnik.

VIEW ONLINE AT:
https://www.miamiherald.com/news/local/environment/climate-change/article296831519.html

| View Cullen College videos online at youtube.com/UHCullenCollege YouTube

MAE'S XU RECEIVES CAREER AWARD

to Investigate Laser-Induced Bubble Dynamics in Hydrogels

BY ALEX KEIMIG

Assistant Professor of Mechanical & Aerospace Engineering **Ben Xu** has received a National Science Foundation CAREER award for $598,991 for his research to understand bubble dynamics in hydogels.

His project, "Multiscale Understanding of Laser-Induced Bubble Dynamics and the Mechanism of Resultant Jet Flow in Thin-Shearing Hydrogels," seeks to advance the understanding of bubble dynamics in hydrogels – which are widely used in biomedical and energy applications – and their interactions with lasers, focusing on how these interactions drive material behavior and jet flow formation.
This year marked Xu's third submission for the award, and indeed, the third time was the charm.

"I've been working on this topic since 2018, so that's six years of effort," he said. "I've kept working on this topic, improving it, refining the hypothesis, and fortunately everything went well this time. When I got the award email… It was a relief."

While significant research has been conducted on interactions of lasers with water and other Newtonian fluids, growing use of laser-assisted bioprinting (LAB) has highlighted our need to better understand the behavior of complex materials like hydrogels.

Laser-assisted bioprinting (LAB) uses lasers to precisely deposit materials, such as hydrogels embedded with cells, onto a surface substrate. In this process, hydrogels serve as a carrier, or "bioink," encapsulating bioactive cells to enable controlled placement and create functional biological structures.

The laser-induced bubble dynamics and subsequent hydrogel jet flow play a critical role in determining the precision and quality of the printing process. Understanding these dynamics is essential for optimizing printing processes and ensuring reliable fabrication of functional biological structures.

Unlike Newtonian fluids, which maintain a constant viscosity regardless of applied strain, non-Newtonian fluids – such as hydrogels – exhibit viscosity that changes with variations in shear rate. This means the behavior of non-Newtonian fluids depends on the forces acting upon them, adding a layer of complexity to the study of laser-material interactions in these systems.

"We don't yet fully understand how the short pulse, high-frequency laser interacts with the hydrogel, or how and when the initial bubble is formed within a thin hydrogel layer," Xu said. "Once we gain a clearer idea about the bubble and jet flow, we'll be able to better control the hydrogel printing process."

He added that "these processes are happening at such incredibly small scales, both temporally and spatially, that our current understanding remains limited."

During his undergraduate studies, Xu developed a deep fascination with the cavitation phenomenon while interning at a large hydropower plant.

"When I saw the large holes and damage on the turbine blades caused by cavitation, I became deeply intrigued by the complexity of this phenomenon," Xu said. This experience sparked his curiosity about fluid mechanics and the mechanisms driving bubble formation and dynamics.

"At the very beginning, this work was driven by my curiosity about how the bubble was generated when a laser interacts with hydrogels," Xu said. "I initially hypothesized that these are cavitation bubbles. However, I later realized the laser-induced hydrogel bubble formation is far more complex than simple cavitation. Instead, the process involves a combination of multiphysics phenomena, including thermal effects, phase transitions, and plasma generation. Now we get to test the new hypothesis using this CAREER funding."

"Why does this work? Why can the laser induce bubbles and jet flow in hydrogels?" Xu continued. "Once we clearly understand this process, we will have opportunities to develop the next generation of bioprinting technologies, significantly enhancing printing efficiency and enabling fabrication of multifunctional materials for complex structures."

Xu is further interested in using this research to develop a new academic course focusing on thermofluids sciences in advanced manufacturing processes.

"We don't have that course in our mechanical engineering curriculum right now, and I think it would be great for me to help develop some new courses in the department to help our graduate students improve their understanding," he said.

Alongside this research, Xu and his team plan to develop test kits for local K-12 classrooms, collaborating with science teachers to engage students in hands-on activities that explore principles of non-Newtonian fluids and demonstrate how bubbles can play a role in engineering and manufacturing.

"I want to trigger that curiosity for the next generation," Xu said.

CHBE'S ZERZE EARNS NSF CAREER AWARD

to Study Dynamics of Liquid-like Macromolecular Condensed Phases

BY ALEX KEIMIG

William A. Brookshire Department of Chemical and Biomolecular Engineering assistant professor **Gül Zerze**, Ph.D., has earned a National Science Foundation (NSF) CAREER award for $500,000 for her proposal, "Unveiling the Dynamics of Liquid-like Macromolecular Condensed Phases from Nucleation to Stability."

The three states of matter are largely conceived of as separate entities, but the behaviors and boundaries between these concepts are perhaps more fluid than many might first think. Zerze's research concerns liquid solutions containing polymers, or macromolecules, and is "100 percent computational."

"I still remember, as a kid, how excited I was when I first got to see how tiny particles wiggle and jiggle. You can only see it under a microscope, but that wiggling and jiggling behavior leads to the collective behavior of matter," Zerze said.

"[Polymer solutions] are liquids, but not a pure substance like water or ethanol. These liquids – mixtures of these polymers – sometimes split into two distinct liquid phases. One would be what we call the dilute phase, which would be rich in solvent (typically water); the other would be the dense phase, which is richer in polymer but retains liquid-like properties," she said. "What I am studying in this project is the nucleation of these liquid condensed phases from solutions of macromolecules; the formation of macromolecular liquid condensed phases and how they nucleate."

Deepening our understanding of these behaviors paves the way for researchers "to control the formation of those liquid condensates" in specific applications.

"We want to be able to precisely control this nucleation to enable industrial and therapeutic innovations," she said.

Some of these innovations include nutrient encapsulation in the food industry, agricultural formulations, self-healing construction materials, and electrorheological fluids for the automotive and aerospace industries. Intracellular condensates also have implications in human disease processes. Things may occur as expected in healthy cells, but procedural errors or changes in concentration can have clinically significant impacts on the body that lead to disease.

"My engineering education has given me an incredible perspective," she continued. "It gave me the tools of applied math and applied physics so that I can solve outstanding problems of living matter. I think this is a unique advantage of being an engineer or having an engineering background. At heart, I'm a very, very traditional chemical engineer. I may not be literally 'engineering' anything today – I may be using my knowledge in a different field – but that's the beauty of it."

"I am on a quest," she added. "I know that we will find novel phases of matter. What I learn from this process will also, in the future, help us to perhaps learn more or to discover a new phase that hasn't been known before."

Zerze's enthusiasm and gratitude for the award are rooted not only in the material value of the research she is undertaking, but in the immaterial and abstract lessons she has already learned over the course of the application process.

"I outlined, in this project, the trajectory of my career path, my research and my educational goals for not just the next five years, but perhaps the next 10 or more years. It's an honor to have this proposal awarded," she said.

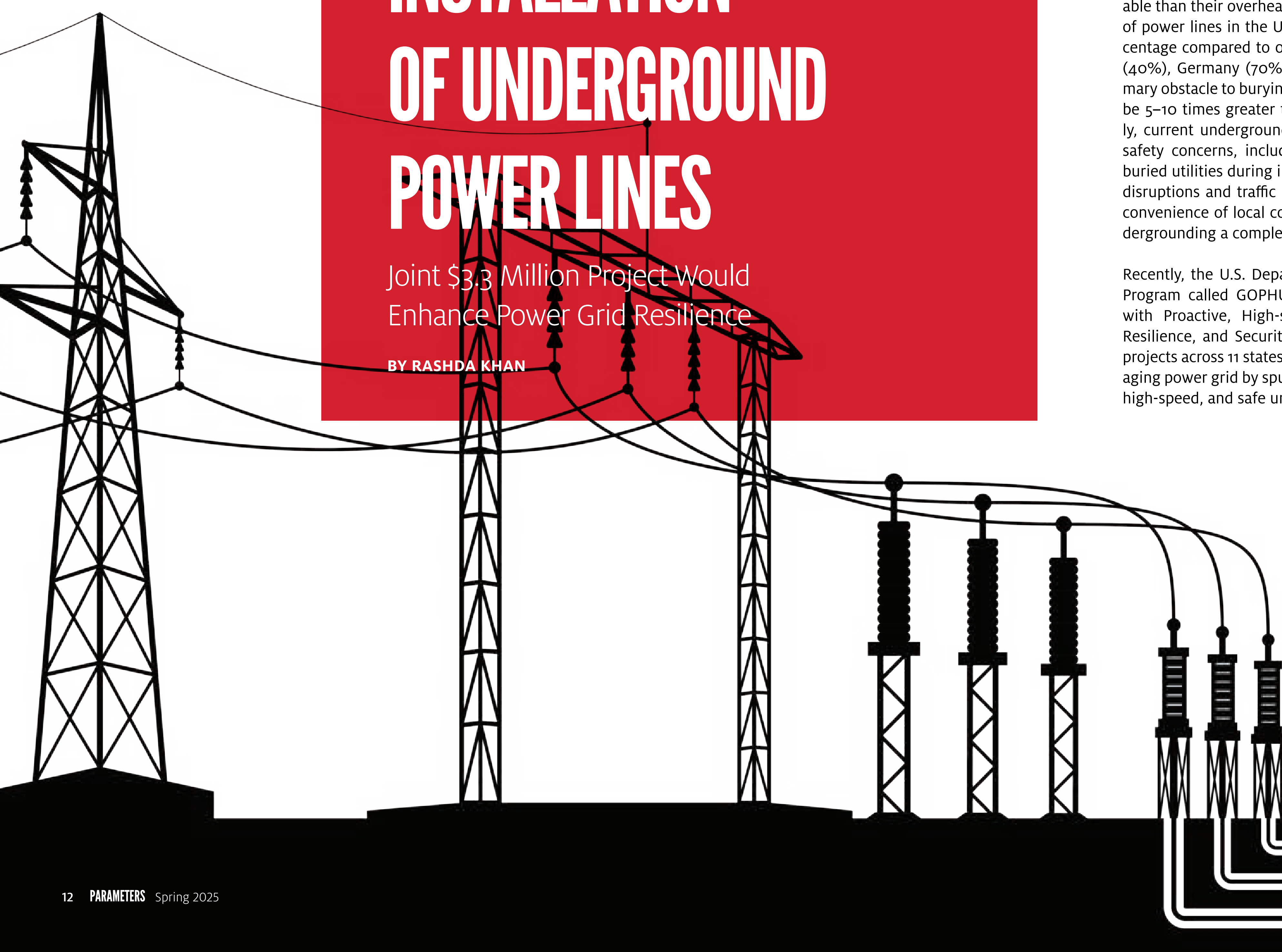
"It's not just for the sake of this specific project. This CAREER award places me, as a whole, into academia – not just as a scholar, thermodynamicist, but also as an educator: teaching undergraduate thermodynamics, teaching graduate statistical mechanics, having outreach programs to high school students to interest them in molecular motions… The monetary prize that comes with this award may not be the largest grant, but this award places me in academia as a teacher-scholar, which I think is unfortunately sometimes a bit overlooked.

"My identity as a scientist – who I actually am – is still a work in progress," Zerze concluded. "Finding the outline of who I actually am came with this proposal. The process itself really taught me a lot about myself. I'm forever thankful for that, and to this award for giving me an opportunity to frame who I want to be as a scholar, educator, and mentor."

UH TEAM WORKING TO IMPROVE INSTALLATION OF UNDERGROUND POWER LINES

Joint $3.3 Million Project Would Enhance Power Grid Resilience

BY RASHDA KHAN



When Hurricane Beryl hit Houston in July, it caused extensive damage to trees and utility poles, leaving over two million households without power. A week later, 250,000 Texans still faced the extreme summer heat without electricity or air conditioning, and at least three people tragically lost their lives due to heat exposure. This disaster spotlighted critical vulnerabilities in Houston's largely above-ground power grid, leading to much analysis.

One key reason Houston, and the U.S. in general, has a vulnerable power grid is the reliance on overhead power lines rather than underground ones. According to the Edison Electric Institute, underground power lines are 8–10 times more reliable than their overhead counterparts. However, less than 20% of power lines in the U.S. are buried, a significantly lower percentage compared to other developed nations, such as France (40%), Germany (70%), and the Netherlands (90%). The primary obstacle to burying power lines is the high cost, which can be 5–10 times greater than that of overhead lines. Additionally, current undergrounding methods, such as trenching, raise safety concerns, including the potential for damaging other buried utilities during installation, as well as prolonged surface disruptions and traffic detours that can impact the safety and convenience of local communities. These challenges make undergrounding a complex and costly undertaking.

Recently, the U.S. Department of Energy launched an ARPA-E Program called GOPHURRS, which stands for Grid Overhaul with Proactive, High-speed Undergrounding for Reliability, Resilience, and Security, and has allocated $34 million for 12 projects across 11 states to strengthen and modernize America's aging power grid by spurring the development of cost-effective, high-speed, and safe undergrounding technologies.

"Modernizing our nation's power grid is essential to building a clean energy future that lowers energy costs for working Americans and strengthens our national security," said U.S. Secretary of Energy Jennifer M. Granholm in a DOE press release.

One of the projects selected, awarded $3.3 million in funding, is the "Artificial Intelligence and Unmanned Aerial Vehicle Real-Time Advanced Look-Ahead Subsurface Sensor," which brings together the technological expertise of Hawaii-based Oceanit with the Tier-One research capabilities of the University of Houston.

The team is working to develop a state-of-the-art subsurface sensing system to guide safe and efficient underground power line installation. The aim is to create a real-time, high-resolution look-ahead sensing system using unmanned aerial vehicles, electromagnetic resistivity well logging, and machine learning. This technology will detect underground obstacles in front of a drill bit, minimizing damage to existing infrastructures and enabling a smoother installation process.

"Advanced subsurface sensing and characterization technologies are essential for the undergrounding of power lines," said **Jiefu Chen**, associate professor of electrical and computer engineering at UH who is a key collaborator on the project. "This initiative can enhance the grid's resilience against natural hazards such as wildfires and hurricanes."

The end goal is to produce a prototype capable of generating near real-time, high-resolution underground images during horizontal directional drilling or HDD.

On the UH team, Chen focuses on designing electromagnetic antennas installed on UAV and HDD drilling string, as well as optimization of the subsurface imaging system; **Yueqin Huang**, assistant professor of information science technology, leads the geophysical signal processing needed to construct precise subsurface images ahead of the drill bit, while **Xuqing Wu**, associate professor of computer information systems, integrates machine learning for faster modeling and real-time image generation.

"If proven successful, our proposed look-ahead subsurface sensing system could significantly reduce the costs of horizontal directional drilling for installing underground utilities," said Chen. "Promoting HDD offers environmental advantages over traditional trenching methods and enhances the power grid's resilience."

UNIVERSITY OF HOUSTON JOINS DOE'S NEW ENERGY INNOVATION HUB TO ADVANCE BATTERY TECHNOLOGY

Energy Storage Research Alliance Aims to Help the U.S. Achieve Clean and Secure Energy Future and Become Dominant in New Energy Storage Industries

BY RASHDA KHAN

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).

Progress in energy storage and batteries is crucial for a clean energy future. It would enhance grid reliability, optimize renewable energy usage, reduce emissions and support the growth of electric transportation and other clean energy technologies.

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."

This project is led by Argonne National Laboratory and co-led by Lawrence Berkeley National Laboratory and Pacific Northwest National Laboratory.

"The demand for high-performance, low-cost and sustainable energy storage devices is on the rise, especially those with potential to deeply decarbonize heavy-duty transportation and the electric grid," said Shirley Meng, ESRA director, chief scientist of the Argonne Collaborative Center for Energy Storage Science and professor at the Pritzker School of Molecular Engineering at The University of Chicago in the Argonne press release. "To achieve this, energy storage technology must reach levels of unprecedented performance, surpassing the capabilities of current lithium-ion technology. The key to making these transformative leaps lies in a robust research and development initiative firmly grounded in basic science."

Leveraging decades of national investment in basic sciences, ESRA seeks to enable transformative discoveries in materials chemistry, gain a fundamental understanding of electrochemical phenomena at the atomic scale and lay the scientific foundations for breakthroughs in energy storage technologies. The hub will focus on three interconnected scientific thrusts – liquids, soft matter and condensed matter phases – and how they work together.

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.

Pieremanuele Canepa, Robert A. Welch Assistant Professor of electrical and computer engineering at UH, will serve as co-PI. Both researchers will investigate phase transitions in multi-electron redox materials and conformable cathodes to enable solid-state batteries by marrying Yao's experimental lab work with Canepa's expertise in computational material science.

Joe Powell, founding director of the UH Energy Transition Institute and a professor in the Department of Chemical and Biomolecular Engineering, will create a community benefit plan and develop an energy equity course to teach students about energy equity and provide avenues for them to research energy equity issues.

"New energy infrastructure and systems can have benefits and burdens for communities," Powell said. "Understanding potential issues and partnering to develop best solutions is critical. We want everyone to be able to participate in the new energy economy and benefit from clean energy solutions."

He added that UH students will be conducting studies to identify gaps in energy equity, particularly concerning the societal impacts associated with new energy systems. Their research will explore opportunities such as job creation and emissions reduction, while also examining strategies to close these equity gaps.

Claudia Neuhauser, UH vice president for research, is proud of the UH researchers participating in the project.

"The partnership with Argonne National Lab to be a part of the DOE-funded Energy Storage Research Alliance is a testimony of our commitment to sustainable energy solutions and our strength in battery science," she said. "We look forward to this multi-institutional collaboration and to leveraging our investments in a battery manufacturing facility."

Collaboration among national laboratories and universities is crucial to discovering new materials, accelerating technology development and commercializing new energy storage technologies. The achievement of ESRA's goals will lead to high-energy batteries that should never catch fire, offer days of long-duration storage, have multiple decades of life and are made from inexpensive, abundant materials.

"To fuel innovation and cultivate a sustainable and equitable energy future, all universities, government entities, industry and community partners have to work together. No one person or entity can achieve all this by themselves," said **Ramanan Krishnamoorti**, Vice President for Energy and Innovation at UH. "As the Energy University and a Carnegie-designated Tier One research university, located in Houston — a center of diverse talent and experience from across the energy industry — UH has a unique advantage of continuing to build on Houston's global leadership and demonstrating solutions at scale."

The DOE will provide up to $62.5 million in ESRA funding over five years.

"Providing the scientific foundation to accelerate this important research is key to our economy and making sure the U.S. plays a lead role in transforming the way we store and use electricity," said Harriet Kung, DOE's Acting Director for the Office of Science. "Today's awards provide our Energy Innovation Hub teams with the tools and resources to solve some of the most challenging science problems that are limiting our ability to decarbonize transportation and incorporate clean energy into the electricity grid."

UH BRAIN CENTER TRAINS FUTURE REGULATORY SCIENTISTS IN SAFE HUMAN-DEVICE INTERACTION

FIRST-EVER REU SITE TO TRAIN FUTURE REGULATORY SCIENTISTS

BY LAURIE FICKMAN

A three-year National Science Foundation program is underway at the University of Houston's Industry-University Cooperative Research Center for Building Reliable Advances and Innovations in Neurotechnology Center. The Research Experiences for Undergraduates, or REU, site is focused on safe and effective human-device interaction to help an ailing body move again.

The REU site will prepare students for future careers in regulatory science and medical device development. Regulatory science is the science of developing new tools, standards, methods, and approaches to assess the safety, efficacy, quality and performance of FDA-regulated products.

It's the first REU site focused on regulatory science.

"The program will address best design and engineering practices, computing tools and new computational methods to support early-stage medical device development and their evaluation so that as a nation, we can keep up with the accelerated pace of technology development and innovation," said **Jose Contreras-Vidal**, REU site program director and faculty mentor and director of the UH IUCRC BRAIN Center.

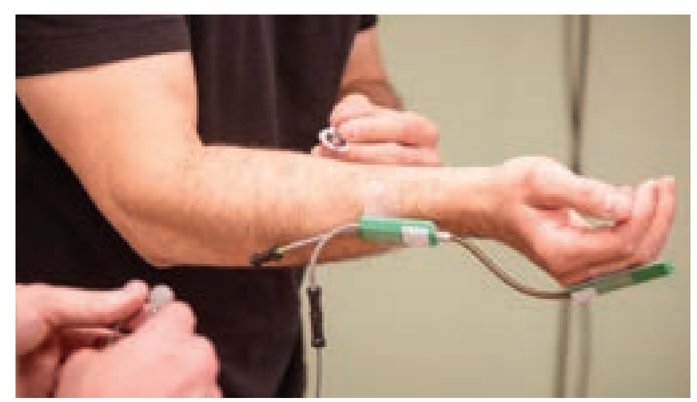
> *THE PROGRAM IS DESIGNED TO INSPIRE BRIGHT AND MOTIVATED UNDERGRADUATES TO PURSUE GRADUATE EDUCATION AND CAREERS IN SCIENCE AND ENGINEERING RESEARCH*
>
> – JOSE CONTRERASS-VIDAL

"The National Science Foundation's REU site program leadership is excited by the unique opportunity for program participants to work at both a research institution and a government agency (FDA) as part of the program," said Patricia Simmons, associate program director at the National Science Foundation.

Seven students will engage in the twelve-week program in Houston, Texas and in Silver Spring, Maryland. They will work closely with leading neural engineers and neuroscientists at the BRAIN Center and then work with FDA scientists at the Office of Science and Engineering Labs in the Center for Devices and Radiological Health on research that leads to development of regulatory science tools to support innovative medical device development and assessment. The tools will be focused on assessment methods for diagnostics, neural interfaces, medical robotics and other ongoing cutting-edge research in neural, cognitive and rehabilitation engineering.

"The program is designed to inspire bright and motivated undergraduates to pursue graduate education and careers in science and engineering research. Our objective is to develop a diverse, inclusive, and socially responsible workforce of young scientists, engineers and design professionals needed to address major gaps in the early-stage development of products and processes to fulfill healthcare needs of the U.S.," said Contreras-Vidal.

A pioneer of brain-related medical devices, Jose Contreras-Vidal, is the REU Site program director, faculty mentor and director of the UH IUCRC BRAIN Center.



The REU site at UH is focused on safe and effective human-device interaction.

In a previous REU camp held at UH, students learned the steps of early-stage medical device development.

NEXT-LEVEL BREAST RECONSTRUCTION AFTER CANCER

Collabortative team develops customs molds with $2.7M NIH grant

BY LAURIE FICKMAN

Professor **Fatima Merchant**, department chair of engineering technology at the University of Houston, is part of a multi-institutional research team designing patient-specific molds for breast cancer patients who undergo reconstructive surgery after cancer surgery.

The project, supported by a $2.7 million grant from the National Institutes of Health, is set to make breast reconstruction more efficient, promoting psychosocial adjustment to cancer survivorship and reducing time in care.

“Breast reconstruction can help women retain or regain quality of life by mitigating the impacts of body image disruption due to appearance changes arising from mastectomy,” said Merchant.

“While a few studies have demonstrated the feasibility of using patient-specific molds to shape tissue into a breast form, a critical barrier to progress in the field is that no one has rigorously evaluated their impact. In contrast, our study includes a randomized controlled clinical trial for evaluation,” Merchant said.

In the grim world of cancer statistics, 1-in-8 women in the United States will be diagnosed with breast cancer in her lifetime, and of those who have surgery, more than 40 percent will have additional breast reconstruction surgery.

During the commonly performed autologous reconstruction, the surgeon uses skin, fat, blood vessels and muscle from another part of the patient’s body to rebuild the breast. This method is widely recognized as effective, with long-term advantages over other techniques.

However, autologous reconstruction procedures are complex, lengthy operations requiring substantial skill and experience. Plus, a revision procedure is typically required to adequately restore the patient’s bodily form; in some cases, multiple revisions are needed.

The team will develop clinical decision-support algorithms for designing patient-specific breast molds for tissue shaping.

HERE’S HOW THE PROCESS WILL WORK:

In practice, the new algorithm-driven breast molds should reduce the cost of reconstruction and the pain and risk associated with reconstruction by reducing the number of procedures a patient undergoes.

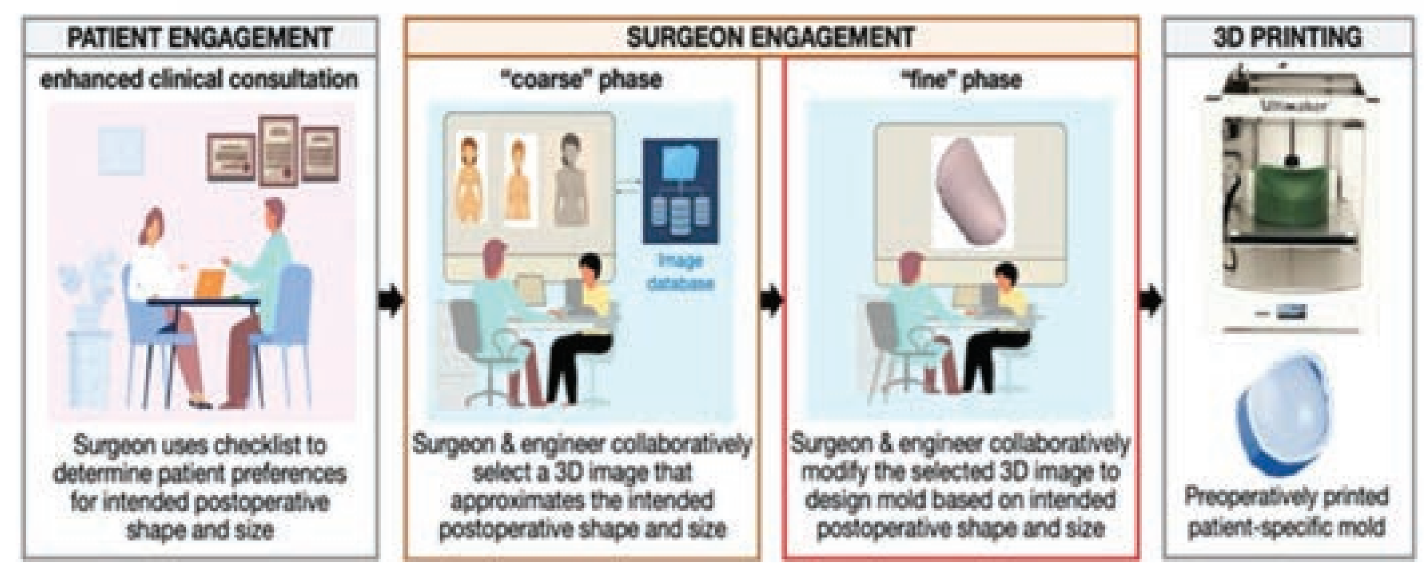
Prior work investigated simple molds that merely copied the preoperative shape and size of the patient's breasts, or a mirrored version of the contralateral breast in the case of unilateral breast reconstruction. But many patients desire or require a different breast form after mastectomy and so simply copying the preoperative breast form is inadequate.

Professor Fatima Merchant, department chair of engineering technology at the University of Houston, is part of a multi-institutional research team designing patient-specific molds for breast cancer patients who undergo reconstructive surgery after cancer surgery.

“Our approach in developing the clinical decision-support algorithms is informed by our experience in image perception, machine learning, image processing, and shape modeling, and conducting a thorough evaluation in a randomized controlled clinical trial,” said Merchant.

The research team includes multiple principal investigators, Ashleigh M. Francis at The University of Texas MD Anderson Cancer Center and Mia K. Markey at The University of Texas at Austin. The team is part of the Multidisciplinary Breast Reconstruction Research Program. Investigators at UT include Haoqi Wang, doctoral student in the Department of Biomedical Engineering, and the MD Anderson team includes Deepti Chopra, Z-Hye Lee, Christopher Parham, Gregory P. Reece, Margaret Roubaud, Mark Schaverien, and John Shuck.

Merchant is supported in this work by UH investigators, **Ann Chen**, research associate professor, HEALTH Research Institute, **Weihang Zhu**, professor, Department of Engineering Technology, and **Elizabeth Rodwell**, assistant professor, Department of Information Systems Technology.



1 in 8 US women who will be diagnosed with breast cancer in their lifetime, and of those who have surgery, more than 40% will have additional breast reconstruction surgery. Merchant's new algorithm will allow surgeons to print patient-specific reconstructive molds.

INDUSTRIAL ENGINEERING NOW INDUSTRIAL & SYSTEMS ENGINEERING AT CULLEN

BY STEPHEN GREENWELL

To reflect the expanded nature of the programs offered at the Cullen College of Engineering, the Industrial Engineering Department is now the Industrial & Systems Engineering Department.

The name change was approved by the Texas Higher Education Coordinating Board on February 3, 2025, effective immediately. The new name reflects the increased scope of industrial engineering that is being offered by Cullen in a world that increasingly relies on the engineering work of complex, integrated systems.

Gino J. Lim, Professor & R. Larry and Gerlene (Gerri) R. Snider Endowed Chair, cited the wide need for skilled professionals and increased visibility as reasons for the name change and the emphasis on Systems Engineering.

"The department introduced the B.S. degree in Systems Engineering to address the urgent demand for well-trained system engineers in the Greater Houston Area," he said. "This program also aims to enhance the expertise of a significant number of local industrial professionals, particularly in Oil & Gas and Healthcare, by equipping them with the confidence and skills required to lead complex engineering projects successfully."

Systems Engineering has been offered by the Industrial Engineering Department since 2020, as part of the College's development of the Katy campus. Lecturers **Neil Diaz Martinez** and **Nirathi Keerthi Govindu** are part of the program, which has produced notable student successes since its establishment, like **Jordyn Sibert**, a member of the 2023 cohort for the Department of Defense's SMART scholarship program. Sibert is also the 2024-25 Outstanding Senior for the Systems Engineering Department.

"Since its inception, enrollment in the Systems Engineering track has grown rapidly, with the first cohort of graduates set to enter the industry this summer," Lim said. "This track will further strengthen the ISE department by fostering innovative solutions and contributing to the development of a highly skilled workforce for our nation."

The new name of the department was already reflected in upcoming events, the first of which was the Industrial & Systems Engineering Awards Banquet on April 10. The keynote speaker for the event is Nancy J. Currie-Gregg ('97), Ph.D., Professor of Practice of Industrial & Systems Engineering and Aerospace Engineering, Director of the Texas A&M University Space Institute and a former NASA astronaut.

"SINCE ITS INCEPTION, ENROLLMENT IN THE SYSTEMS ENGINEERING TRACK HAS GROWN RAPIDLY, WITH THE FIRST COHORT OF GRADUATES SET TO ENTER THE INDUSTRY THIS SUMMER."

– GINO LIM

COLLEGE NEWS

NASA AWARDS UH $1.2 MILLION TO STRENGTHEN STEM AND AEROSPACE ENGINEERING

BY BRYAN LUHN

NASA is awarding the University of Houston $1.2 million to grow initiatives in STEM and aerospace-related engineering fields and address barriers to access and success for historically underserved and underrepresented students.

The award is for a project called the Partnership for Inclusivity in Engineering Education and Research for Space, also known as PIE 2RS, a synergistic collaboration between UH, UH-Clear Lake, NASA's Johnson Space Center, the Boeing Company and the Greater Houston Partnership.

"Our research, as well as the research of leading scholars, has highlighted the challenges underrepresented students face, including isolation, marginalization, racial bias and hostile educational environments," says **Jerrod A. Henderson**, assistant professor of chemical and biomolecular engineering at UH and the project's principal investigator.

"Our goal with PIE 2RS is to improve the recruitment and retention of students in aerospace-related STEM disciplines, increase their sense of belonging and broaden their participation through hands-on research and experiential learning opportunities."

Henderson says the PIE 2RS project will support students in four ways:

• Customized experiential learning through capstone projects, internships and research opportunities, including 10-week paid research experiences for 18 students each year.
• Fostering a sense of belonging by cultivating a supportive community and strong peer relationships.
• Monthly professional development workshops to build essential skills.
• Layered mentoring where older students mentor younger ones, enhancing their own sense of belonging.

Joining Henderson on the UH project team are co-PI **Karolos Grigoriadis**, the Hugh Roy and Lillie Cranz Cullen Endowed Professor and chair of the Mechanical and Aerospace Engineering Department, collaborator **Rick Greer**, and UH professors **Olga Bannova**, **Mariam Manuel** and **Tian Chen**.

"This award is a testament to the amazing work that is happening on our vibrant campus," Henderson says. "Our work will highlight UH as a leader in the emerging field of Engineering Education Research."

"The award also underscores our dedication to advancing aerospace engineering at UH," Grigoriadis says. "It reflects our ongoing commitment to expand research and education in aerospace while broadening opportunities for students to engage in this critical field."

KOLB'S EXPERIENTIAL LEARNING THEORY

Henderson's team will follow Kolb's Experiential Learning Theory, which is characterized by a four-stage cycle in which learners engage in different activities:
• concrete experience (feeling)
• reflective observation (watching)
• abstract conceptualization (thinking)
• active experimentation (doing)

"Learning as an integrated process occurs effectively when a learner engages in all four stages of the cycle," Henderson says. "Ultimately, participants will engage in experiential learning that simultaneously requires them to dismantle non-inclusive notions of knowledge that permeate learning systems."

UH is one of six institutions receiving awards from NASA totaling $7.2 million. The others are Alabama A&M University, Morgan State University, North Carolina A&T University, University of Central Florida and the University of Colorado – Denver.

"NASA is excited to award funding to six minority-serving institutions, paving the way for greater diversity in engineering and STEM," said Shahra Lambert, NASA senior advisor for engagement and equity, NASA's Headquarters in Washington.

NASA's Minority University Research and Education Project, in partnership with the National Science Foundation's Nation of Communities of Learners of Underrepresented Discoverers in Engineering and Science network, provides support engineering and offers academic resources to college students in order to make a long-term impact on the engineering field.

"With these awards, we are continuing to create pathways that increase access and opportunities in STEM for underrepresented and underserved groups," said Keya Briscoe, MUREP manager. "NASA continues to invest in initiatives that are critical in driving innovation, fostering inclusion, and providing access to the STEM ecosystem for everyone."

EMPOWERING UNDERSERVED COMMUNITIES: NEW GRANTS FUEL STEM EDUCATION EQUITY IN HOUSTON

Initiatives Support STEM Access for Underrepresented Youth and Postdoctoral researchers

BY LAURIE FICKMAN

Two new grants from the National Science Foundation to the Cullen College of Engineering are set to break down barriers that prevent low-income and underrepresented students from pursuing STEM education, helping to build a more diverse and supportive learning environment for everyone. Both projects — one addressing postdoctoral researchers preparing for engineering/STEM education careers and one supporting youngsters — will build upon the community partnership between UH and Houston's Third Ward neighborhood.

POSTDOCTORAL SUPPORT

"Literature has shown that postdocs have experienced discrimination, harassment, job insecurity, and gaps remain in understanding how to best support postdocs, especially those underrepresented/underserved in STEM careers," said **Jerrod A. Henderson**, assistant professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, who is leading the two projects.

"While research training and publication have traditionally been the standard for STEM research training programs, these experiences, especially for postdoctoral fellows, often lack structured and formal community support. Because many postdocs transition into positions that involve teaching, communication and mentoring, effective education in these areas should be the standard."

The $1.2 million grant from the NSF will support a new evidence-based postdoc training program for a cohort of three STEM education postdoctoral fellows at the University of Houston and will leverage existing collaborations between the project team and partners in Houston's underserved communities, particularly within the Historic Third Ward. "The PI team and community partners will mentor postdocs and co-create knowledge through collaborative inquiry," said Henderson.>>

The project hopes to foster a robust STEM education research community, broaden participation, and build a community of support. Co-investigators on this project include **April Peters-Hawkins**, professor in the UH College of Education, **Mariam Manuel**, clinical assistant professor of teachHouston, and **David Horton, Jr.**, research assistant professor of Chemical Engineering. Building upon their prior work, the team will advance research in the newly minted Engineering Education Certificate Program at UH.

SUPPORTING YOUNGSTERS TOO

A $1.9 million collaborative grant from the NSF will support a new research focus for the St. Elmo Brady STEM Academy founded by Henderson and **Rick Greer**, a K-12 education specialist and program director in the Cullen College of Engineering. The academy brings together underrepresented youth to expose, engage, and empower them to become the next generation of scientists, engineers, and mathematicians.

This grant will support the academy's engineering learning environment, which is grounded in the Framework for P12 engineering learning, and the project research, which will be led by Henderson, Greer, Horton Jr. and Christopher Wright of Drexel University.

"The intervention seeks to help re-envision how engineering looks, who leads it, and whose ways of knowing are valued. At the same time, the research will explore how aspects of this informal engineering environment support the engineering identities of participating youth and their families," said Henderson.

"Our team at the St. Elmo Brady STEM Academy is dedicated to bridging the gap for those who are often marginalized, offering opportunities through mentorship and transformative informal learning environments. It is this deep sense of purpose that drives the team to create a space where every individual can thrive," said Greer.

The academy promotes informal STEM learning through developing an engineering literate society which can recognize and appreciate the influence of engineering on society.

Other researchers have highlighted that informal programs are shown to be ideal for counteracting challenges by supplementing students' formal learning experiences and identities. For example, informal learning environments provide opportunities for students to engage with STEM concepts with smaller group sizes and greater instructional flexibility and give students more agency to discover and explore questions that appeal to them in a lower stake setting compared to traditional classroom," said Henderson.

Special attention will be paid to 4th and 5th-grade students and families in Houston's Second and Third Ward neighborhoods in Houston who are historically underrepresented and underserved when it comes to engineering education, thus broadening participation.

"The project stands to impact over 200 students and hundreds of family and community members through our annual community engineering fair," said Greer.

CHBE FACULTY SEEK TO SUPPORT TALENTED LOW-INCOME STUDENTS, BUILD INTERCOLLEGIATE CONSORTIUM WITH NSF GRANT

BY ALEX KEIMIG

Two faculty from the William A. Brookshire Department of Chemical and Biomolecular Engineering – assistant professor **Jerrod A. Henderson**, Ph.D., and lecturer **Hasan Zerze**, Ph.D. – have been awarded a share of a $100,000 planning grant from the National Science Foundation (NSF) Scholarships in Science, Technology, Engineering, and Mathematics program (S-STEM).

The collaborative project, "Building a Chemical Engineering Inter-Institutional Consortium to Support Talented, Low-income Students," runs through 2025 and will also involve the University of Kentucky and Prairie View A&M University.

S-STEM "supports institutions of higher education to fund scholarships for academically talented low-income students and to study and implement a program of activities that support their recruitment, retention and graduation in STEM" to "enable low-income students with academic ability, talent or potential to pursue successful careers in promising STEM fields."

"Our aim is to build a consortium among the University of Houston, Prairie View A&M, and the University of Kentucky in an effort to support engineering students who face financial barriers and challenges pertaining to engineering identity development," said Zerze. "Our aim to mitigate the impact of financial stress on students' academic success and overall well-being is driven by the recognition that financial difficulties can significantly hinder educational outcomes.

"Data shows that financial stress is closely linked to decreased academic performance and mental health challenges. By addressing these issues, the consortium can play a pivotal role in empowering academically promising students who might otherwise be discouraged by financial burden."

Henderson connected with University of Kentucky PI Sarah Wilson, Ph.D., and Prairie View A&M PI Keisha Antoine, Ph.D., at the American Institute of Chemical Engineers' Chemical Engineering Faculty Summer School held at the Colorado School of Mines in 2022. Henderson describes the chemical engineering community as "tight-knit", connected by "strong support for student success, belonging, and wellness."

"The potential benefits of the trio collaboration are centered on not working in silos and understanding how to support students more broadly," he added. "We hope to learn through this planning grant that engages institution types – Historically Black Colleges and Universities (HBCU), Hispanic-Serving Institutions (HSI), and Predominantly White Institutions (PWI) – ways that we can better support highly gifted chemical engineering students who may have high financial need."

"We want to build institutionalized supports that will exist and be supported after the duration of the grant," Henderson continued. "From this planning grant, we also hope to apply for a large-scale S-STEM grant to provide student scholarships. We anticipate that what we learn will be transferable to other disciplines and will be published so that researchers from other disciplines might start with our work as a foundation."

Though some existing intervention approaches, such as financial support, mentorship programs, and networking opportunities may provide an initial plan of approach, Zerze emphasizes that these are only a starting point, and that investigators "are primarily relying on the insights from student groups to guide [the] shaping [of] services that address their specific needs."

"So often we develop services and supports for students but do not consider or center their voices," added Henderson. "This planning grant boldly foregrounds student-driven ideas and solutions."

OLD STEREOTYPES OF ONLINE GAMING

UPENDED BY NEW REPORT FROM THE UNIVERSITY OF HOUSTON

BY LAURIE FICKMAN

Maybe the naysayers and detractors of online gaming and its ill effects on youth need to stand down. That's what science is telling us in a new report in the journal *Human Resource Development International* from **Melika Shirmohammadi**, assistant professor at the UH Cullen College of Engineering Division of Technology.

The article reports that — contrary to popular belief — massive multiplayer online gamers learn by gaming and their skills in the workplace are enriched by those seemingly endless hours previously thought of as frittering away time.

"Online gaming often gets a bad reputation, but our study reveals a different story. We found that gaming can actually help people develop valuable workplace skills," reports Shirmohammadi. "These skills include problem-solving, teamwork, leadership, and even self-confidence. Our research shows that gaming, when done in moderation, can be a way for people to grow both personally and professionally."

GAMING TRUTHS

Whether they know it or not, companies are already hiring an enormous amount of multiplayer online gamers. The math on this is simple. Millions of people play "massively multiplayer online" or MMO games, in which they play together in a virtual world. The top three games - World of Warcraft, Destiny 2, and Final Fantasy - claim 150.6 M, 49.7 M, and 60.3 M total players respectively.

"The purpose of the present study was to examine hobby – an understudied but prevalent part of the nonwork domain – to understand if and how MMO gaming positively enriches employees' work domain," said Shirmohammadi.

Shirmohammadi's team conducted a qualitative study among 23 employed MMO gamers who had an average of 20 years of video gaming experience and had played MMO games for at least 10 years.

> **FAILURE DOESN'T MEAN THE GAME IS OVER, IT MEANS TRY AGAIN WITH EXPERIENCE.**
>
> – MELIKA SHIRMOHAMMADI

The MMO games examined (including World of Warcraft, EVE Online and Final Fantasy XIV) require players to coordinate tasks to achieve collective goals, respect team norms (e.g., arriving on time for missions), collaborate with others as part of a team, and avoid reckless or uncalculated behaviors that would jeopardize the mission.

GAME MORE, WORRY LESS

Among the positive outcomes of the research, gamers reported viewing work as solvable puzzles, and their experience resulted in improved patience in encountering problems and encouraged them to persevere in solving them.

One participant, an engineer, said: "I just see a puzzle and I'm motivated to solve it. So, it's affected, I guess, my mindset in that way, such that I look at things as solvable."

Other players say they developed self-confidence through game playing because they feel good about the level of success in the online gaming world. Still others reported developing self-awareness as they received feedback on their own skills and how they played alongside team members.

Gamers' ability with coaching skills – such as evaluating performance, providing feedback, giving instructions and inspiring others – was also traced to their gaming. Several participants mentioned the similarities between gaming and work that made such skills transferrable.

An IT specialist, described it this way: "I deal with a lot of new people [at work]. Since I kind of go out of my way in game to do all the coaching, I've become ahead of some of colleagues in explaining how to do certain things [to new employees]."

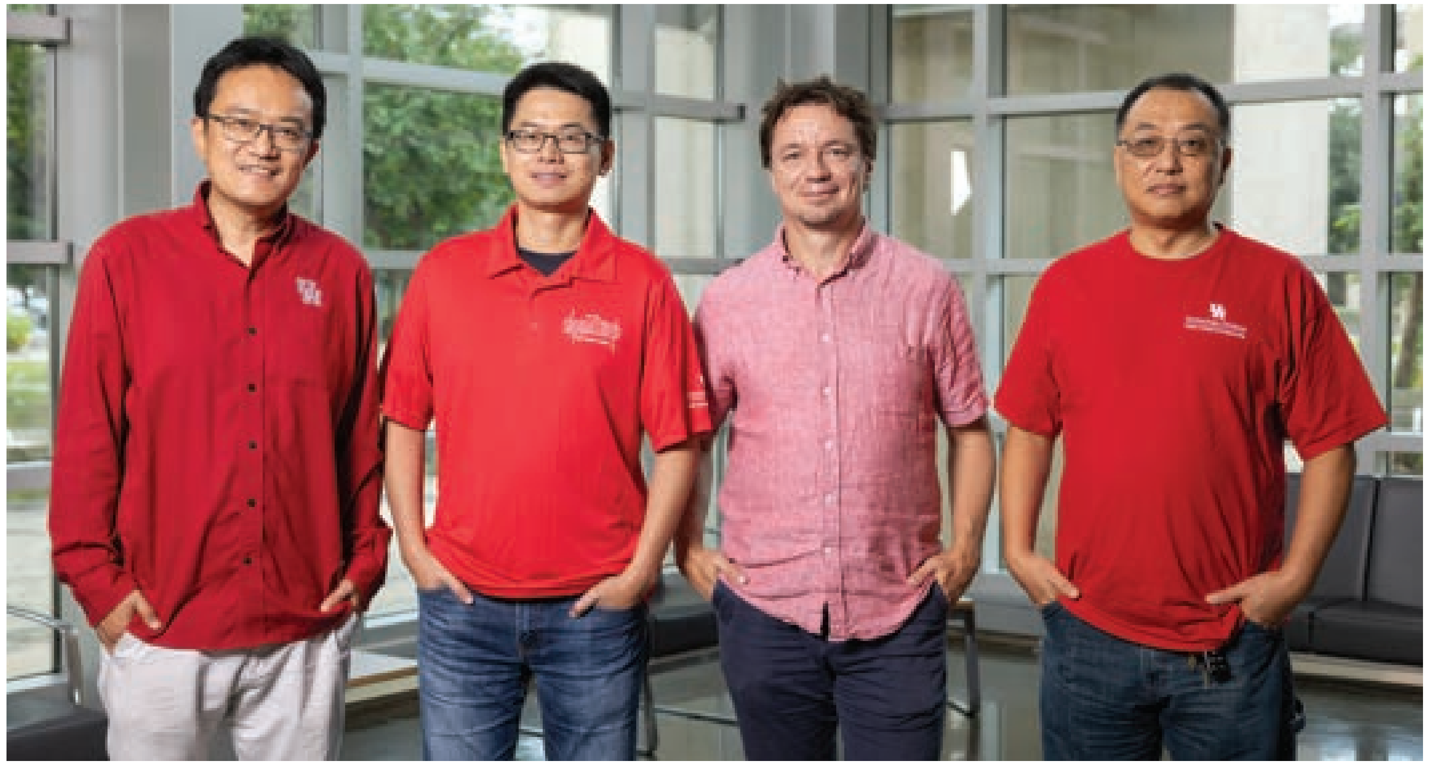
"Failure doesn't mean the game is over, it means try again with experience."

GAMING FOR THE GOOD

"Our study extends the understanding of nonwork-to-work enrichment to the MMO gaming context and reveals how a hobby, as an understudied subdomain of life, could benefit work," said Shirmohammadi.

BOOSTING CLEAN ENERGY WITH **AI-POWERED** CATALYSTS AND MICROWAVE PLASMA TECHNOLOGIES

BY RASHDA KHAN



From left to right: Xiaonan Shan,, Jiefu Chen, Lars Grabow, and Xuquing Wu.

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.

An interdisciplinary team of scientists is collaborating to find a workable solution by harnessing the power of artificial intelligence and microwave plasma, and blending knowledge from chemistry, materials science and engineering.

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

This 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."

PROJECT DETAILS

Discovering materials for new catalytic processes is a slow and challenging task, requiring expertise in various disciplines such as robotics, AI, material science, synthesis, testing and modeling. The researchers plan to assemble a robotic synthesis and testing facility while simultaneously programming the AI model for unsupervised learning.

Automating the experimental testing and verification process with robotic facilities will make the catalyst design process much more efficient by closely integrating theory and experiments through advanced, unsupervised machine learning techniques, according Shan and Wu.

> "THIS INTERDISCIPLINARY EFFORT ENSURES COMPREHENSIVE AND INNOVATIVE SOLUTIONS TO COMPLEX PROBLEMS"
>
> –JIEFU CHEN

THE PROJECT HAS FOUR MAJOR RESEARCH THRUSTS:

1. Machine learning driven catalyst discovery for plasma assisted chemical reactions: The team will use a graph neural network model trained on the Open Catalyst Project dataset to discover promising materials for plasma-assisted catalytic reactions.

2. Multiscale and multiphysics microwave-plasma simulation: New methods will be developed to model and simulate complex interactions involving electromagnetics, plasma physics and thermodynamics at various scales, including studies of micro-plasma heating with different catalysts to better understand the microwave-plasma assisted heating phenomena.

3. Design, synthesize and characterization of the catalyst support material and architecture: The researchers will optimize catalyst supports for efficient microwave-assisted reactions, such as pyrolysis and steam reforming, and to improve methane conversion by controlling micro-plasma efficiency. The goal is to facilitate micro-plasma generation and improve energy conversion efficiency.

4. Bench scale demonstration of efficient reactions using the micro-plasma catalyst system: The researchers will establish a bench scale reactor to further demonstrate the efficiency of the designed and optimized catalyst support system.

Another important component is establishing a multidisciplinary research and education program involving machine learning, computational catalysis, applied electromagnetics and material synthesis and advanced characterization. It will serve to educate and train the next generation STEM workforce.

"This project will help create a knowledgeable and skilled workforce capable of addressing critical challenges in the clean energy transition," Grabow said. "Moreover, this interdisciplinary project is going to be transformative in that it advances insights and knowledge that will lead to tangible economic impact in the not-too-far future."

He said the team is open to partnering with industry on related projects and further development during and after the project.

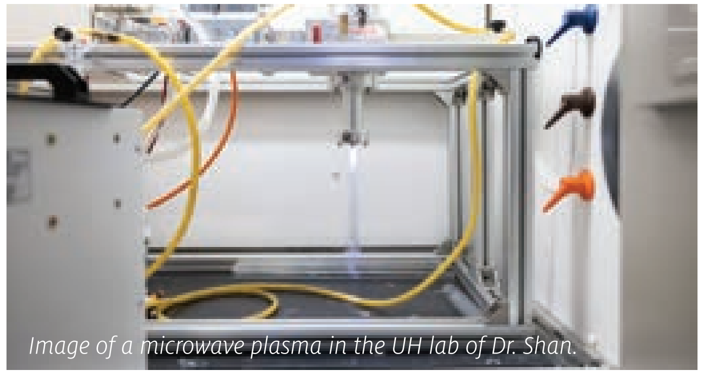


Image of a microwave plasma in the UH lab of Dr. Shan.

MAE'S AGRAWAL EXPLORING NEW GEOMETRIC DESIGN WITH VARIED ENGINEERING APPLICATIONS

BY ALEX KEIMIG

Associate professor of mechanical and aerospace engineering Ashutosh Agrawal, Ph.D., is putting a newly-awarded $334,569 grant from the National Science Foundation toward the study of "Mechanics of Optimal Biomimetic Torene Plates and Shells with Ultra-High Genus".

Torenes are unique structures that resemble the nuclear envelope of a eukaryotic cell and have the potential to scale up into "lightweight shell structures for extreme mechanical environments."

Ordinary shell structures – rounded structural components with few to no joins – are an elegant solution to support large loads with relatively thin, lightweight construction in almost any size. Common man-made examples include bicycle helmets, airplane fuselages, and the Sydney Opera House.

Agrawal, however, believes that the torene shell structure may be an innovative solution for redesigning or reinforcing the shell structures we currently know and rely on.

So dubbed by Agrawal because they comprise "concentric shell layers fused via torus-shaped holes", torenes are a "novel geometric strategy" that exhibit one to two orders of magnitude greater flexural stiffness than corresponding solid cylinders and solid domes. These torene shell structures "could provide novel ways to design lightweight structures across length scales for countering extreme mechanical loads."

"Our findings are length-scale and materials-properties independent, and therefore suggest that the torene architecture could be used to design lightweight shell structures for extreme environments in diverse set-ups," Agrawal explained.

"In civil and mechanical engineering, structures called I-beams are routinely used in high-rise structures and bridges as they offer high flexural rigidity. We realized that Nature is using a 2D analog of this concept in the architecture of the nucleus to safeguard the genome. Subsequently, we thought of using this geometry in man-made plate and shell materials."

"The applicability is very diverse because it's a general principle. It's not tied to any one material or particular type of structure. That means that this idea can be incorporated into a huge range of structures: aerospace structures, transport structures, defense structures, sports engineering, biomedical engineering..."

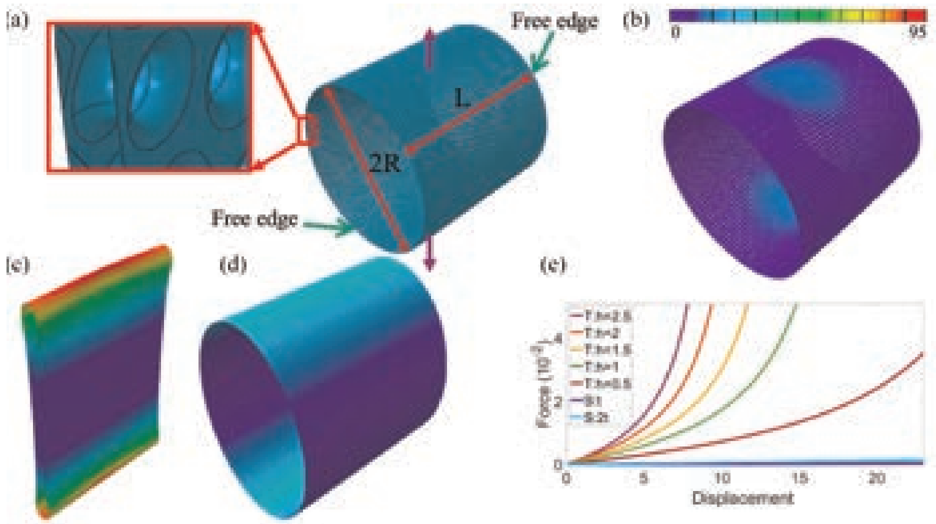
One area Agrawal is particularly interested in is the exploration of prosthetic and orthotic design.

"Those are shell structures as well," he said. "So we can now come up with lighter and stronger designs that will mitigate wear and tear experienced by the users."

The project is a collaboration with Princeton University, who will assist in the topological optimization – a mathematical method of optimizing material distribution for a given application – of the design.

"This is a whole new class of structures which has the potential to turn into its own subfield," Agrawal said. We are hoping that people will see the benefit and use it for a wide range of diverse applications."

Funding for the project runs through 2026.



Cylinder subjected to tensile point loads

IMPROVING EYE TRACKING TO ASSESS BRAIN DISORDERS

New Eye Sensors Use Special Material That Generates Electricity When It Bends

BY LAURIE FICKMAN

A University of Houston engineering team has developed wearable sensors to examine eye movement to assess brain disorders or damage to the brain. Many brain diseases and problems show up as eye symptoms, often before other symptoms appear.

You see, eyes are not merely a window into the soul, as poets would have it. These incredibly precious organs are also an extension of the brain and can provide early warning signs of brain-related disorders and information on what causes them. Examining the eyes can also help track the progression and symptoms of physical and mental shocks to the brain.

Researchers say current eye-tracking systems have flaws and deliver insufficient amounts of data. Plus, they're bulky, with multiple electrodes on the face and neck, expensive and have weak outputs.

AND IN THE BLINK OF AN EYE... IMPROVEMENT.

New wearable sensors, developed by UH engineers, examine eye movement to assess brain disorders or damage to the brain.

The sleek new eye sensors improve on the older models which are bulky and require multiple electrodes on the face and neck.

The new method, developed in the UH lab of **Jae-Hyun Ryou**, associate professor of mechanical engineering, with assistance from **Nam-In Kim**, post-doctoral researcher, is non-invasive, comfortably wearable, and safe, enabling easy and continuous measurements and monitoring of eyeball movements when combined with a hand-held display and computing device.

The new sensors are sleek and flexible, made from very thin, crystal-like film that generates electricity when it bends or moves. That's a phenomenon called the piezoelectricity effect, and it allows certain materials to generate an electric charge in response to applied mechanical stress.

The output voltages from upper, mid, and lower sensors, or transducers, on different temple areas generate discernable patterns of voltage.

"Skin-attachable wearable sensors for monitoring vital signs and biomedical parameters are components of great importance in personal healthcare and portable diagnostic systems," reports Ryou in Advanced Healthcare Materials.

"Among them, thin-film piezoelectric sensors offer unique advantages of easy fabrication at low cost, a wide range of available sizes, lightweight, excellent mechanical flexibility and stability, rapid reaction rate, high sensitivity, high signal-to-noise ratio and excellent long-term stability and durability."

"The new sensors are easy to wear and can be used in brain-eye relationship studies to evaluate the brain's functional integrity," he said.

INTENSE FOCUS ON DISEASE

Ophthalmological assessments of eye blinking patterns have been used for early diagnosis of disorders such as stroke, multiple sclerosis, Parkinson's disease and Alzheimer's disease. Also, ocular movements are strongly linked to various brain disorders, as eyeball and upper eyelid controls are affected by brain function.

In former studies, aberrant blink rate and blink modulation was measured in children with attention-deficit hyperactivity disorder with the spontaneous blink being a measure of the integrity of the dopaminergic system in the brain. Motor neurons in the brain, which relate to eyes and their muscle, have also been associated with autism.

"We believe that the F-PEMSA can be employed in many clinical studies concerning brain disorder conditions such as ADHD, autism, Alzheimer's disease and Parkinson's disease as well as the aftermath of traumatic brain injuries like post-concussion syndrome and post-traumatic stress disorder, potentially offering the prospect of early and accurate diagnoses and the development of personalized therapies," said Ryou.

LIFE FROM A DROP OF RAIN: NEW RESEARCH SUGGESTS RAINWATER HELPED FORM THE FIRST PROTOCELL WALLS

A Nobel-Winning Biologist, Two Engineering Schools, and a Vial of Houston Rainwater Cast New Light on the Origin of Life on Earth

One of the major unanswered questions about the origin of life is how droplets of RNA floating around the primordial soup turned into the membrane-protected packets of life we call cells.

A new paper by engineers from the University of Houston's William A. Brookshire Department of Chemical Engineering (UH ChBE) and the University of Chicago's Pritzker School of Molecular Engineering (UChicago PME), and biologists from the UChicago Chemistry Department have proposed a solution.

In the paper published today in Science Advances, UH ChBE's former graduate student **Aman Agrawal** (now a postdoctoral researcher at UChicago PME) and his co-authors – including UH ChBE's **Alamgir Karim**, UChicago PME Dean Emeritus Matthew Tirrell and Nobel Prize-winning biologist Jack Szostak – show how rainwater could have helped create a meshy wall around protocells 3.8 billion years ago, a critical step in the transition from tiny beads of RNA to every bacterium, plant, animal, and human that ever lived.

"While it is impossible to know the exact conditions on early Earth, our experiments show that this pathway for stabilizing protocells might have been a critical step in enabling evolution in these protocells," said Karim. Karim is UH Dow Chair and Welch Foundation Professor of chemical and biomolecular engineering, and director of both the International Polymer & Soft Matter Center and the Materials Engineering Program at UH.

"This is a game-changing discovery in the context of pre-biotic life," Karim said.

University of Houston Prof. Alamgir Karim, Dow Chair and Welch Foundation Professor of chemical and biomolecular engineering, first suggested rain as a possible source of distilled water that would have existed in the era when protocells first formed. The investigator of the new research trained under Karim while at the University of Houston.

Chicago Pritzker School of Molecular Engineering postdoctoral researcher Aman Agrawal discusses his coacervate droplet research with Nobel Prize laureate Jack Szostak of the Chicago Center for the Origins of Life. Agrawal began his research at the University of Houston, initially unaware of its possible implications for life's early formation. (UChicago Pritzker School of Molecular Engineering / John Zich)

The research looks at "coacervate droplets" – naturally occurring compartments of complex molecules like proteins, lipids, and RNA. The droplets, which behave like drops of cooking oil in water, have long been eyed as a candidate for the first protocells. But there was a problem. It wasn't that these droplets couldn't exchange molecules between each other, a key step in evolution, the problem was that they did it too well, and too fast.

Any droplet containing a new, potentially useful pre-life mutation of RNA would exchange this RNA with the other RNA droplets within minutes, meaning they would quickly all be the same. There would be no differentiation and no competition – meaning no evolution.

Aman Agrawal

And that means no life.

"If molecules continually exchange between droplets or between cells, then all the cells after a short while will look alike, and there will be no evolution because you are ending up with identical clones," Agrawal said.

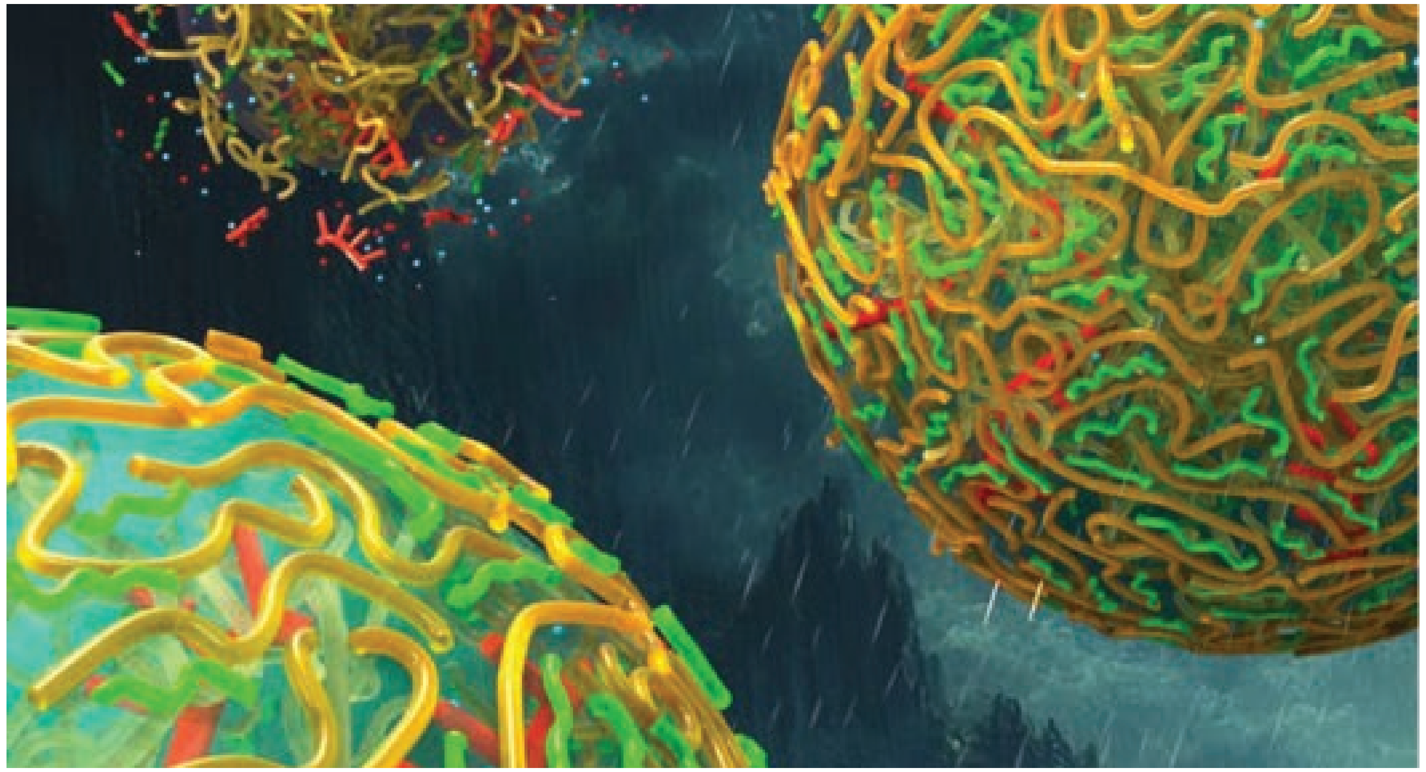
ENGINEERING A SOLUTION

Life is by nature interdisciplinary, so Szostak, the director of UChicago's Chicago Center for the Origins of Life, said it was natural to collaborate with both UChicago PME, UChicago's interdisciplinary school of molecular engineering, and the chemical engineering department at the University of Houston.

"Engineers have been studying the physical chemistry of these types of complexes – and polymer chemistry more generally – for a long time. It makes sense that there's expertise in the engineering school," Szostak said. "When we're looking at something like the origin of life, it's so complicated and there are so many parts that we need people to get involved who have any kind of relevant experience."

In the early 2000s, Szostak started looking at RNA as the first biological material to develop. It solved a problem that had long stymied researchers looking at DNA or proteins as the earliest molecules of life.

"It's like a chicken-egg problem. What came first?" Agrawal said. "DNA is the molecule which encodes information, but it cannot do any function. Proteins are the molecules which perform functions, but they don't encode any heritable information." >>



Graphic enlargement of rainwater that could have helped create a meshy wall around protocells 3.8 billion years ago, a critical step in the transition from tiny beads of RNA to every bacterium, plant, animal, and human that ever lived. (UChicago Pritzker School of Molecular Engineering / Peter Allen, Second Bay Studios)

Researchers like Szostak theorized that RNA came first, "taking care of everything" in Agrawal's words, with proteins and DNA slowly evolving from it.

"RNA is a molecule which, like DNA, can encode information, but it also folds like proteins so that it can perform functions such as catalysis as well," Agrawal said.

RNA was a likely candidate for the first biological material. Coacervate droplets were likely candidates for the first protocells. Coacervate droplets containing early forms of RNA seemed a natural next step.

That is until Szostak poured cold water on this theory, publishing a paper in 2014 showing that RNA in coacervate droplets exchanged too rapidly.

"You can make all kinds of droplets of different types of coacervates, but they don't maintain their separate identity. They tend to exchange their RNA content too rapidly. That's been a long-standing problem," Szostak said. "What we showed in this new paper is that you can overcome at least part of that problem by transferring these coacervate droplets into distilled water – for example, rainwater or freshwater of any type – and they get a sort of tough skin around the droplets that restricts them from exchanging RNA content."

'A SPONTANEOUS COMBUSTION OF IDEAS'

Agrawal started transferring coacervate droplets into distilled water during his PhD research at the University of Houston, studying their behavior under an electric field. At this point, the research had nothing to do with the origin of life, just studying the fascinating material from an engineering perspective.

"Engineers, particularly Chemical and Materials, have good knowledge of how to manipulate material properties such as interfacial tension, role of charged polymers, salt, pH control, etc.," said University of Houston Prof. Alamgir Karim, Agrawal's former thesis advisor and a senior co-author of the new paper. "These are all key aspects of the world popularly known as 'complex fluids' - think shampoo and liquid soap."

> **WHEN WE'RE LOOKING AT SOMETHING LIKE THE ORIGIN OF LIFE, IT'S SO COMPLICATED AND THERE ARE SO MANY PARTS THAT WE NEED PEOPLE TO GET INVOLVED WHO HAVE ANY KIND OF RELEVANT EXPERIENCE**
>
> –JACK SZOSTAK

Agrawal wanted to study other fundamental properties of coacervates during his PhD. It wasn't Karim's area of study, but Karim had worked decades earlier at the University of Minnesota under one of the world's top experts – Tirrell, who later became founding dean of the UChicago Pritzker School of Molecular Engineering.

During a lunch with Agrawal and Karim, Tirrell brought up how the research into the effects of distilled water on coacervate droplets might relate to the origin of life on Earth. Tirrell asked where distilled water would have existed 3.8 billion years ago.
"I spontaneously said 'rainwater!' His eyes lit up and he was very excited at the suggestion," Karim said. "So, you can say it was a spontaneous combustion of ideas or ideation!"

Tirrell brought Agrawal's distilled water research to Szostak, who had recently joined the University of Chicago to lead what was then called the Origins of Life Initiative. He posed the same question he had asked Karim.

"I said to him, 'Where do you think distilled water could come from in a prebiotic world?'" Tirrell recalled. "And Jack said exactly what I hoped he would say, which was rain."

Working with RNA samples from Szostak, Agrawal found that transferring coacervate droplets into distilled water increased the time scale of RNA exchange – from mere minutes to several days. This was long enough for mutation, competition, and evolution.

"If you have protocell populations that are unstable, they will exchange their genetic material with each other and become clones. There is no possibility of Darwinian evolution," Agrawal said. "But if they stabilize against exchange so that they store their genetic information well enough, at least for several days so that the mutations can happen in their genetic sequences, then a population can evolve."

RAIN, CHECKED

Initially, Agrawal experimented with deionized water, which is purified under lab conditions. "This prompted the reviewers of the journal who then asked what would happen if the prebiotic rainwater was very acidic," he said.

Commercial lab water is free from all contaminants, has no salt, and lives with a neutral pH perfectly balanced between base and acid. In short, it's about as far from real-world conditions as a material can get. They needed to work with a material more like actual rain.

What's more like rain than rain?

"We simply collected water from rain in Houston and tested the stability of our droplets in it, just to make sure what we are reporting is accurate," Agrawal said. Agrawal and fellow UH graduate student Anusha Vonteddu grabbed a couple of beakers from Karim's lab to collect some rainwater just outside the Agrawal Engineering Research Building during a downpour.

"Agrawal and Vonteddu, with their rain samples in beakers, set out to prove our major hypothesis that rainwater could have stabilized the protocells on early Earth," said Karim.

In tests with the actual rainwater and with lab water modified to mimic the acidity of rainwater, they found the same results. The meshy walls formed, creating the conditions that could have led to life.

"This is a game-changing discovery in the context of pre-biotic life," Karim said.

The chemical composition of the rain falling over Houston in the 2020s is not the rain that would have fallen 750 million years after the Earth formed, and the same can be said for the model protocell system Agrawal tested. The new paper proves that this approach of building a meshy wall around protocells is possible and can work together to compartmentalize the molecules of life, putting researchers closer than ever to finding the right set of chemical and environmental conditions that allow protocells to evolve.

"The molecules we used to build these protocells are just models until more suitable molecules can be found as substitutes," Agrawal said. "While the chemistry would be a little bit different, the physics will remain the same."

Aman Agrawal discusses his coacervate droplet research with Nobel Prize laureate Jack Szostak of the Chicago Center for the Origins of Life.

Story courtesy of the University of Chicago's Pritzker School of Molecular Engineering and edited by the University of Houston's Media Relations Department.

ECE PH.D. STUDENT CHEN

Makes Battery Breakthrough, Authors Cover Article In Advanced Energy Materials

BY ALEX KEIMIG

Cullen College of Engineering Ph.D. student **Zhaoyang Chen's** research article, "Manipulating Hardness to Construct Favorable Electrode Microstructures for All-Solid-State Batteries," was not only published in the highly-respected, peer-reviewed journal *Advanced Energy Materials* this November, but it also earned a spot on the issue's cover.

This research builds on work initiated in 2021 in the lab of **Yan Yao**, Hugh Roy and Lillie Cranz Cullen Distinguished Professor in the Department of Electrical and Computer Engineering.

With their first related paper, published in 2019, Yao's group reported on the use of organic materials in solid-state sodium batteries. Then, in 2021, they published another paper — second-authored by Chen — investigating the composite cathode, which combined the use of safer, more efficient solid electrolytes and organic electrode materials.

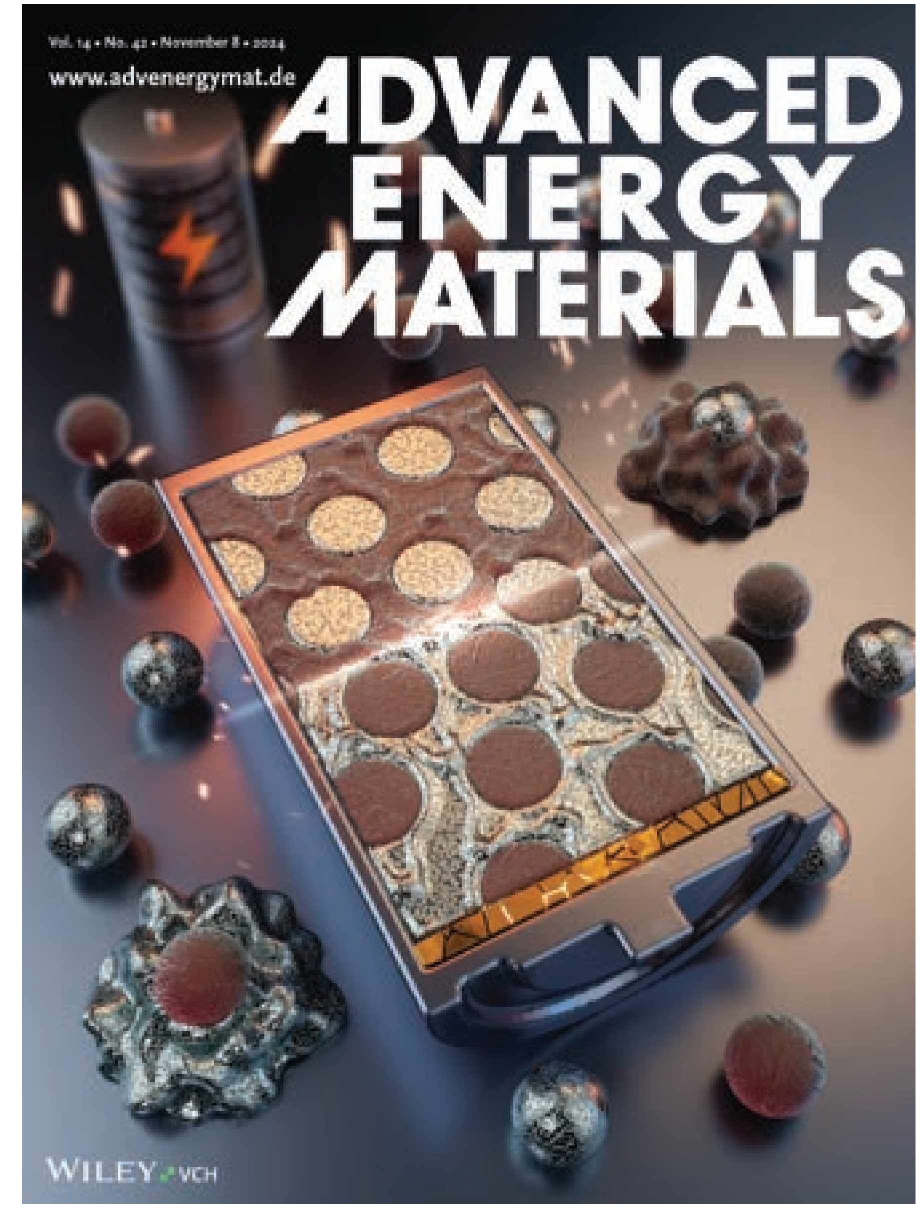
"We started this work back in 2021," Chen said. "In our first paper, we focused on the microstructure in the organic composite electrode, and observed we could reverse the microstructure, but we didn't fully understand why. In this work, we figured out that the main reason is due to the mismatched mechanical properties of the two components — the organic compound and the solid electrolyte — and we identified a better way to control microstructure."

Their newest article demonstrates an innovative methodology, according to Chen and Yao, to address the issue of microstructure optimization in all-solid-state batteries.

"With our cover," Chen added, "we want to show the differences in microstructure. The key concept is reducing the hardness of the solid electrolyte to make it softer than the organic compounds. This inversion of mechanical properties reverses the unfavorable microstructure, improving electrochemical performance."

The cover art features a shiny, silver-colored metal of the harder solid electrolyte alongside a wavy, brown "chocolate" texture for the softer organic materials. The boundary line between them represents how Chen's method reverses the microstructure into a more favorable arrangement.

Inorganic materials, which are mechanically harder than solid electrolyte, facilitate the desired ionic percolation but rely on costly and supply chain limited metals used for cathode. In contrast, organic materials composed of abundant elements such as carbon, nitrogen and oxygen are mechanically softer but struggle to achieve sufficient ionic percolation when compacted with solid electrolytes.



Chen and Yao developed a novel solvent treatment method to address this issue. By treating solid sulfide electrolytes and combining them with PTO (an organic compound), the method inverts the hardness relationship. This results in a favorable microstructure that mimics the ionic percolation efficiency of inorganic materials while maintaining the benefits of organic compounds. This process represents the culmination of years of research work by Chen, Yao, and their colleagues, including ECE research assistant professor and LiBeyond CTO Yanliang Liang, Ph.D.

"These changes result in the formation of favorable microstructure, improving material utilization and performance," Yao said. "We also show that this hardness manipulation strategy is not limited to this specific organic material; it can also be applied to other soft cathode material, like sulfur, for solid-state batteries. This work opens a new direction for understanding and controlling battery microstructure."

The new method sets the stage for a variety of successes for advancing the energy density and safety of batteries. Benefits of all-solid-state batteries include reduced fire risk and increased safety compared to liquid-state batteries, reduced dependence on rare earth materials, greener and cost-saving opportunities by centering abundant organic materials in production, and increased performance in terms of charge time, charge capacity, and general usage improvements.

"Our group pioneered the conformal organic cathode for solid-state batteries, and we're excited to collaborate with other leading experts in the Energy Storage Research Alliance," Yao added. "Over the next five years, we aim to uncover new redox-active organic materials and reaction mechanisms."

Chen echoed this enthusiasm, sharing her plan to remain in Yao's research group as a postdoctoral researcher to continue advancing this innovative work.

THE HUMANS BEHIND THE AI

The potential of artificial intelligence, with the raw computing power and quick content generation it provides, has been alluring and transformational to many fields of everyday life already. However, it is equally apparent that without human guidance and editing at the helm, the output doesn't meet the rigorous standards needed to be valuable for research.

While AI has swelled and become omnipresent in the consciousness of the general public, the researchers at the Cullen College of Engineering have responsibly been using this technology for several years. Like any scientific tool, AI can generate junk data or even outright dangerous conclusions in the wrong hands. But as these stories illustrate, with the proper oversight AI is capable of supercharging diverse fields of research, whether that is cancer clusters, earthquake seismology or pandemic spread.

University of Houston Engineers Unveil AI Model for Predicting,

CONTROLLING PANDEMIC SPREAD

BY LAURIE FICKMAN

RESEARCHERS FIND REDUCING INTERNATIONAL FLIGHTS IN WESTERN EUROPE RESULTS IN FEWER GLOBAL COVID-19 CASES

A team of engineers at the University of Houston has published a study in the journal Nature on how international air travel has influenced the spread of COVID-19 around the world.By using a newly developed AI tool, the team identified hotspots of infection linked to air traffic, pinpointing key areas that significantly contribute to disease transmission.

The analyses identified Western Europe, the Middle East and North America as leading regions in fueling the pandemic due to the high volume of outgoing international flights either originating or transiting through these areas.

“Our work provides a robust deep learning-based tool to study global pandemics and is of key relevance to policymakers for making informed decisions regarding air traffic restrictions during future outbreaks,” said **Hien Van Nguyen**, lead researcher and associate professor of electrical and computer engineering at UH.

THE TOOLS

Nguyen and team developed a computer program, called Dynamic Weighted GraphSAGE, that helps analyze big networks of constantly changing data, like flight schedules, to see patterns and trends.

“It looks at spatiotemporal graphs, or how things are linked across both space (different locations) and time to better understand how this affects things like the spread of diseases or transportation patterns,” said Nguyen.

To understand how air travel affects the spread of infections, Van Nguyen and graduate students Akash Awasthi and Syed Rizvi tested small changes in their model (perturbation analysis) to see how sensitive it is to different factors and examined flight connections between different regions and countries.

This helped them analyze which parts of air traffic have the biggest impact on the spread of the virus and which flight reductions in highly sensitivity areas would efficiently reduce predicted global cases.

THE STRATEGIES

“We propose air traffic reduction strategies that can significantly impact controlling the pandemic with minimal disruption to human mobility,” said Nguyen. “Policies including stringent reduction in the number of Western European flights are predicted to cause larger reductions in global COVID-19 cases.
This work represents a novel usage of perturbation analysis on spatiotemporal graph neural networks to gain insight on pandemic forecasting,” he said.

Although the findings stem from the COVID-19 context, the insights gained are generalizable to any pandemic, said Nguyen.

Additional researchers on the project are from the Houston Methodist Research Institute.

"CODA: Temporal Domain Generalization via Concept Drift Simulator"

BY IE'S ZOU WINS BEST PAPER COMPETITION

BY ALEX KEIMIG

The work of assistant professor of industrial engineering **Dr. Na Zou** was recently recognized with the Best Paper Award in a competition associated with the 2024 Institute for Operations Research and the Management Sciences (INFORMS) Conference on Quality, Statistics, and Reliability (ICQSR) — described by Zou as "a major research community."

The paper, *CODA: Temporal Domain Generalization via Concept Drift Simulator,* was co-authored by Zou and her research partners at Rice University and Texas A&M University: Chia-Yuan Chang, Yu-Neng Chuang, Zhimeng Jiang, Kwei-Herng Lai, and Anxiao Jiang. Funding for the project came from an NSF award earlier this year; the total $1.2 million award is split across the three collaborating institutions.

"In real-world applications, machine learning models often become obsolete due to shifts in the joint distribution arising from underlying temporal trends, a phenomenon known as the 'temporal concept drift'," assert Zou et al. in the paper's abstract.

With machine learning currently at the forefront of innumerable innovative efforts, investigating solutions for issues such as concept drift is critical work.

"We're addressing a data challenge related to the quality of the data used to train a model. We propose a [new] method from a data-centric perspective," said Zou.

This method is the COncept Drift simulAtor (CODA) framework: a way to simulate future data with potential changes that machine learning models may face before they actually face them.

"Previously, most existing work relied on model-centric methods; that is, applying different models to a fixed data set to enhance prediction. Since the temporal distribution shifts arise from data, we incorporate the temporal trends in a simulator to generate out-of- distribution future data. The generated data can be used to train various models for improving generalization."

Zou uses a real-world example to illustrate what makes this research so important, not to mention practical:

"For example, consider the task of using Twitter data to predict seasonal flu trends. Over time, the number of active users on Twitter is increasing, new friendships are formed, and user profiles evolve, all of which can significantly affect the model performance for future flu prediction using models trained on the initial data. But this future data, such as new users and friendships for the next year, is not yet available and cannot be accessed now. Instead of training new flu prediction models after collecting Twitter data next year, our proposed method can simulate the future Twitter data via capturing the temporal trends. The simulated Twitter data can be used to train various models, leading to more accurate flu prediction for the upcoming year."

Compared to model-centric modeling, a data-centric approach is critical because it addresses underlying data quality and distribution issues and can significantly enhance model performance and generalization, leading to more reliable, robust and effective solutions for real-world applications.

Dr. Na Zou

AI Drives Development of

CANCER FIGHTING SOFTWARE

BY LAURIE FICKMAN

$2.5 MILLION FAST-TRACK GRANT TO DEVELOP ANALYSIS OF SINGLE CELLS

University of Houston researchers and their students are developing a new software technology, based on artificial intelligence, for advancing cell-based immunotherapy to treat cancer and other diseases.

CellChorus Inc., a spinoff from the University of Houston, is commercializing the UH-developed Time-lapse Imaging Microscopy In Nanowell Grids™ platform for dynamic single-cell analysis with label-free analysis. Now they've received a $2.5 million grant from the National Center for Advancing Translational Sciences of the National Institutes of Health to fast-track the development of an advanced "label-free" version of this technology in partnership with the University of Houston.

Badri Roysam, Hugh Roy and Lillie Cranz Cullen University Professor of Electrical and Computer Engineering at the University of Houston, is collaborating with **Navin Varadarajan** on the project. Varadarjan is an M.D. Anderson Professor, Chemical and Biomolecular Engineering also at UH and co-founder of CellChorus.

Badri Roysam

"This is an opportunity to leverage artificial intelligence methods for advancing the life sciences," Roysam said. "We are especially excited about its applications to advancing cell-based immunotherapy to treat cancer and other diseases."

TIMING™ is a specialized tool for studying single cells over time. Because it is a video-array-based technology, it observes cell interactions and produces tens of thousands of videos. Analyzing these massive video arrays requires automated computer vision systems.

"By combining AI, microscale manufacturing, and advanced microscopy, the label-free TIMING platform will yield deep insight into cellular behaviors that directly impact human disease and new classes of therapeutics," said Rebecca Berdeaux, chief scientific officer at CellChorus and co-Principal Investigator on the grant. "The generous support of NCATS enables our development of computational tools that will ultimately integrate single-cell dynamic functional analysis of cell behavior with intracellular signaling events."

The goal of the grant, a Small Business Technology Transfer Fast-Track award, is to quantify the behavior of cells without the need to fluorescently stain them. Label-free analysis, or analysis without fluorescent dyes, allows scientists to watch cells in their natural state and gather important information about their movement, interactions and changes. It will also allow them to use selective fluorescent staining to observe new molecules of interest. This is useful in studying diseases like cancer or how cells react to treatments.

The label-free analysis is enabled by new artificial intelligence and machine learning models trained on tens of millions of images of cells and will be optimized for fast, high-throughput single-cell analysis by customers.

This grant is under Award Number 1R42TR005299. The content of this release is solely the responsibility of the authors and does not necessarily represent the official views of the National Institutes of Health.

This still from a sample TIMING video shows T cells interacting with tumor cells leading to killing. Scale bar = 20 microns.

C-ViSER Sees the Future of AI

IN STRUCTURAL ENGINEERING

BY ALEX KEIMIG

CAN ARTIFICIAL INTELLIGENCE TRANSFORM THE PRACTICE OF STRUCTURAL ENGINEERING?

Imagine a future where structural engineers not only rely on their own knowledge and experience, computational tools, or evaluation equipment, but also utilize powerful AI assistants to significantly boost their productivity. This vision is becoming a reality through a groundbreaking collaboration between the University of Houston and Purdue University, supported by the National Science Foundation (NSF).

The newly planned Center for Visual Structural Expertise for Resilience (C-ViSER) aims to develop and equip engineers with cutting-edge AI and machine learning tools, transforming traditional workflows. This center is an Industry-University Cooperative Research Center (IUCRC) — a partnership structure designed to generate breakthrough research by enabling close and sustained engagement between industry innovators, world-class academic teams and government agencies.

The new center spans two sites: Purdue University and the University of Houston. A University of Houston workshop scheduled for October 21-22 of this year will disseminate the goals of the center, including fostering the new partnerships between industry and academia mentioned above, and will engage prospective center members in discussions around C-ViSER's focus, value propositions and potential research projects to develop a research roadmap that aligns with the needs and interests of industry.

"My team at UH and I have been developing deep learning, computer vision, and artificial intelligence solutions for varied structural engineering problems over the past decade," said Director of the Structures and Artificial Intelligence Lab **Vedhus Hoskere**, assistant professor of civil and environmental engineering (CEE) and electrical and computer engineering (ECE).

Hoskere currently leads projects with the Texas Department of Transportation on developing digital twins of bridges and the U.S. Navy for improving structural inspections, and leads research on Large Language Models as part of the university's recent Department of Defense contract to revolutionize U.S. Army decision-making.

Now, he is looking to bring these technologies to the structural engineering industry through C-ViSER.

Structural engineers draw on centuries of experience captured in detailed documents like codes and specifications to create designs, develop drawings, capture photos, and produce reports that guide construction and maintenance decisions.

"By using AI to tap into insights from past projects, our goal with the Center is to help engineers realize efficiencies that ultimately result in more sustainable, cost-effective, and resilient construction and maintenance of civil infrastructure," said Hoskere.

Deepank Kumar Singh, a civil engineering Ph.D. student under Hoskere's advisement and a member of the C-ViSER team, also works on a project sponsored by the NASA Commercial SmallSat Data Acquisition (CSDA) Program to assess buildings in the aftermath of disasters.

"In a recently published paper, we introduced a state-of-the-art semi-supervised Transformer model trained on vast amounts of unlabeled data to categorize buildings into one of five damage states automatically," Singh said.

This past summer, Singh was able to apply his unique skills during an internship at a structural engineering firm, experiencing firsthand the impact that AI can have on real-world challenges in structural engineering. "During my internship, I developed 2 tools that utilize similar AI models: a project search tool and a report generation tool specifically for building fire inspection."

Muhammad Taseer Ali is another Ph.D. student advised by Hoskere and working towards realizing the Center, enrolled at UH after 10 years of experience as a structural engineer designer in industry.

"I have directly encountered the challenges that hinder efficiency in structural engineering and design processes," Ali said. "This experience drives my strong interest in developing novel solutions that streamline these processes."

"Another major goal the center is to mentor our students to be leaders at the forefront of technology and help them directly work on pressing industry-relevant problems. The center will provide students opportunities for networking and building relationships with companies interested in their work," said Hoskere.

Other UH collaborators include **Roberto Ballarini**, Thomas and Laura Hsu Professor and Chair of the Department of Civil and Environmental Engineering, and **Craig Glennie**, Hugh Roy and Lillie Cranz Cullen Distinguished Chair and director of the National Center for Airborne Laser Mapping. Glennie also leads the project team funded by UH's $63.5 million U.S. Department of Defense Contract to help modernize U.S. Army decision-making.

Hoskere (center) discusses the applications of AI for design and evaluation of structures with PhD students Taseer Ali (left) and Deepank Kumar Singh (right).

New Deep Learning Method

AUTOMATES ANTARCTIC GLACIER GROUNDING LINE MAPPING

BY ALEX KEIMIG

University of Houston researchers have validated a method that uses deep learning to automate the mapping of glacier grounding lines in Antarctica. This innovative approach could greatly enhance the accuracy and efficiency of tracking glacier retreat, a critical indicator of sea-level rise.

The study, led by Ph.D. student **Natalya Ross** from the Department of Civil and Environmental Engineering and co-authored by Pietro Milillo, assistant professor of Civil and Environmental Engineering, was recently published in the high-impact journal Remote Sensing of Environment.

Grounding lines mark the transition point between the grounded and floating sections of glaciers, and their precise identification is crucial for understanding glacier behavior and the potential impacts of ice loss on global sea levels.

Traditionally, this mapping has relied on labor-intensive manual analysis of satellite data. However, as the volume of available data continues to increase, there is an urgent need for automated methods.

"We developed a deep learning model that outperforms existing techniques by automating the detection of grounding lines using X-band radar data," Ross said. "This method will allow us to analyze vast datasets more quickly and accurately, helping us understand how Antarctic glaciers are evolving."

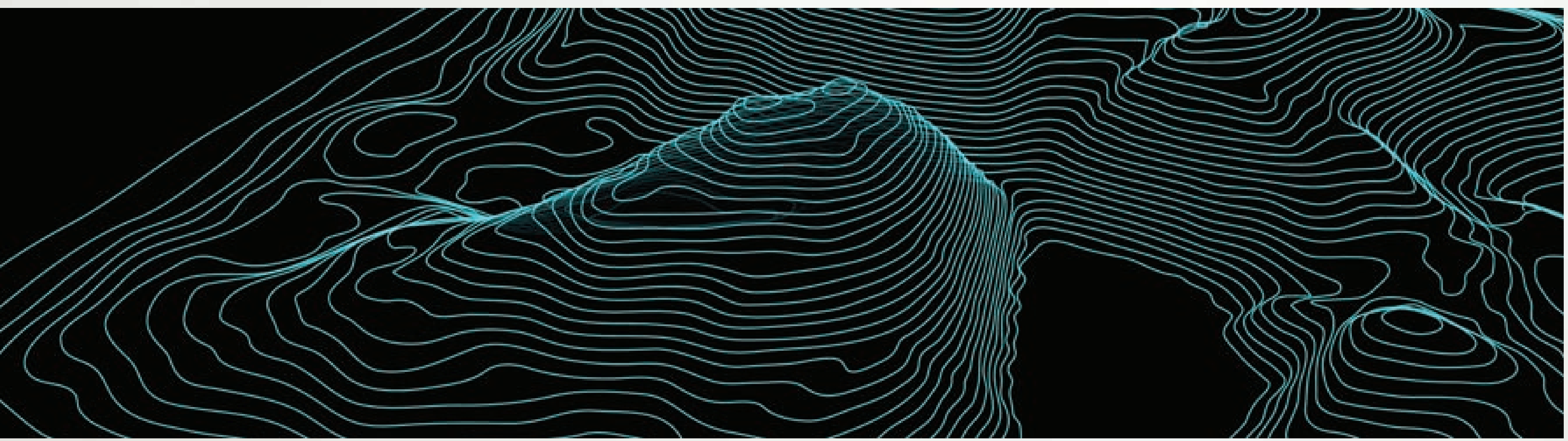
The research team tested their method on five key glaciers in Antarctica, including the Moscow University Glacier, which has shown significant retreat in recent decades. The findings revealed that the glacier's grounding line has been retreating at a rate of 340 meters per year since 1996, while other glaciers in the study showed no signs of retreat.

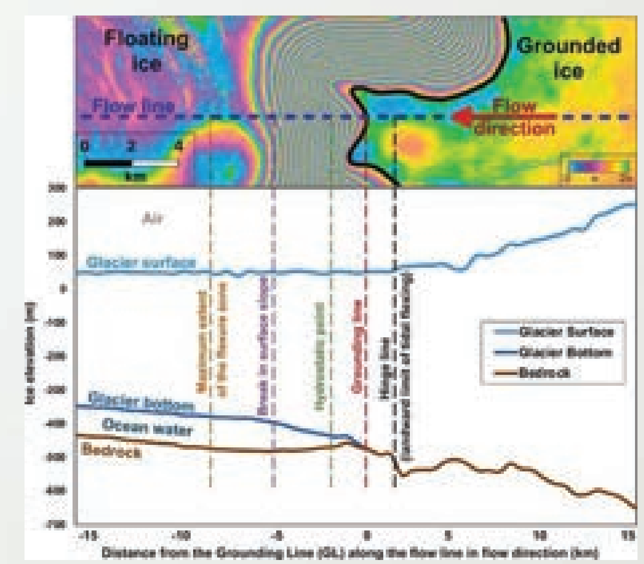
"This research underscores the importance of monitoring grounding lines, especially as we anticipate accelerated ice loss due to climate change," Milillo said. "The ability to automate this process means we can keep pace with the growing volume of satellite data, ensuring timely analysis and response."

The study, developed in collaboration with Luigi Dini at the Italian Space Agency through an international agreement, provided critical insights into the complex behavior of grounding zones, which fluctuate with tides. The findings also emphasized the need for continued technological advancements in satellite data analysis.

This research is supported by the NASA Cryosphere Program and the Italian Space Agency's COSMO-SkyMed mission, which supplied the high-resolution radar data used in the study. For more information about this research and its implications for glacier monitoring, visit the University of HoustonGeosensing Lab.

Press release by staff in the lab of Pietro Milillo, with editing by the Communications Department of the Cullen College of Engineering.

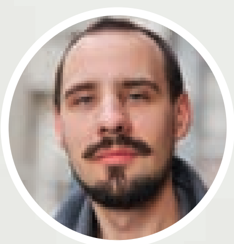




The team used advanced satellite imaging to visualize the glacier's surface and the bedrock beneath it.

Ph.D. student Voelker leads in transforming

REMOTE SENSING-BASED EARTHQUAKE ASSESSMENT PROCEDURES



A doctoral candidate from the University of Houston's Department of Civil and Environmental Engineering has co-authored a transformative study that redefines approaches to assessing earthquake damage using cutting-edge remote sensing technologies.

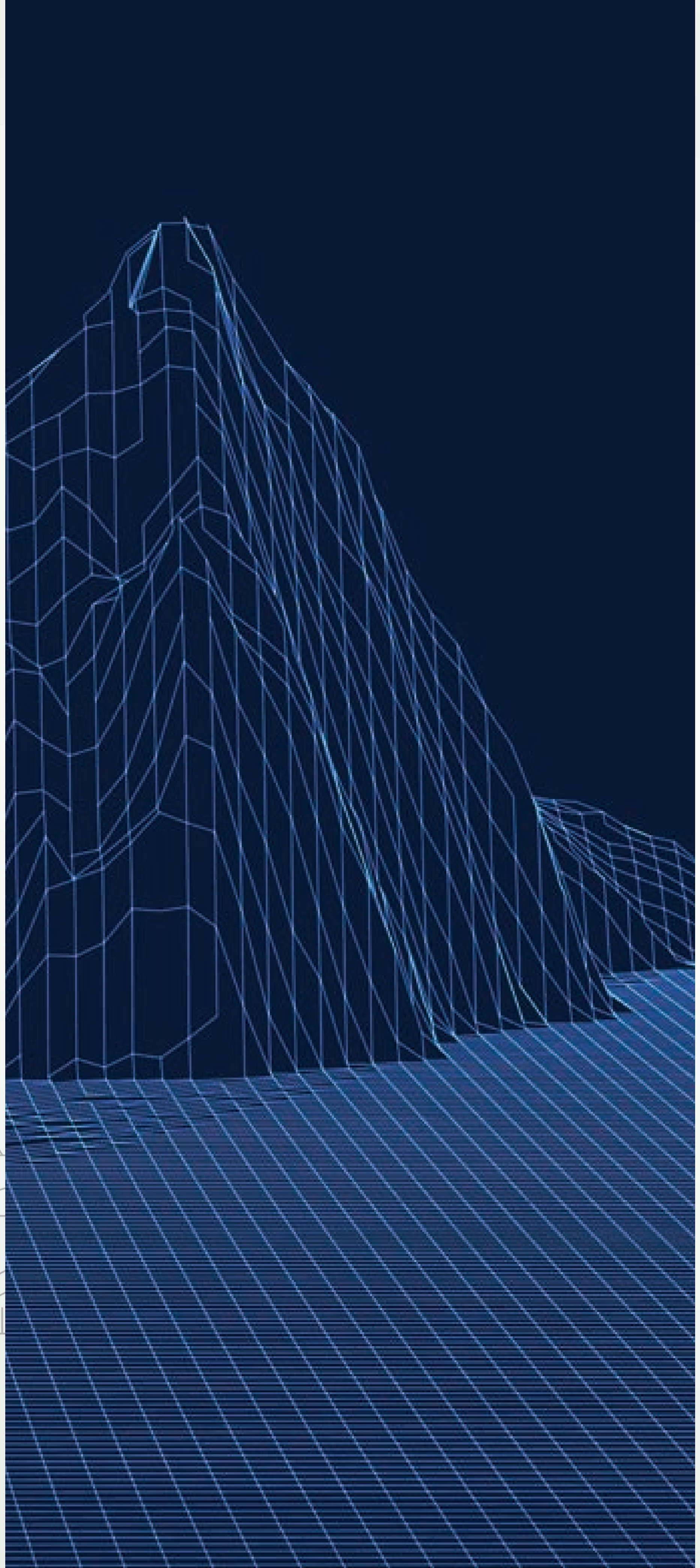
The findings, now featured in the IEEE *Journal of Selected Topics in Applied Earth Observations and Remote Sensing*, offer valuable perspectives for enhancing disaster response strategies in the wake of the 2023 Turkey-Syria earthquakes.

Brandon Voelker, working closely with his advisor, **Pietro Milillo**, Ph.D., Assistant Professor of Civil and Environmental Engineering at UH, led the Earthquake Engineering Field Investigation Team's (EEFIT) mission remote sensing team. The research utilized Synthetic Aperture Radar (SAR) and high-resolution optical imaging to map the structural damage across the earthquake-impacted regions of southeastern Turkey, providing a rapid, large-scale view of the destruction.

The February 2023 earthquakes wreaked havoc, claiming thousands of lives and devastating infrastructure across the region. Voelker's work underscores the crucial role of remote sensing in facilitating swift damage assessments – a vital component for directing emergency relief and planning recovery efforts.

By evaluating a range of damage mapping methodologies, the study sheds light on disparities in data accuracy, underscoring the importance of harmonized validation practices.

"Integrating satellite data with direct field observations is a game-changer for disaster response," Voelker said. "It enables teams on the ground to zero in on the most affected areas, ensuring their efforts are both efficient and effective."



a) A building in Antakya, Turkey waſ rated aſ having "very heavy damage" during a ſurvey in March 2024, which meanſ it waſ ſeriouſly affected.

(b) A satellite image shows the same building. The building's outline is marked in red on this image. However, despite its severe condition, currently adopted AI algorithms assessed it as having no visible damage.

In collaboration with an international consortium of researchers, the study harnessed satellite data from the European Space Agency and processed by the NASA's Jet Propulsion Laboratory and the German Aerospace Center, among other sources. The team employed a hybrid approach, blending remote sensing insights with ground-based data to produce detailed, actionable damage maps. These maps proved invaluable for directing field surveyors to a variety of sites, capturing a nuanced picture of the region's resilience and structural challenges.

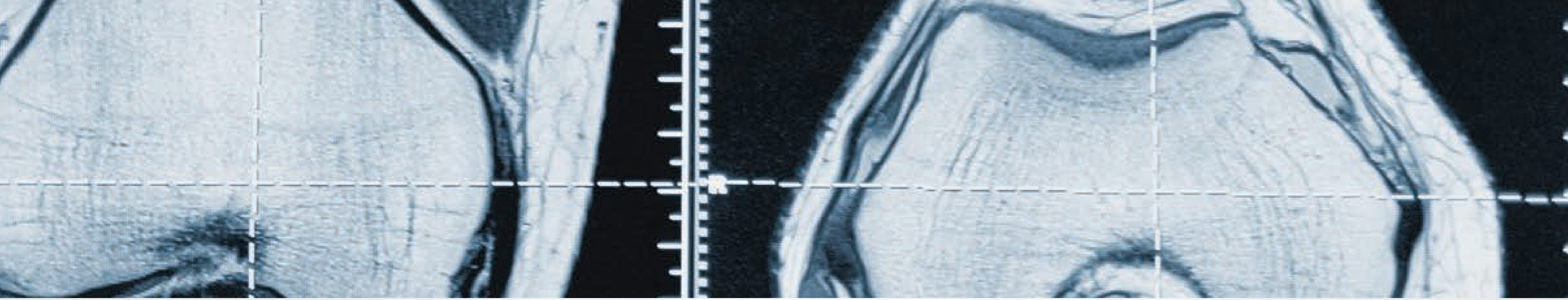
Milillo, who co-authored the study, highlighted the research's broader impact.

“Brandon's contributions have established a new standard in the field of disaster damage assessment through remote sensing,” Milillo said. “This work paves the way for faster, more reliable disaster response efforts, potentially making a life-saving difference in future emergencies.”

This achievement represents a notable advancement for the University of Houston's Geosensing Lab and its Civil and Environmental Engineering Department, further cementing their leadership in the field of remote sensing and disaster resilience research.

The study, conducted in collaboration with an international team of scientists, included partners from various prestigious institutions, such as Delft University of Technology, University College London, Bundeswehr University Munich, the German Aerospace Center (DLR), and the University of Cambridge, UK. This diverse expertise enriched the research, enabling a comprehensive analysis of earthquake damage through a multidisciplinary lens.

Press release by staff in the lab of Pietro Milillo, with editing by the Communications Department of the Cullen College of Engineering.



Akash Awasthi, ECE Ph.D. Student,

CONDUCTING CRITICAL RESEARCH IN AI & IMAGE ANALYSIS

BY ALEX KEIMIG

Electrical and Computer Engineering senior Ph.D. candidate Akash Awasthi is making a name for himself. With a paper nominated for the 2024 IEEE International Symposium on Biomedical Engineering's Best Poster Award, a second paper selected for oral presentation at the IEEE 26th International Workshop on Multimedia Signal Processing, and a third co-authored paper with Houston Methodist published in Nature Scientific Reports, his recent research efforts in artificial intelligence, computer vision and biomedical image analysis have been receiving significant attention from the academic community.

"Decoding radiologists' intentions: a novel system for accurate region identification in chest X-ray image analysis", 2024 IEEE International Symposium on Biomedical Imaging — Best Poster Award

"This nomination was a very prestigious honor, and my work was mostly about using AI models to assist radiologists in disease diagnosis. We don't want to develop an AI model as a standalone system, or one which can replace the radiologists or doctors. We want to develop a system that can be a collaborative resource with the radiologist, because medical diagnosis is a critical task — there is a lot of trust involved there, and we cannot just completely hand that over to a machine. We want the doctor to be able to learn from the AI, and for the AI to be able to learn from the doctor in order to help with diagnosis and enhance training programs in medical science.

"Anomaly Detection in Satellite Videos using Diffusion Models", IEEE 26th International Workshop on Multimedia Signal Processing — Oral Presentation

"This work was in collaboration with NASA Ames. We were trying to use diffusion models — basically generative AI — in detecting anomalous events in the livestreams of NASA satellite video feeds. NASA collects satellite data from all over the US, and we wanted to use that high-resolution satellite video and some kind of generative AI technique that can detect anomalous events like a fire in the forest, or even fog or a tornado — any kind of anomaly event in the live stream of video. We made the focus a theoretical problem of anomaly detection rather than doing any specialized focus on a specific type of event, and that theoretical framework can ultimately — hopefully — be put anywhere with any problem and solve it in a particular way."

"Deep learning-derived optimal aviation strategies to control pandemics", Nature Scientific Reports

"We wanted to develop a specific framework using the edge graph neural network and see how we could use that to understand the non-linear dynamics of pandemics. This work specifically concerned COVID-19, but we developed a very generalized framework which can be applied to any potential future pandemics, or even past pandemics, to understand the factors which really drive pandemic spread. Because my work is more into developing very specialized algorithms for scientific applications, this was really interesting work."

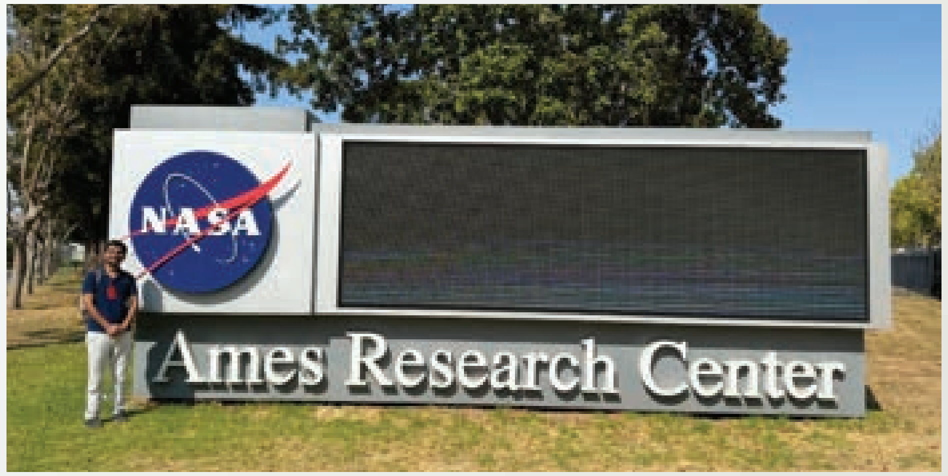
"My research is mostly about large multimodal models, and how we can use current large language models and large multimodal models for certain scientific applications — specifically medical data and radiology," Awasthi said. "For example, we're working on using all of the current AI tools available to develop collaborative systems, for both diagnostic and training purposes, for radiologists."

In addition to medical imaging, Awasthi also works with the Department of Energy's Argonne National Laboratory using generative AI to solve problems related to weather and wind data, and has been invited by NASA Ames to present his work on novel approaches to urban mapping and the precise classification of urban elements like trees and buildings with combined LIDAR and aerial imagery.

"AI has a lot of power," he said, "and I would say it's as intelligent as it is unintelligent. We have to develop an understanding of how we can really make sense out of these models for useful tasks, because there's a lot of capability there, but we have to instruct it in the proper direction to really make use of it."

While Awasthi's recent above-mention projects appear to span a broad spectrum of topics — enhanced biomedical radiological image analysis, the automatic detection of anomalous events via satellite feed, and a framework for understanding the dynamics of pandemic spread and growth — they all boil down to one essential focus: algorithms.

"My particular area of research is more into algorithmic sciences and even basic algorithms: how can we specialize our foundational models for different tasks? Every application and dataset has a different group of challenges and complexities to address," Awasthi added. "If we can harness the power of these big models and personalize them for our specific use cases, we will be able to automate many, many tasks and make them more efficient. These models won't be making big scientific discoveries for us, but they can absolutely be used to automate certain tasks and find patterns in data. AI can run the calculations that allow humans to use reasoning and innovation to move us forward."



Akash Awashti at the Ames Research Center

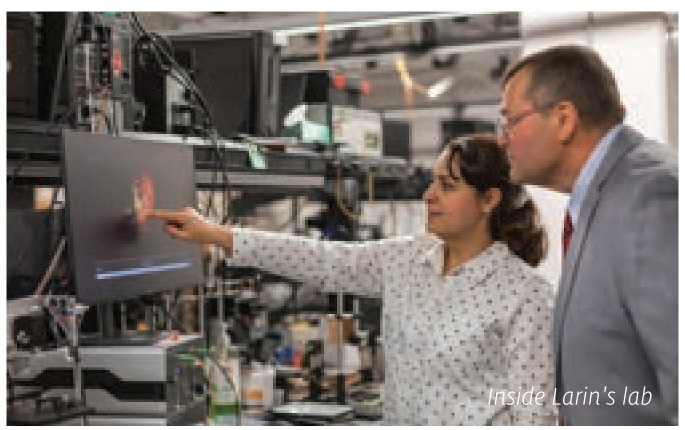
BME'S LARIN WINS
2025 SPIE BIOPHOTONICS TECHNOLOGY INNOVATOR AWARD

BY STEPHEN GREENWELL

Kirill Larin, Cullen Endowed Professor and the interim Chairman of the Biomedical Engineering Department at the University of Houston's Cullen College of Engineering, is the recipient of the 2025 SPIE Biophotonics Technology Innovator Award.

SPIE is the international society for optics and photonics, with more than 258,000 constituents worldwide. Larin is the first professor from the University of Houston to win this prestigious award, which dates back to 2013.

"I am deeply honored and humbled to receive the SPIE Biophotonics Technology Innovator Award," Larin said. "Being placed among the distinguished scientists who have shaped the landscape of biophotonics in the past decade is a profound privilege."


Inside Larin's lab

Larin was recognized for his research into developing optical methods for structural and functional imaging of various tissues, cells and organs. Recently, he has received multiple grants totaling more than $6 million to develop high-resolution imaging platforms for fetal brains and corneas.

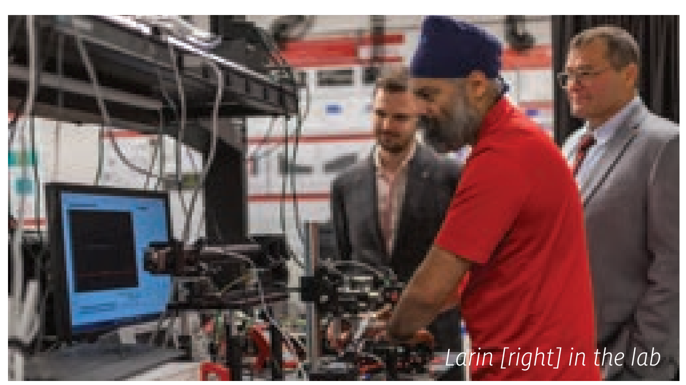
"What I personally admire about Kirill is his collaborative spirit and ability to see the big picture," said 2025 SPIE Immediate Past President Jennifer Barton. "Unlike some technology developers, he is not – well, at least not only – enamored with technology for its inherent appeal."

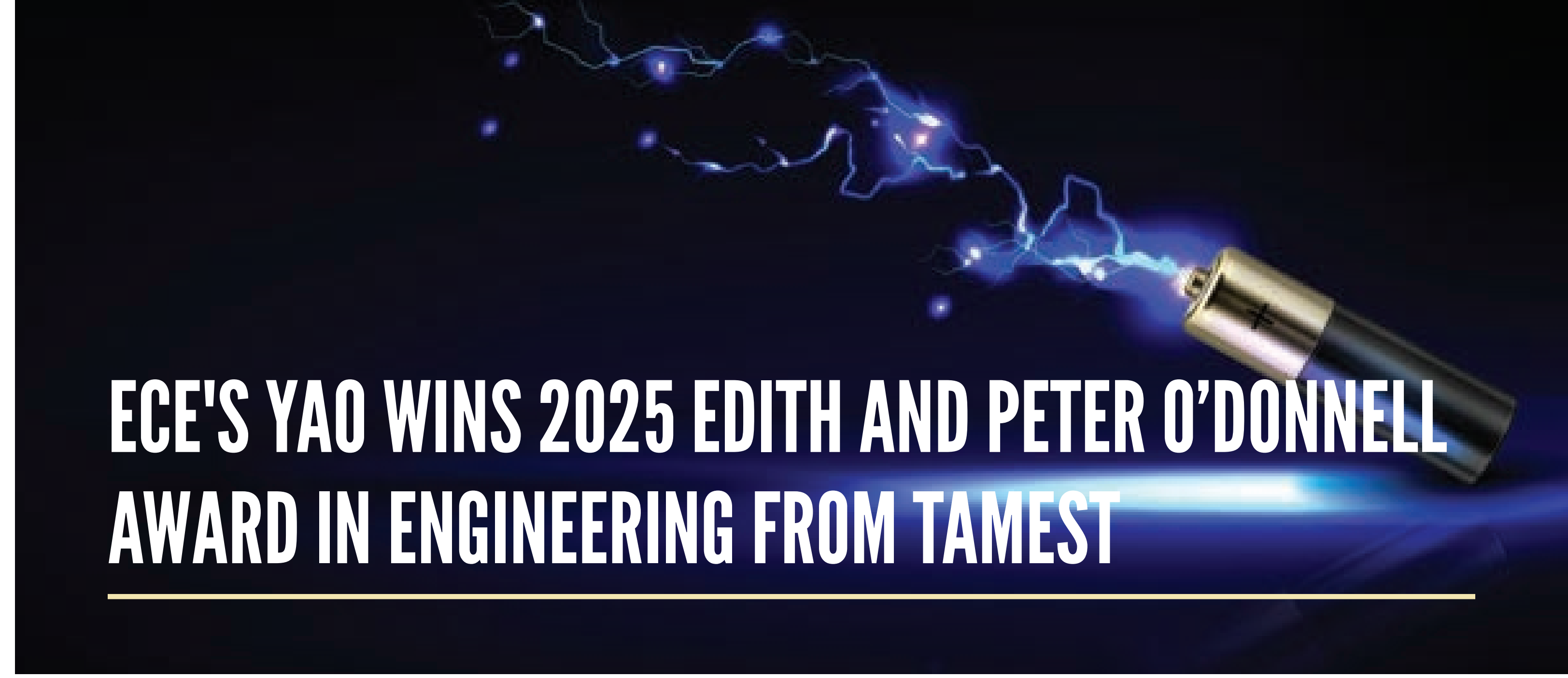
"Also, while he is working on several applications, Kirill has the focus and energy to make tremendous advances and take these innovations to clinical translation, a lengthy and sometimes tedious process. Kirill is broadly admired and liked in the community. Much of this comes from his friendly, open demeanor, and also from his love of teaching. At his home institution of University of Houston, he has been honored for his undergraduate mentoring. Overall, Kirill's imaginative mind and dedication to clinical translation and its critical impact make him an inspiring and compassionate leader, and a pillar of the biophotonics community."

Larin, an SPIE Fellow, is a founding chair of the SPIE Optical Elastography and Tissue Biomechanics conference, which has run as part of BiOS for more than a decade. He is also a frequent contributor to SPIE's Journal of Biomedical Optics.

At Cullen, Larin heads the Biomedical Optics Laboratory and leads several multidisciplinary research projects ranging from developmental biology to tissue biomechanics. He was recognized as the University's top research-producing faculty in 2022 and 2023.

"I would like to extend my thanks to my students, postdocs, and research faculty. Their tireless efforts, innovative ideas, and unwavering support have been instrumental in achieving this milestone," he said. "Also, special thanks go to my long-term collaborators, Drs. Irina Larina (having the title not only the longest collaborator but also the spouse), **Michael Twa**, Rajesh Miranda, **David Mayerich**, Fabrice Manns, Giuliano Scarcelli and Richard Finnell, just to name a few."


Larin [right] in the lab



ECE'S YAO WINS 2025 EDITH AND PETER O'DONNELL AWARD IN ENGINEERING FROM TAMEST

Forward-thinking materials scientist **Yan Yao**, Hugh Roy and Lillie Cranz Cullen Distinguished Professor of Electrical and Computer Engineering at the University of Houston's Cullen College of Engineering, is the recipient of the 2025 Edith and Peter O'Donnell Award in Engineering from TAMEST. He was chosen for creating environmental and sustainable solutions for lithium-ion battery technology.

The world runs on lithium-ion batteries, but their dependence on scarce resources, like lithium, cobalt and nickel creates environmental challenges. These critical minerals require intensive mining and are not renewable. To combat this, Yao's research focuses on discovering new materials and storage mechanisms for batteries based on abundant materials while creating energy storage solutions that reduce reliance on critical resources and have a positive environmental impact.

Yao and his team started by looking at materials available at scale and developing methods to design and synthesize new materials with tunable electrochemical responses and transport properties similar to those in lithium-ion batteries. By learning to control reactivity at interfaces, his team demonstrated sustainable batteries that outperform traditional battery technologies.

Building on advances in materials development and mechanistic understanding, his team developed aqueous batteries, which use water as an electrolyte, making them inexpensive, nonflammable and abundant. By utilizing materials such as sodium and magnesium, which can be extracted from seawater and are largely available in the United States, his team is creating renewable energy storage solutions that are cheaper, safer and less energy intensive to produce without worry of supply chain issues.

"As energy demands from electric vehicles and grid storage continues to escalate, the importance of producing more environmentally friendly batteries has never been greater," said nominator **Pradeep Sharma**, Dean of the Cullen College of Engineering and Hugh Roy and Lillie Cranz Cullen Distinguished University Professor. "Dr. Yao is tackling critical scientific challenges and is focused on developing technologies that power a sustainable, better future. His inventions, including aqueous organic batteries, magnesium batteries and solid-state sodium batteries, will undoubtedly have an enormous impact on environmental and energy sustainability."

"The Edith and Peter O'Donnell Awards are a huge award in our state, and it is extremely competitive due to the fact that Texas has many talented scientists deserving of this award," said Edith and Peter O'Donnell Awards Committee Chair Margaret "Peggy" A. Goodell, Baylor College of Medicine, who herself received the O'Donnell Award in Medicine in 2011. "I've seen firsthand how impactful these awards can be to a young researcher in our state, and it is an honor to help carry the tradition to the next generation. These five researchers are truly among the best and brightest in Texas, and we can't wait to see where their careers take them from here."

More than $1.5 million has been awarded to more than 75 recipients in the categories of Medicine, Engineering, Biological Sciences, Physical Sciences and Technology Innovation since the inception of the O'Donnell Awards in 2006. Sixteen O'Donnell Awards recipients have gone on to be elected to the National Academies, including five who have been elected to more than one National Academy.

The recipients were honored at the 2025 Edith and Peter O'Donnell Awards Ceremony and give presentations on their research at the TAMEST 2025 Annual Conference: Transformational Breakthroughs, at the Westin Las Colinas in Irving, Texas.

All are welcome to register to attend the ceremony and the TAMEST Conference.

Press release courtesy of TAMEST, with additional editing and information from the Communications Department of the Cullen College of Engineering.

BME'S HORTON WINS CAREER DEVELOPMENT AWARD

FROM LUPUS RESEARCH ASSOCIATION

BY ALEX KEIMIG

Assistant professor of biomedical engineering **Renita Horton**, Ph.D., has been awarded the Lupus Research Alliance's (LRA) Diversity in Lupus Research (DLR) Career Development Award.

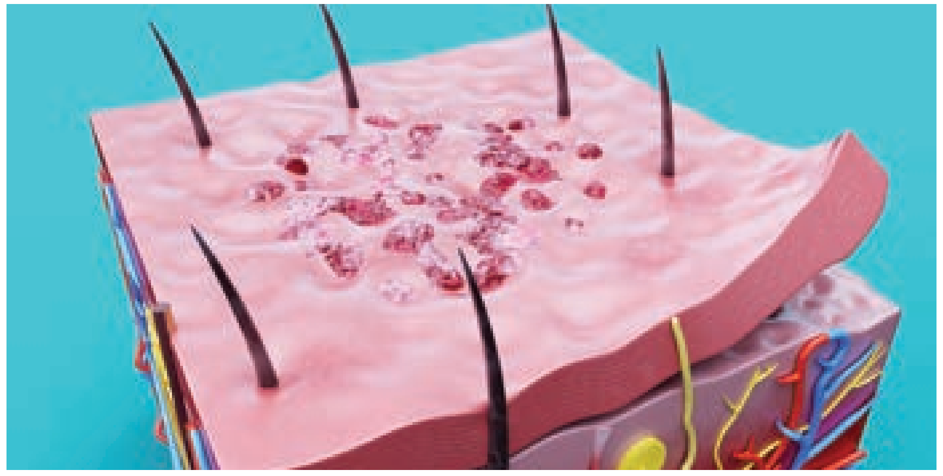
Lupus is a potentially debilitating autoimmune disease disproportionately affecting Black, Hispanic, Indigenous, and Asian and Pacific Islander people. Three years ago, the LRA introduced the DLR awards to "foster a diverse scientific community that mirrors the populations most impacted by lupus."

"We are delighted to recognize the talented recipients of the 2024 LRA Diversity in Lupus Research Awards," said Teodora Staeva, Ph.D., LRA Vice President and Chief Scientific Officer. "By supporting these outstanding individuals, we are not only broadening the diversity of our scientific community, but also paving the way for innovative approaches to drive advancements in lupus research."

Horton was one of three 2024 awardees, each of whom received up to $600,000 disbursed over four years to support the establishment of a competitive research program. Her research proposal, "Investigating the role of SLE serum factors in neonatal lupus cardiac fibrosis", aims to identify biomarkers and actionable therapeutic targets that may allow clinicians to treat or prevent the fibrosis associated with a condition called neonatal lupus.

Expectant mothers with certain lupus related autoantibodies (antibodies that mistakenly target the body's own cells and tissues) are at a higher risk of having babies with congenital heart block — a serious heart condition. Horton's innovative heart-on-a-chip model — for which she recently won a CAREER award — will be critical in helping to identify key factors that contribute to cardiac fibrosis (the formation of scar tissue) and heart block in newborns.

Awardees select professional mentors whose experiences and research foci allow them to offer key expertise.



Renita Horton

"**Dr. Chandra Mohan**, an expert in the lupus field, serves as my primary mentor, and Dr. Todd Rosengart, cardiologist and clinician researcher with the Baylor College of Medicine, serves as my secondary mentor," said Horton. "My mentorship team combines my research interests, lupus and the heart, and will support the continued development of my research program."

"Supporting diverse perspectives in research is crucial, as the lived experiences of scientists enhance the relevance and impact of their work. Additionally, representation fosters trust and relatability, which can improve communication and understanding between researchers and individuals within the affected communities.

"When you look at backgrounds, women of color tend to have higher incidences or higher disease burdens than other groups, so I think mechanisms such as this [program] support the ability to study these issues and ask questions that have yet to be examined. There's no one-size-fits-all approach. Being mindful of diversity when we're designing experiments, when we're asking questions — will really continue to move the needle in a positive direction," she added.

The Lupus Research Alliance is the largest non-governmental, non-profit funder of lupus research worldwide.

ECE'S STUART LONG RECEIVES DISTINGUISHED ACHIEVEMENT AWARD FROM IEEE

BY ALEX KEIMIG

Moores Professor of Electrical and Computer Engineering and Associate Dean of Undergraduate Research and the Honors College **Dr. Stuart Long** 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.

"I was most honored to receive the 2024 IEEE AP-S Distinguished Achievement Award," said Long. "I thank those who have mentored me over my career, my colleagues at the University of Houston, and my former students, all of whom have contributed toward this accomplishment."

The development of the two classes of antenna that distinguished Long for this award – the microstrip patch antenna and the dielectric resonator antenna – span decades.

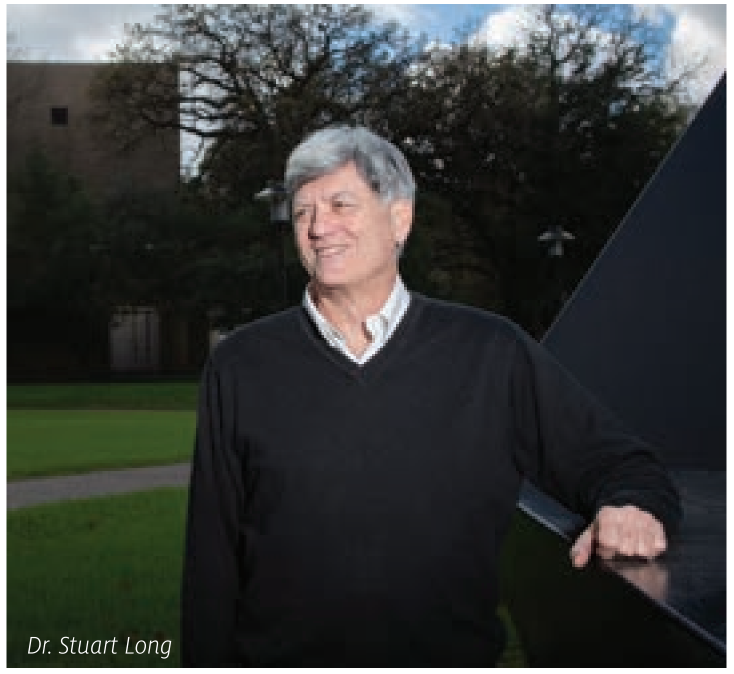
The former was developed with a grant from the U.S. Army in the 1970s in response to the need for a rugged, conformal antenna that could be used on artillery shells; now, nearly any portable device intended to facilitate wireless communications – such as laptops and cell phones – has at least one such antenna.

The latter is a response to the need for an antenna capable of high-efficiency transmission at high frequencies. As most antennas are made of metal, and metal is an imperfect conductor, increasing losses are incurred at high frequencies. The dielectric resonator antenna contains no such conductors, making it much more efficient at higher frequencies which are required, for example, for some military applications and for the newest communications systems like 5G.

In addition to his work with IEEE AP-S, Long has also led programs with the university to engage young women in exploring potential STEM careers, involve public high school teachers in research initiatives, and pair Ph.D. students with science and math classes across the Greater Houston Area to further promote K-12 STEM education and engagement.

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.

"This award recognizes not just a single achievement, but the contributions of my entire career," Long said. "Though I'm not quite ready to quit yet. But it is very gratifying. This represents a lot of peoples' work: of my colleagues here at the university, my students, my mentors... In many ways, this award honors them as well."



Dr. Stuart Long

MAE'S KULKARNI WINS 2024

ASME Materials Division Centennial Mid-Career Award

BY ALEX KEIMIG

Yashashree Kulkarni, the Bill D. Cook Professor of Mechanical & Aerospace Engineering at the University of Houston's Cullen College of Engineering, has received the 2024 American Society of Mechanical Engineers (ASME) Materials Division Centennial Mid-Career Award. She is being recognized for her "pioneering work in applying statistical mechanics methods to problems at the interface of mechanics and materials science."

The ASME Materials Division Centennial Mid-Career Award was established in 2020 to celebrate the 100th anniversary of the Materials Division. The award honors mid-career researchers who have made impactful contributions at the interface of materials and mechanics.

"It is an honor to receive this prestigious award, and I am really humbled by it. I am grateful to all my wonderful students, mentors, and colleagues for their support through these years." said Kulkarni.

Kulkarni is a recognized leader in mechanics and computational materials science. Specifically, her research focuses on elucidating the mechanical behavior of materials from fundamental scales using statistical mechanics, continuum mechanics, atomistic simulations and multi-scale modeling approaches with potential applications spanning the aerospace and energy industry to biotechnology and healthcare industry. Her work continues to push the boundaries of our understanding of the role of mechanics in materials science and biology.

In 2017, Kulkarni received ASME's Sia Nemat-Nasser Early Career Award recognizing her work on twin boundaries in crystalline materials and their role in next-generation nanostructured materials. She was named a fellow of the ASME in 2022 and is currently serving as the 2024 President of the Society of Engineering Science and as an associate editor of ASME's flagship journal in mechanics, Applied Mechanics Reviews.

The award was presented to Kulkarni at the 2024 ASME International Mechanical Engineering Congress & Exposition (IMECE) in Portland, Oregon.

CHBE'S BOLLINI RECEIVES ISCRE 2025 RUTHERFORD ARIS AWARD TO RECOGNIZE EARLY CAREER SUCCESSES

BY ALEX KEIMIG


Praveen Bollini

William A. Brookshire Department of Chemical and Biomolecular Engineering Associate Professor **Praveen Bollini** is the recipient of the 2025 Rutherford Aris Award of the International Symposia on Chemical Reaction Engineering (ISCRE).

This award recognizes outstanding contributions in experimental and theoretical reaction engineering research of investigators in the early stages of their career.

The award is supported by Honeywell UOP and is presented every three years at a North American ISCRE (NASCRE) meeting. Bollini was surprised to learn of his recognition with this award.

"Looking at the list of past awardees, the winners have all been from very prestigious institutions, including MIT, Purdue, and the University of Minnesota, which has a very storied department of chemical engineering. So, I was pleasantly surprised and humbled to receive for this award," he said.

He continued, "I was reminded of the journey of learning and creating knowledge that started under the guidance of my graduate and postdoctoral mentors and continues at UH with my students and UH colleagues. My students helped me build my research lab at UH, and together we have overcome many obstacles along this path."

Bollini's research focuses on improving the ways we currently use and convert hydrocarbons pulled out from the earth into more useful products, and for capturing and converting CO_2 from the air to value-added chemicals.

"A lot of the materials that we use in our everyday lives are chemical products that are manufactured from basic hydrocarbons," he said. "An example of that would be natural gas, which is converted through a catalytic process into polymers, which we all use. My group's research focuses primarily on improving the way that we use these chemicals and convert them into more useful products by developing catalysts and reactors to render these processes more efficient and sustainable."

"Historically, our chemical engineering department at UH has been very strong in my particular research area. There's a tradition of excellence in catalysis and reaction engineering in this department, and I think that played a huge role in me winning this award as well."

The tradition continues today, with professors such as Hugh Roy and Lillie Cranz Cullen Distinguished University Chair **Vemuri Balakotaiah**, William A. Brookshire Department Chair **Triantafillos J. (Lakis) Mountziaris**, and Cullen Engineering Professor **Michael P. Harold** offering lectures in advanced graduate courses that still enchant him.

"I've sat in on their graduate reaction engineering courses," Bollini said. "When I was going through the pressures of being on the tenure track as an assistant professor, no matter what constraints I was operating within personally or what pressures I was under in my professional life, I would always sit in on their courses and make sure that I was learning what I needed to learn."

Bollini said that this recognition "gives [him] a much-needed dose of confidence."

CHBE'S BHOWMICK AWARDED BY INTERNATIONAL RUBBER CONFERENCE ORGANISATION

BY ALEX KEIMIG

Anil K. Bhowmick

Research professor **Anil K. Bhowmick**, Ph.D., in the William A. Brookshire Department of Chemical and Biomolecular Engineering has been awarded the International Rubber Conference Organisation's (IRCO) Gold Medal for his contributions to research, education, and industry in the field of rubber science and engineering.

"This is the overall recognition for my lifetime work. I have been working in the area of elastomers for the last 40 years, and this is a recognition of that, but I am especially honored because I am from an academic institute – a university – and generally this award is given to people working in the industry. So I feel great about this. I'm glad that my work [as an academic] is useful to the industry and has been recognized," said Bhowmick, who currently holds 23 relevant patents.

"Many of my ideas, mostly published in the form of papers and publications in international journals, are used extensively in the industry," he added.

First awarded in 1994, the IRCO notes that the medal should recognize "a personality of exceptional merit in the rubber community" and "have made distinguished contributions to IRCO conferences as an organizer, as chairman of conferences or symposia or as a presenter." Bhowmick is the fifth US-based recipient to be recognized with the award since its inception.

> I HAVE BEEN WORKING IN THE AREA OF ELASTOMERS FOR THE LAST 40 YEARS, AND THIS IS A RECOGNITION OF THAT, BUT I AM ESPECIALLY HONORED
>
> – ANIL K. BHOWMICK

"This award is given by the IRCO, which is based in the UK. That means my work has gone beyond the boundary and appeals to people overseas as well," he said.

"Rubbers and elastomers are very useful materials," Bhowmick continued. "Any automotive vehicle will use tires, airplanes use tires, even military tanks – they all use a lot of rubber materials. They are used extensively in critical applications, but not just those which people don't often encounter.

"Rubber is the modern material of civilization. It has been a stable material for many, many years, and it cannot be replaced."

Bhowmick was presented with the award in Instanbul, Türkiye at IRC 2024 last October.

CEE'S RAHIMI NAMED TO 40 UNDER 40 CLASS BY AAEES

BY STEPHEN GREENWELL

Mim Rahimi

An assistant professor in the Civil and Environmental Engineering Department at the Cullen College of Engineering has been recognized as a rising star in environmental engineering and science, thanks to his research on electrochemical carbon capture.

Mim Rahimi is part of the 2025 cohort for the American Academy of Environmental Engineers and Scientists' 40 Under 40 Recognition Program. Founded in 1955, the AAEES has more than 3,000 members and is vone of the preeminent organizations for environmental engineers and scientists.

"I am deeply humbled and honored to be recognized with this prestigious award," Rahimi said. "It is a testament to the hard work and dedication of my research team and the support I have received throughout my career."

> IT IS A TESTAMENT TO THE HARD WORK AND DEDICATION OF MY RESEARCH TEAM AND THE SUPPORT I HAVE RECEIVED THROUGHOUT MY CAREER
>
> – MIM RAHIMI

According to the AAEES, the program was introduced to recognize talented individuals who have been responsible for helping to advance the fields of Environmental Science or Environmental Engineering in a demonstrable way within the last 12 months. A nominee must be under 40 at the end of the calendar year in which they are nominated. The distinction dates back to 2022, and this is the first time a University of Houston professor has been recognized.

Earlier this year, Rahimi received an NSF CAREER award for his research into electrochemical carbon capture. His research proposal, "Leveraging Liquid-Liquid Interfaces for Innovative Electrochemical Carbon Capture," was selected for $537,719 in funding. He also provided insight into carbon dioxide removal for the University of Houston's Energy magazine, Energy @ Scale.

"I want to express my deepest gratitude to my incredible research team, especially my Ph.D. students, whose dedication and innovation make achievements like this possible," he said. "I also extend my sincere thanks to Professor **Roberto Ballarini**, our department chair, for nominating me for this honor, and to Professor **Hanadi Rifai** for her invaluable mentorship and guidance throughout my academic journey."

MAE'S LOVE ELECTED
UH FACULTY SENATE PRESIDENT

BY NATASHA SAAD

As the 2024-25 Faculty Senate President at the University of Houston, **Holley Love** brings a wealth of experience and leadership to the role. A lifelong Houston Cougar, Love's connection to UH runs as deep as her commitment to its continued growth and success.

Love is passionate about advancing faculty interests and fostering collaboration across the University. In addition to her role as Faculty Senate President, she serves as an instructional associate professor in the Cullen College of Engineering Department of Mechanical and Aerospace Engineering.

Love recently sat down with us to share insights on her goals, her academic journey, hobbies and her vision for the future of the Faculty Senate.

CAN YOU TELL US A LITTLE ABOUT YOURSELF AND YOUR BACKGROUND?

HL: I was born in Houston to parents who are also native Houstonians. Since I was little, I loved nature and science — I did a lot of home science experiments and nature explorations with my mom and a lot of work fixing things around the house with my dad. Or at least I tried to help!

I ended up focusing my studies on the intersection of biomedical and mechanical engineering.

HOW LONG HAVE YOU BEEN WITH UH?

HL: I was a student from August 2003 to May 2013. [Love earned a B.S. in Biomedical Engineering, M.S. in Mechanical Engineering, and Ph.D. in Mechanical Engineering from UH.] I returned as an instructional faculty member in Fall 2016, and I've been here ever since.

WHAT INSPIRED YOU TO PURSUE A CAREER IN ACADEMIA?

HL: Reflecting back, it's difficult to pinpoint a single event. When I was graduating with my bachelor's degree, I didn't feel "ready" to leave school and go to work. I stayed on just to do a master's degree … but I ended up really enjoying my work and wanted to keep going. The girls on my floor at Moody Towers started to call me "Dr. Love"— even though I was only starting my graduate studies … but, honestly, it felt pretty good!

When the teaching position at UH in the mechanical department opened, I was nervous about applying. I had gotten some exposure to teaching in my graduate studies and supervising interns in my post-doc. I am so glad that my family encouraged me to apply — my time teaching and advising are very rewarding.

And I am very grateful to **Dr. Jagannatha "JR" Rao**, who has been a kind and supportive mentor throughout my career — he believed in my capabilities before I did. He's helped me grow into my multifaceted role at UH — and taught me a fair amount of south Indian cooking along the way.

WHAT MOTIVATED YOU TO TAKE ON THE ROLE OF FACULTY SENATE PRESIDENT?

HL: I was [a student] at UH during our push to earn a Carnegie Tier 1 designation in research. I heard President **Renu Khator** speaking about the goal of UH being ranked among the Top 50 public institutions by U.S. News and World Report. I thought that my service in undergraduate academic advising, and on the University's Undergraduate Committee, would be valuable in supporting that aspiration.

I also saw many faculty feeling burned out or stretched thin, particularly after the onset of the pandemic. I believe that achieving a Top 50 goal or AAU [Association of American Universities] eligibility cannot come at the expense of the well-being of our faculty and staff. Without faculty and staff wellness, I think it will not be possible to achieve student wellness and student success. So, I ran for a leadership position in the Senate to advocate for keeping both of these in balance: faculty wellness and student success.

IN YOUR WORDS, HOW WOULD YOU DESCRIBE THE ROLE OF THE FACULTY SENATE? AND HOW DO THEY REPRESENT UH?

HL: Faculty Senate is important for advocating to the administration on behalf faculty. It is important for shared-governance — that idea that we as faculty should take ownership of and have a voice in the operation of the University. Through open communication and respectful discourse, my predecessors in the Senate have fostered a productive working relationship with the administration. I intend to maintain that mutually beneficial arrangement while pressing forward concerns raised by faculty.

WHAT ARE YOUR MAIN GOALS FOR YOUR TERM AS FACULTY SENATE PRESIDENT?

HL: I want to support the University's mission of student success, and I want to enhance faculty wellness, particularly by making faculty realize that they are welcome and belong to the vibrant UH community. [I want them to know] that they are seen and valued for their work: not only their major creative or research works, but their teaching, mentoring, administrating, advising, volunteering, speaking, advocating — all the little things that together make UH a place that accomplishes big things and improves the lives of its students, staff, alumni, community and faculty.

HOW WOULD YOU DESCRIBE YOUR LEADERSHIP STYLE AND HOW DO YOU INSPIRE YOUR COMMITTEE?

HL: The executive committee is a mixture of senators who are appointed by the president and senators who are elected by groups within the Senate. Each of the executive committee members brings their own unique set of strengths and background knowledge. I trust the leadership of the committee chairs, and I have encouraged them to explore the issues that they and their members find most pressing, relying on their expertise and experience.

I view my role as facilitating conversations with the Faculty Senate executive committee about items that cut across the individual committees. And connecting information from various sources to the folks who can make meaningful contributions and improvements.

WHAT IS YOUR FIELD OF STUDY, AND WHAT DREW YOU TO THIS AREA OF RESEARCH?

HL: I was drawn to study engineering because I wanted to do something where I could make a difference, make a living and learn more about math and science — engineering seemed to provide all three.

When I came to orientation, I was still undecided about which specific engineering major I should choose. I saw a brief presentation about biomedical engineering, and I knew that's where I wanted to be. It fused the experiences I had with machinery to my interest in space exploration, because at the time I wanted to work on life support for long-term shuttle missions.

But as I got into the major, I stumbled onto a different path: I had the opportunity to work with heart assist pumps. And that led me to get my graduate degrees in mechanical engineering, to work as a research engineer at the Texas Heart Institute as a post-doc, and then to return to UH as an instructional faculty.

WHAT ARE SOME OF YOUR HOBBIES AND INTERESTS OUTSIDE OF YOUR ACADEMIC WORK?

HL: Outside of work I really enjoy spending time outdoors — but I'm less a "ranger" and more a "hobbit" when it comes to my activities: choosing to take part in hiking at a laid-back pace; looking at rocks, flora, fauna and fungi; and enjoying picnics.

I also really enjoy music; I learned the term "polyJAMorous" from my students, which is a much more fun and passionate descriptor to describe my listening than just saying I have "eclectic" musical taste.

WHAT DO YOU WANT OUR UH COMMUNITY TO KNOW ABOUT YOU?

HL: I've spent the better part of my adult life here. My two best friends and I are all three UH Alumni Association Life Members, our spouses are all UH grads and our sons were all born in 2017. My father, two aunts and dear family friend (the late Robin Lee) are all Cougars. Even my son was a Cougar of sorts through his early years enrolled at the Children's Learning Center; he's in elementary school now and still loves coming to campus.

WHAT DO YOU PLAN TO DO AFTER YOUR TERM IS OVER?

HL: Celebrate! And relax a bit before I lean in to a new service opportunity.

WHAT ARE THREE WORDS YOU WOULD USE TO DESCRIBE UH?

HL: Vibrant, driven, practical.

FRANCIS, GUTIERREZ, WALK NEWEST MEMBERS OF CULLEN'S EXECUTIVE LEADERSHIP BOARD

Jim and Nadine Francis.

The Cullen College of Engineering is proud to announce the addition of three new members with decades of industry experience between them to its Executive Leadership Board.

Joining the board are **Jim Francis**, the CTO/Vice President Information Technology and Shared Services at Houston Methodist; **Indra Gutierrez**, the President of Gutier; and **Erika Walk**, the Chief Technology Officer of Abercrombie Technology, LLC.

Francis provides leadership for the Project Management Office, Enterprise Data Analytics, Enterprise Architecture and Engineering, as well as the development of information technology platforms and solutions throughout the Houston Methodist Health System. Annually, the system's eight hospitals service more than 2 million outpatient visits and employs more than 32,000 people.

Renu Khator and Indra Gutierrez.

Gutierrez has served as President of Gutier for the past five years, and she has more than 17 years of experience working in the construction industry overseeing multi-billion-dollar projects across the Gulf Coast. She is part of the 2023 class of the Houston Business Journal's 40 Under 40.

Walk is the CTO of Abercrombie Technologies, LLC., a new venture. Previously, she was the head of Global Infrastructure and Technology Services at WM, and led a digital organization of more than 400 in support of enterprise-wide infrastructure, operations and applications. She owns a U.S. patent for the invention of an Employee Self-Service Mobile application for more than 50,000 employees. As a leader in the technology field, Erika inspires young girls and women to enter STEM fields through volunteering with organizations like Girls Who Code and Girls Empowerment Network.

Erika Walk and LaShonda Anderson-Williams.

Established in 1999, the Executive Leadership Board provides valuable assistance in the development of College programs. Comparable to a company's Board of Directors, the board provides advice and counsel, assists in establishing program priorities and objectives, provides review and critique, provides liaison to the outside industrial and government communities, promotes College interests inside and outside the University, and helps define needs and assists in the development of resources.

Press release prepared by the Communications Department of the Cullen College of Engineering, with information supplied by Engineering Advancement.

ECE FACULTY PARTNER WITH HARRIS COUNTY ON VISION FOR SUSTAINABLE ENERGY FUTURE

BY ALEX KEIMIG

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. This baseline will enable programs aimed at reducing total energy consumption, maximizing savings and increasing the use of renewable and resilient energy sources for County-owned buildings and operations.

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.

Their focus has centered warehousing and analyzing energy consumption data from hundreds of County-owned buildings and facilities. Among other accomplishments, the team successfully identified key summertime energy-saving opportunities and completed the retro-commissioning – a process by which the energy performance of existing buildings is analyzed and optimized – of four County buildings. These efforts resulted in over $230,000 in annual electricity savings, with an average simple payback period of two years.

"Over the past two years, Harris County has made significant strides in its energy initiatives, focusing on reducing greenhouse gas emissions, enhancing resilience, and achieving cost savings. ... These efforts have led to substantial cost savings and emission reductions," said Harris County Director of Sustainability Lisa Lin.

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. These initiatives aim to reduce electricity usage by at least 5% per year for County-owned buildings and operations by 2030. The success of this project will support other energy-related initiatives, set a precedent for sustainable practices, and advance the County's vision of a resilient and sustainable energy future.

"I am very fortunate to have seen first-hand how data-driven strategies can shape energy initiatives that transform the way we operate our buildings," Zhang said.

In collaboration with the University of Houston, Harris County's energy initiatives not only enhance grid reliability and reduce energy costs but also contribute to the climate action plan (CAP) goal of reducing greenhouse gas emissions from County-owned buildings by 50% over the next five years. By fostering community-based energy programs and promoting sustainable practices, Harris County is reinforcing its leadership in climate action and energy efficiency.

"As the Energy University, UH has core strength in the research and development of carbon neutralization and smart grid technologies," said Han. "The strategic partnership between the University of Houston and Harris County will amplify our research impacts and benefit the 4.8 million residents in Harris County by saving cost, cutting down emissions, and enhancing resilience."

SPACE ARCHITECTURE AT UH:

WHAT MAKES A HOUSE (OR A LUNAR BASE CAMP) A HOME?

BY ALEX KEIMIG

The Cullen College of Engineering's Sasakawa International Center for Space Architecture (SICSA) and its space architecture degree program might be the University of Houston's unintentionally-best-kept secret.

Though last year marked 20 years of the accreditation of the Master of Science in Space Architecture program by the Texas Higher Education Coordinating Board, program director **Olga Bannova** still regularly encounters people who aren't familiar with the field of study.

That's perhaps understandable, given that SICSA houses the only Master of Science in Space Architecture program in the world United States.

"[Space architecture entails] a lot of systems engineering with significant human factors embedded in it," she said. "It's about human spaceflight, of course, but it goes way beyond the design of, say, interiors of space habitats. We really want to teach our students to define a potential problem in design, and that includes from not only a systems engineering point of view, but also thinking about the humans."

"It's a little bit sci-fi," Bannova laughed, "But it's not at all fiction. [This work] needs to be based in reality. That's what is unique, of course, about our program. We don't design based on magic, or based on the assumption that in 50 or 100 or 500 years, somehow something impossible will become possible. Because then why not just plan to have teleportation, and say we don't even need rockets? That's just Star Trek!"

"You're not just doing research on what's happening right now — what's on the market right now and how these things can be designed — but also doing it with developing concepts and testing them," she continued. "That's why we developed the mixed reality lab here at SICSA: to test and evaluate our design decisions from an operational point of view. We want to interact with them and see how comfortable they are — how effective a crew member will be using them in these environments. Life-centered design is really the goal."

"If you ask several space architects to give you the definition of a space architect, they'll probably tell you several different answers," added adjunct professor and SICSA graduate Vittorio Netti, calling the field a "cross-discipline meeting" of architecture, aerospace engineering and human-centered design. "It's the science and the heart of putting people in space and designing environments that will make space compatible with long-term human presence."

Four other space architecture master's students and two alums – **Kai Kai Bailey**, **Paula Drozdowska**, **Corrado Testi**, **Kelly Mann**, and **Chi Lan Huynh** and **Paolo Mangili** – recently traveled to the 2024 International Astronautical Congress in Milan, Italy to present innovative research and connect with contemporary leaders in the fields of aerospace and space architecture.

"It's definitely very important for us to participate, not only be cause of the program and for networking for our students, but also to put the University of Houston and the Cullen College of Engineering's newly named Mechanical and Aerospace Engineering department on the map," Bannova said. "Believe it or not, many people know about our programs at UH because of ours and our students' participation and presentations at these conferences."

"Companies like SpaceX and Axiom and Blue Origin are trying to build the future of space exploration: not just what we did until now — that is, basically, to survive in space — but also to thrive in space," Netti added. "We are trying to design environments that aren't just purely functional, that would be appealing and usable only to trained astronauts, but for a variety of figures who may not be as trained — like space tourists."

The field's unprecedented growth in recent years is reflected in a key area – Netti noted that the program is seeing "way more" applications than they can currently admit and support. Bannova has also reported seeing increasing interest in an Aerospace Engineering Ph.D. program, with the option to add work related to space architecture.

While some emerging research focuses on the use of robotic technology to accomplish critical tasks in hostile environments, SICSA remains focused on amplifying and accommodating human ingenuity in space.

That focus on the human at the core of innovation and exploration is just as evident in SICSA's academic pursuits as it is in the center's groundbreaking research initiatives.

"It's very important for us that when our students graduate, they feel like they are well-equipped to contribute to space exploration and the space industry, and that they can be hired successfully. To me, the success and recognition of the program is how hirable our graduates are." Bannova concluded. "Research is important to us, but our biggest project is our students."

Olga Bannova

IN THEIR OWN WORDS: STUDENTS DESCRIBE THEIR EXPERIENCES WITH SICSA AND IAC 2024

Paula Drozdowska, an international student from Poland, is pursuing her MS in space architecture and expects to graduate in Fall 2025.

"My dream has always been to share knowledge and inspire others, and I am grateful to have had the opportunity to present the lunar lava tube habitat project to a diverse audience of 80 professionals and researchers [at IAC]," she said. "This was an invaluable opportunity to grow my network, explore new projects in human-centered design, and discuss recent advancements in the space industry."

Chi Lan Huynh, a 2023 SICSA graduate, attended the conference for the first time this year and described it as "a huge and eye-opening event" where she "met experts who have devoted years to exploring what many consider 'mere science fiction'." Huynh's research focused on the applications of space elevators, for which there was a specific dedicated technical session.

Originally trained to design buildings as an architect, she became captivated by the concept of space architecture during the 2020 COVID-19 pandemic after stumbling upon a book authored by Bannova herself.

"The program encourages independent research, allowing everyone to pursue what they're passionate about. Students are the owners of their projects, and I learned equally from my peers and mentors as from my professors," she said, further citing strong faculty connections to industry leaders, the combination of architecture and aerospace engineering, and knowledgeable and experienced faculty members as key components of SICSA's/the program's success. "They teach us not just how to create beautiful designs, but how to develop solutions that could actually work."

Paolo Mangili is an international student from Italy and a 2024 graduate of the Space Architecture program at UH, having earned his BS in industrial design from Milan in 2022. He is currently continuing his research work with SICSA as the leading member of Research Staff.

"Space and its exploration have been among my interests and passions since I was a little kid," he said. "I became interested in the humanities in addition to the study of the sciences, which, combined with my creative take on the world, led me to a very non-linear academic path. Space architecture meant for me the (almost) perfect combination of creativity and technical wisdom that I was looking for."

"The personal and creative freedom I've been granted to pursue my visions for the exploration and utilization of space" with the "multi-disciplinary powerhouse" that is SICSA has proved incredibly valuable to Mangili. "Everything I've gone through is worth the effort.

OUTSTANDING SENIOR

Tari Rockets Toward Success

BY ALEX KEIMIG

Parsa Tari, graduating with his Bachelor of Science in Mechanical Engineering this spring, has been selected to receive this year's Outstanding Senior award.

Having developed an early interest in aerospace engineering thanks to a NASA-employed neighbor when he was a child, Tari said that it was an "obvious choice" to attend the University of Houston due to its physical proximity to aerospace industry opportunities.

His decision has paid off in more ways than one.

"At the end of my junior year, I found a job opportunity at a company called Leidos. I've learned a lot, and I think my learning in that position has been really important. That was a very big deal for me, and it's something I'm definitely proud of and happy about," he said.

Though getting involved with campus life and social opportunities was a bit trickier as a commuting student, Tari is particularly thankful for the friendships he made in his junior year and through Space City Rocketry, for which he also served as a lead on two different sub-teams last year.

Tari initially joined Space City Rocketry to get more hands-on aerospace-related skills and experience, learning to make things from solid rocket propellant to fiberglass tubes.

"You're working with a lot of other people, and I really enjoy getting to interact with people and learn more about different types of engineering, like electrical and chemical engineering. It broadens your horizons," he said.

Some of those same friends are now members of Tari's capstone team, which he credits with bolstering his development as an engineer.

"They've helped me get through hard patches and have taught me so much," he added. "If I need cheering up, they're always there for me."

Tari also expressed his gratitude for the support of Kamel Salama Endowed Professor of Mechanical & Aerospace Engineering **Haleh Ardebili**, who helped connect him with her research group from which he had the opportunity to learn more about problem-solving approaches and operating in professional engineering environments.

After graduation, Tari hopes to continue with Leidos in a full-time capacity.

"In addition to their support for the ISS," he said, "Leidos is also getting into some other projects that I hope be able to work on after graduation as an engineer and help further support the development of space exploration."

OUTSTANDING JUNIOR

Gaucin Excels as First Gen Scholar

BY ALEX KEIMIG

Jonathan Gaucin, currently pursuing his Bachelor of Science in electrical engineering, has been selected as this year's Outstanding Junior. He is a first-generation student who hopes to illustrate the impact that others in similar circumstances can have in academia and the world.

"My mom didn't graduate from high school in Mexico. My dad did. But I don't have anybody in my family who's ever been to university before, so being the first one here was a little bit nerve-wracking at the beginning," Gaucin said. "Still, my family has always supported me wholeheartedly, instilling the values of hard work and perseverance which I've carried with me throughout my journey."

He poured his energy into "trying to thrive, not just survive" by getting to know his fellow students and staying caught up on academics.

"At the beginning I was very nervous; I wanted to be able to talk to people and make friends naturally – to make connections and grow within the college," he said. "Seeking mentorship helped me a lot in being where I am today. I'll always be grateful to those people and to the Engineering and Honors Colleges as a whole for helping me get through the transition and really start thriving."

Gaucin chose the University of Houston because he "was looking for something close to home that would also offer a good education," which was a great fit for his "curiosity and passion for" engineering.

"I've always wanted to be an engineer," he said. "I really like the potential to innovate in electrical engineering."

When he's not knee-deep in the books, Gaucin serves as both a research assistant for **Vedhus Hoskere's** Structures and Artificial Intelligence Lab (SAIL) as well as president of student organization CougarAI.

"I kind of grew up with them, moving up through the ranks of officership, and now [as president] I've been able to give back to the community across UH: to help educate, lead workshops, and get industry partners engaged in this new technological revolution. It has felt really amazing to be part of that team and that community – helping first to build it and now to lead it," he said. In February, Gaucin received an award from the Engineering Alumni Association (EAA). As a senior, Gaucin looks forward to continuing his "good work."

"I'll still be supporting CougarAI, doing research here at UH and for another NSF-sponsored research project, which I was able to present at a conference this semester. I'm looking forward to continuing my research and my community-based endeavors, as well as rising to that next level and applying for graduate school to see what opportunities lie ahead."

SOCIETY OF AUTOMOTIVE ENGINEERS

KEEPS PACE AT TEXAS AUTOCROSS WEEKEND, LOOKS TO THE FUTURE

BY ALEX KEIMIG

Mechanical engineering junior **Rasheed Korayem**, director of communications, and mechanical engineering technology senior **Rohit Amaravadi**, vice president, know that first place isn't won in a day. Texas Autocross Weekend 2024 wrapped up just last month, and the Society of Automotive Engineers at UH is already looking forward to Cougar Racing's success in 2025 and 2026.

Established in 2015, the student chapter of the Society of Automotive Engineers (SAE) at University of Houston "aims to make UH competitive within Formula SAE" – a design competition that challenges students to conceive, design, fabricate, and compete with small formula-style racing cars. UH student members are "provided with both technical and teamwork experience by working together to design, build and compete with a Formula-style open-wheel race car."

Texas Autocross Weekend 2024 marked the first official event in which the team has competed with their most recently built vehicle.

"We haven't had a car built in about four years – since COVID started – and we have spent this time designing, manufacturing, and finally testing. The UTA Autocross event was us finally putting our car through its paces," said Korayem. "Given all of that, it was definitely a success. We placed somewhere around 39 out of 59 cars – right in the middle of the pack. Considering that this was our first car in a long time and our current members' lack of previous competition experience, I'd say that was a pretty big success."

"Anybody familiar with motorsports knows just how ridiculously expensive of a sport it is," added Amaravadi, "and that definitely applies to FSAE and this competition."

Amaravadi characterized many of the teams UH competes with as "generational teams": teams that are designing, manufacturing, and bringing a new car to competition year after year, back-to-back, with significant industry support. Teams are indeed expected to bring a new chassis to competition each year, often with a different set of objectives to match: one year a team may focus on acceleration, the next on braking, and after that perhaps the fastest overall time.

"They may be spending upwards of $40,000 to $50,000, even $60,000, on these cars each year. Some teams spend upwards of $100,000. We built our car for under $10,000," he said. But generational teams don't just benefit from monetary industry support; they thrive on the transference of institutional knowledge and momentum.

"We had no transfer. We had no blueprint to go off of. That's why we were very impressed with how well the car performed, even with the issues we had," said Amaravadi.

He described the topic of sponsorships as a bit of a "chicken and egg" situation: "Sponsors want to see that the team they're supporting is going to use that support effectively. They want to see that you have a car... but how do you build the car without the funding? When you're dealing with that situation, it just takes that much longer to build your car. That's why it's taken us two years for our current build."

It may be an expensive sport, but the organization's value to its members can't be understated. One of SAE at UH's overarching goals for their members is to provide "real-world engineering experience." Amaravadi cited real-world applications of classroom topics like thermodynamics, solid mechanics, statics, dynamics, and others as areas that student members gain valuable experience in over the course of building a Formula SAE car. "Learning how to validate a design is crucial in making good engineering decisions, and projects such as FSAE provide a great opportunity to learn these skills."

After debuting their first Formula SAE car in four years at Texas Autocross Weekend 2024, Cougar Racing is setting the stage for even greater success in 2025 and beyond.

"[For a lot of our members], we're the first step into hands-on experience with things like machining and using power tools. Employers really like to see that, and it helps students avoid falling into the cycle of needing experiencing to get an internship, needing an internship to get experience... Student orgs like ours are where you can learn how engineering decisions are made and how to overcome common issues in the shop. We're that first step into valuable, marketable experiences and skills that can apply towards internships and impress potential employers," said Korayem.

"If you feel you lack the experience to participate, dive off the deep end and learn to swim. It's a gradual learning process: join Cougar Racing and learn the skills that will not only develop you as a professional but also as an individual," said organization president Patrick Sanchez.

Though students from related programs may benefit the most, Amaravadi and Korayem made clear that SAE at UH welcomes students from any major or program of study.

"A lot of [our members] who aren't engineering or technology division students still have that passion for cars and motorsports that drives them to want to be part of the team, and even in leadership positions for our organization," said Korayem, noting that one suspension sub team lead is double-majoring in biology and psychology and on a pre-med track.

Bhuvanesh "Ben" Jagasia, powertrain sub team lead, describes the diverse team as "a passionate group of dreamers and doers, with a bold vision, uniting to face a great challenge."

"We all have a lot of pride in our school and in the city of Houston itself, as well as Texas, but beyond that, we want to turn our organization into a generational team. We have the passion. We have the interest. We have the know-how. We just need the continued experience and the sponsor support. Now that we have things rolling, that's the legacy that this generation of leadership wants to leave behind: the tools and connections to keep having a car built year after year. We know that expanding to reach the level we want to reach will take a few generations of work, but we know we'll be able to get there," said Amaravadi.

NATIONAL ACADEMY OF INVENTORS *Honors UH MAE Student Innovators with Inaugural Genspiration Prize*

BY ALEX KEIMIG

Jian Chen and **Thomas "Tico" Hannan** of the University of Houston Cullen College of Engineering were awarded the inaugural university-level Genspiration Prize at the National Academy of Inventors (NAI) 13th Annual Conference in Raleigh, North Carolina this summer.

Jian Chen and Thomas "Tico" Hannan of the University of Houston Cullen College of Engineering were awarded the inaugural university-level Genspiration Prize at the National Academy of Inventors (NAI) 13th Annual Conference in Raleigh, North Carolina this summer. Created in partnership with the Genspiration Foundation, the Genspiration Prize recognizes outstanding innovation "with the potential to benefit society and the economy" by K-12 and university level teams or individuals.

The UH team was celebrated for their Revolutionary Sensing Technology and received an oversized check for $2,500 during the ceremony, highlighting their significant contribution to the field.

"It is so exciting to develop a novel health monitoring method for Lithium-ion batteries under the supervision of **Dr. Yan Yao** and **Dr. Gangbing Song**," said Chen, who was also recognized earlier this year with the Cullen College of Engineering Young Innovator Award. "It is a great honor to win the first place in National Academy of Inventors Genspiration Prize competition. As a Ph.D. student, I am eager to continue the research on applying machine learning to monitor lithium-ion batteries and improve this sensing technology."

NAI boasts over 4,600 individual members across U.S. and international universities, governmental agencies, and non-profit research institutes. The organization was founded "to recognize and encourage inventors with U.S. patents, enhance the visibility of academic technology and innovation, encourage the disclosure of intellectual property, educate and mentor innovative students, and create wider public understanding of how its members' inventions benefit society."

> IT IS A GREAT HONOR TO WIN THE FIRST PLACE IN NATIONAL ACADEMY OF INVENTORS GENSPIRATION PRIZE COMPETITION
>
> – JIAN CHEN

L to R: Genspiration Foundation founders Judy Genshaft and Steve Greenbaum; awardees Tico Hannan and Jian Chen; Bryan Greenbaum; and Genspiration Foundation CEO Noreen Segrest.

"I was thrilled to be invited to present our team's efforts developing this game-changing battery monitoring technology to the National Academy of Inventors, and I am delighted that we won the final Genspiration Prize!" said Hannan. "I have learned so much working with Jian Chen, Dr. Song, and Dr. Yao throughout this project. Having the significance of our innovation's societal impact recognized and awarded in a national competition is a great honor personally as well as a testament to the strength of Cullen College of Engineering, the power of interdisciplinary collaboration, and the value of creativity and curiosity."

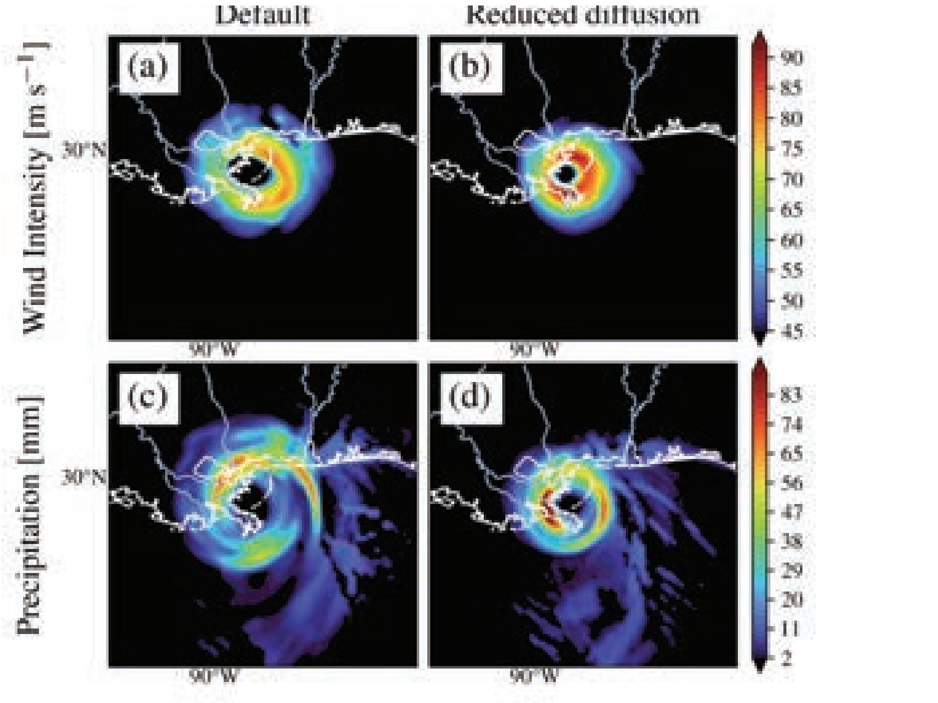
The experience has inspired Hannan to pursue a Ph.D. in mechanical engineering.

"I'm enthusiastic to continue this research and enable improved battery safety, reliability, re-use, and lifespan," he said.

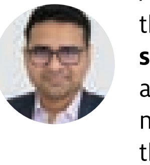
CEE Ph.D. Candidate Khondaker

Identifies New Approach to Improve Hurricane Forecast Accuracy

BY ALEX KEIMIG



This figure shows the simulated intensity and precipitation distribution for Hurricane Katrina at 1200 UTC 29 August 2005. (a),(b) illustrate wind intensity at 500-m altitude and (c),(d) illustrate induced precipitation, with default (left) and new RD WRF-ARW (right) configurations.



A paper recently co-authored by **Md Murad Hossain Khondaker**, a civil and environmental engineering Ph.D. candidate at the University of Houston, may hold key insights that allow for better predictions of catastrophic flooding produced by hurricanes in the United States. the paper published in the August 2024 issue of the Journal of Hydrometeorology.

A paper recently co-authored by Md Murad Hossain Khondaker, a civil and environmental engineering Ph.D. candidate at the University of Houston, may hold key insights that allow for better predictions of catastrophic flooding produced by hurricanes in the United States.

“Weather prediction models still struggle to accurately forecast hurricanes, even with recent advances in computational power,” said Khondaker. “Our research focused on the idea that current weather models overestimate how much hurricanes' kinetic energy spreads out or diffuses.”

They hypothesized that over-estimations of diffusivity lead to weaker intensity forecasts, which creates a discrepancy between forecast and reality.

“Our research was motivated by the significant impact of hurricanes: the most destructive and costly natural disasters in U.S. history. We observed that current models often underestimate hurricane intensity, leading to critical gaps in disaster preparedness. Our goal was to improve existing forecasting methods to reduce the devastating effects of hurricanes by enhancing both intensity and rainfall predictions,” he added.

Khondaker and his supervisor, assistant professor of civil and environmental engineering Mostafa Momen, Ph.D., saw the paper published in the August 2024 issue of the Journal of Hydrometeorology. It was also highlighted by phys.org and the Pittsburgh Supercomputing Center (PSC), whose flagship supercomputer, Bridges-2, played a pivotal role in the project.

“We needed significant computational resources to run a coupled atmospheric and hydrological model. For example, simulating 17 days of Hurricane Irma at 8 km horizontal resolution took 22 hours using 128 processors. Although we have access to dedicated computing nodes at the University of Houston, such as Carya and Sabine, the scale and complexity of our research required additional resources. This led us to rely on the Bridges-2 system at PSC as well as the National Center for Atmospheric Research supercomputers.

“The computational power provided by Bridges-2 was essential for running our simulations, and its high-memory nodes were critical in handling our large datasets, enabling us to perform detailed analyses,” Khondaker explained.

Their time on Bridges-2 was allocated by the National Science Foundation's (NSF) Advanced Cyberinfrastructure Coordination Ecosystem: Services and Support (ACCESS) program. ACCESS helps researchers and educators utilize the United States' collective advanced computing systems and services at no cost.

“One of the most important discoveries from our research was the significant impact that adjusting turbulence parameters had on improving hurricane intensity forecasts, with enhancements of up to 40% compared to the default weather models. »

This improvement will be crucial in preparing for damages associated with high winds and storm surges," he added. "An interesting finding was that in the more intense hurricanes, the total amount of rainfall does not increase; instead, precipitation becomes more localized and intense."

This phenomenon was observed in 2017 with Hurricane Harvey, highlighting the vulnerability of urban areas with more impervious surfaces, such as concrete, to severe flooding as a result of concentrated rainfall. Khondaker and Momen's adjusted model significantly improved forecast accuracy - hurricane intensity forecasts by up to 40%, and flood predictions by up to 34% - and the resulting improved rainfall predictions may be able to mitigate some of the danger and risk to life for individuals living in vulnerable areas of hurricane-prone regions.

> "THESE IMPROVEMENTS ARE CRUCIAL, AS BETTER FORECASTS CAN LEAD TO MORE EFFECTIVE EVACUATION AND REDUCE THE OVERALL DAMAGE CAUSED BY THESE EXTREME WEATHER EVENTS"
>
> – MD MURAD HOSSAIN KHONDAKER

"These improvements are crucial, as better forecasts can lead to more effective evacuation and reduce the overall damage caused by these extreme weather events," he said.

"The future of our research will focus on two key objectives. First, we aim to deepen our understanding and improve the prediction of compound precipitation and storm surge floods, a major contributor to the damage caused by hurricanes along coastal areas. Second, we plan to develop a general turbulence diffusion adjustment for hurricane simulations by considering the rotational dynamics of these storms and incorporating more advanced physics-based models. These efforts are designed to enhance the accuracy of hurricane predictions and strengthen preparedness, ultimately reducing the risks and impacts on coastal communities," Khondaker concluded.

GHOSH, CHAKRABORTY
EARN AICHE'S PD2M STUDENT AWARDS

BY STEPHEN GREENWELL

left: Dipayan Chakraborty right: Sreyashi Ghosh

Two doctoral candidates at the Cullen College of Engineering have been recognized for their research work with student awards from the Pharmaceutical Discovery, Development and Manufacturing Forum (PD2M).

Sreyashi Ghosh and **Dipayan Chakraborty**, both students in the William A. Brookshire Department of Chemical and Biomolecular Engineering, received the awards in San Diego during the 2024 American Institute of Chemical Engineers (AIChE) Annual Meeting in late October. Ghosh is a student of Mehmet Orman, associate professor, and Chakraborty is mentored by Jeffrey D. Rimer, Abraham E. Dukler Professor.

The PD2M student awards are chosen based on an evaluation of a submitted presentation that has potential relevance to pharmaceutical discovery, development and manufacturing. Nationally, only 10 students received awards.

Chartered in 2012, the PD2M "promotes the interchange of ideas, concepts, know-how and experiences in Pharmaceutical Discovery, Development and Manufacturing with other groups within and outside of the Institute." It is part of the AIChE, the professional organization for chemical engineers. AIChE has more than 60,000 members in more than 110 countries.

Ghosh is examining antibiotic resistance, which occurs when bacteria change and are no longer targeted by the medicine meant to kill them. She noted that it was a critical global health crisis that leads to countless hospital infections, fatalities and a significant economic strain on healthcare systems.
"Preventing the rise of antibiotic resistance is essential," she said. "My research centers on understanding the complex mechanisms of intracellular mutagenesis that drive antibiotic resistance. Additionally, I am developing targeted strategies based on experimental insights to reduce or prevent mutagenesis, making a meaningful contribution to the fight against antibiotic resistance."

Ghosh described receiving the award as a moment she was incredibly grateful for.

"Being recognized on such a prominent stage as the 2024 AIChE Annual Meeting made this moment even more special, as it provided a unique opportunity to connect with esteemed members of the PD2M community during the award ceremony," she said. "I am especially grateful to my advisor, Dr. Orman, for his unwavering support, and to my family, who are my constant motivators and pillars of strength."

Chakraborty's research takes a deeper look at cholesterol, one of the key components of what he called pathological diseases like heart plaque and gallstones.

> "BEING RECOGNIZED ON SUCH A PROMINENT STAGE AS THE 2024 AICHE ANNUAL MEETING MADE THIS MOMENT EVEN MORE SPECIAL"
>
> – SREYASHI GHOSH

"Despite its relevance to worldwide healthcare problems, few studies have examined fundamental mechanisms of cholesterol crystallization," he said. "Mechanistic understanding would lead to innovation of drugs that would eliminate the need for surgical procedures by inhibiting the crystallization process, as current drugs affect the blood cholesterol levels not the crystallized one."

Chakraborty was thrilled to receive recognition for his work.
"It's a great honor to be recognized with such a prestigious award! A heartfelt thank you to PD2M and the American Institute of Chemical Engineers for the support. I'm also incredibly grateful to my advisor, Dr. Rimer, for his unwavering guidance and encouragement. This recognition means so much, and I look forward to continuing to contribute to the field!"

Sreyashi hopes to continue using her engineering skills to improve health outcomes.

"I am exploring opportunities in the pharmaceutical industry, particularly within the research and development sectors, where I can apply my expertise in bioengineering and my foundation in chemical engineering to develop scalable solutions that enhance human health and make a meaningful impact on society," she said.

Chakraborty wants to use the research skills he's learned and honed from his studies in the field.

"Upon graduating, I aim to step into an R&D role in industry to expand the perspective and skills I developed through my doctoral research," he said. "I look forward to applying my technical expertise and analytical skills to create impactful, real-world solutions and gain hands-on experience with innovative projects."

Sreyashi Ghosh

MAE'S JOZWIAK NAMED 2025 TEXAS SPACE GRANT CONSORTIUM FELLOW

BY ALEX KEIMIG

Cullen graduate student **Amber Jozwiak**, who is currently pursuing dual master's degrees in aerospace engineering and space architecture, has been selected as a NASA/Texas Space Grant Consortium (TSGC) Fellow for the 2025 academic year. The fellowship includes a $5,000 stipend and is open to students from any field with an interest in STEM and space-based research; Jozwiak fits the bill perfectly.

With education and experience in mechanical and aerospace engineering plus space architecture, including internships with Boeing and NASA, she's eager to find practical, hands-on applications for her knowledge and research.

Jozwiak chose to pursue her bachelor's degree in mechanical engineering at UH instead of going straight into an aerospace education so as not to commit to a niche too early, but she quickly "fell in love" with controls. "Aerospace is all controls," she said. "So now here I am!"

Jozwiak also noted that AIAA — the UH student chapter of the American Institute of Aeronautics and Astronautics — helped further develop her "love for aerospace". AIAA comprises four sub-teams: competitive international rocketry and aerodynamics teams as well as hobby rocketry and radio club teams. Students can compete in design-and-build competitions on the first two teams or obtain rocketry (levels one and two) and HAM radio certification on the second two.

"Since we don't really have an aerospace undergraduate program, and this was before we became the Mechanical and Aerospace Engineering department, that was really the only 'aerospace' I had on campus. I didn't really know any graduate students or anybody with aerospace experience except for these people," she said. Jozwiak now serves as the organization's secretary.

As an intern with Boeing, Jozwiak worked on the 777 Full-Scale Fatigue Test Program assisting with testing and inspections on the largest twin engine commercial aircraft they manufacture. Then, in the summer of 2024, Jozwiak returned to Houston to work with NASA on Payload Integration Management (PIM) for the International Space Station. She has since received an offer to soon begin full-time work with Boeing under the South Design Center's senior management as a Mechanical System Design and Analysis Engineer.

Her current research with Hugh Roy and Lillie Cranz Cullen Endowed Professor & Department Chair and Aerospace Engineering Graduate Program Director **Karolos Grigoriadis** is a collaboration with the Air Force Research Laboratory (AFRL) to investigate and prevent flutter, which is a detrimental aeroelastic phenomenon affecting airplane wings during flight.


Amber Jozwiak

"Flutter is the phenomenon of wings flapping like birds, and we want to prevent that at any speed. We want to ensure that the bigger airplanes with larger wingspans can still fly at the speed that they need without having that flutter phenomenon happen, so we use control methods such as linear-quadratic regulation and linear-quadratic-Gaussian control — usually in MATLAB simulations — with state observers to push the speed at which flutter begins to occur higher and higher.

"Flutter can be disastrous," she added. "It could rip apart a plane at its most drastic, or it could cause damage that may not be seen in general ground checks but still presents a safety risk. We want to be able to prevent all of that from happening."

Jozwiak looks forward to opportunities to work hands-on in her field once her research and thesis are complete — something she hopes that her fellowship with TSGC could help facilitate.

"Maybe I'll help create some device that can monitor the appearance of flutter using prognostics, so we know when we need to slow down or change something to prevent further issues," she mused. "I'm a very visual person. I like seeing the fruits of my work."

> I'M A VERY VISUAL PERSON. I LIKE SEEING THE FRUITS OF MY WORK.
>
> – AMBER JOZWIAK

ASME-UH WINS STUDENT SECTION ACHIEVEMENT AWARD

BY ALEX KEIMIG

The American Society of Mechanical Engineers (ASME) at the University of Houston has been awarded the ASME Student Section Achievement Award for 2023-2024.

ASME-UH is "a professional student organization that aims to lead engineering students to success in all aspects of the engineering disciplines," with "conscious intention to promote diversity, equity, and inclusion in all... programs, events, member outreach, learning and development opportunities, scholarships, and communications."

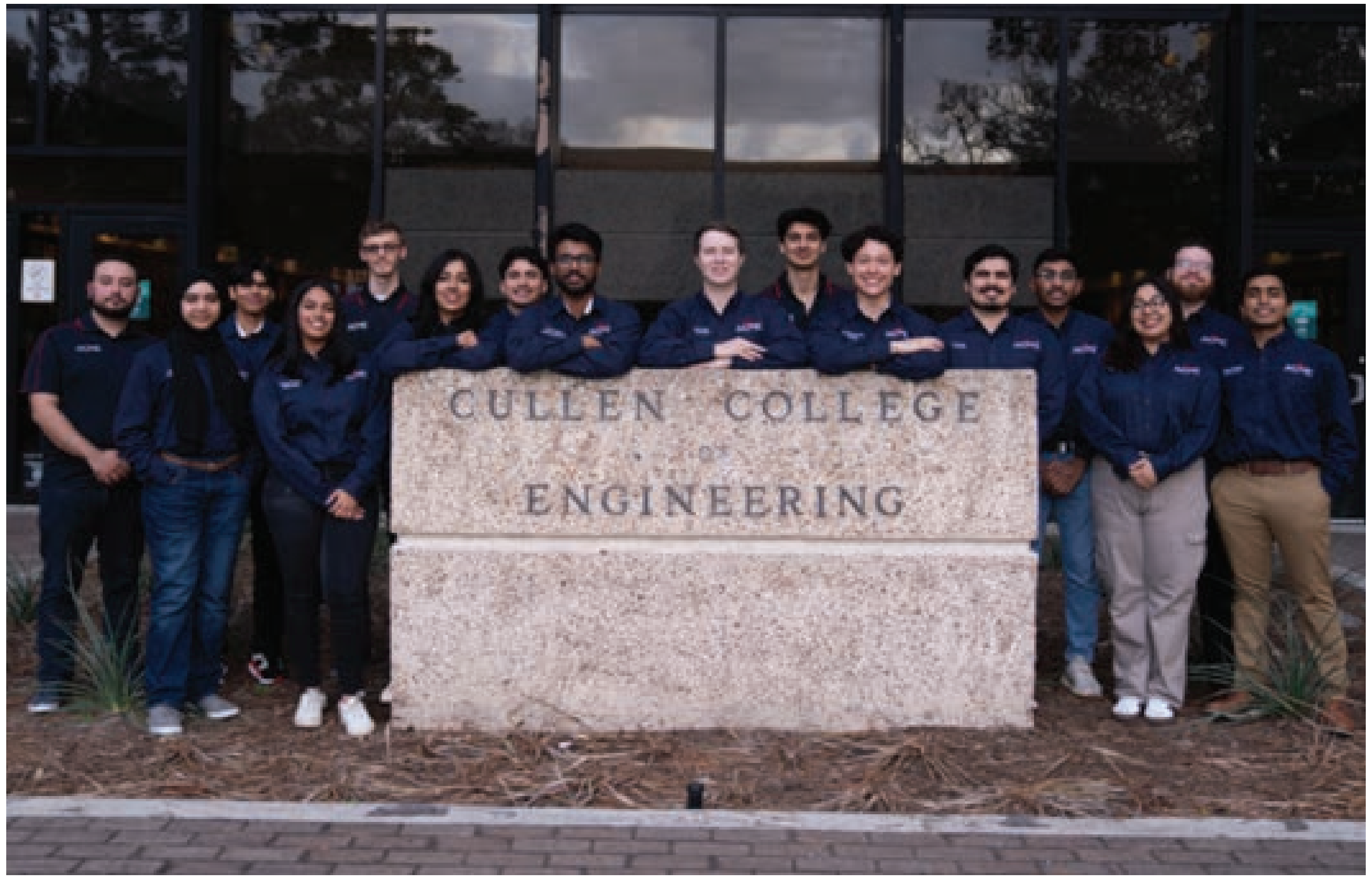
Most ASME-UH members are mechanical engineering students, but the organization is not major-or college-specific, and it welcomes students from any field of study who may be interested in learning more about mechanical engineering or the related tools and resources available.

"We continue to be impressed by your commitment, new ideas, and collaboration with other student leaders," said ASME Student Section Engagement Coordinator **Janice Parker**.

According to former president **Kevin Jandal**, who began his freshman year as a mechanical engineering student at the Cullen College of Engineering in 2020, the award represents not only the organization's success in the 2023-24 academic year, but their growth and re-development post-COVID.

"I really wanted to focus on [reconnecting] ASME-UH to the larger national ASME. We weren't interacting to take full advantage of all of the resources available to us, so one of my first initiatives was to make sure that student ASME-UH members got all of the full benefits of becoming national members," Jandal said.

His goal of reinvigorating academic and professional development resources for students helped jumpstart multiple new initiatives, including study nights for specific courses as well as MATLAB and technical writing refresher tutorials, connections to national scholarships, mentorship programs, new networking opportunities, and the ASME Lab.



The 2023-24 officers for ASME-UH.

Located in the ASME lounge, this lab features six 3D printers, hand tools, and materials intended "to provide students all the resources they need, whether for classes or for personal projects."

"Our lab committee operates [the facility] nearly 24/7, providing students with rapid prototyping and 3D printing for any project they have," said Jandal. "The way ASME-UH has built and operates this lab is something that hasn't been done before by any student organization and supplements all departments of engineering."

"As an aspiring leader, I'm looking forward to seeing what more I may be able to do for our organization given how Kevin has left it," said 2024-25 ASME-UH president and mechanical engineering student Bryan Haro. "We won this one award this time, but we want to see if we can continue to level up and set a new foundation. Mechanical engineering is one of the largest majors in the college, and I think we have a vast number of ways to continue to grow and provide our fellow students with professional and academic skills."

The continued cooperation between Haro and Jandal is no accident.

"Kevin's leadership actually inspired me to run for president," Haro said.

Jandal, having seen the difficulty that disconnected officer cohorts can cause for student organizations that are looking to grow and thrive rather than just continue existing, was determined to ensure that a proper hand-off took place for ASME-UH.

"Here in my last semester, I really want to make sure I'm present for the new leadership and able to server as an advisor," he said.

This year Haro looks forward to continuing to support ASME-UH's academic and professional development initiatives, their K-12 STEM interest and education outreach program, and the organization's student mentorship program, which matches student mentors and mentees according to their individual strengths and goals for the academic year.

MAE STUDENT RESEARCHER AWARDED BY DIABETES TECHNOLOGY SOCIETY

BY ALEX KEIMIG

Anurag, an Indian Institute of Technology Delhi chemical engineering undergraduate student affiliated with **Marzia Cescon's** lab and multidisciplinary research group, has been awarded the Diabetes Technology Society's Bronze Student Research Award for his work investigating the application of predictive digital twins in diabetes management.

His winning abstract, "Predictive Digital Twin (DT) of Type 1 Diabetes (T1D) Using Physiology-Informed Liquid Time Constant (LTC) Neural Networks in Presence of Exercise", will be presented at the 2024 Diabetes Technology Meeting poster session alongside other winning entries in California next month.

Anurag was "genuinely thrilled and honored" to learn that his abstract had been selected for this award and looks forward to engaging with other researchers and experts in the field this October.

"It was a moment of validation for the hard work and dedication that went into the project. Being recognized among so many talented researchers was incredibly motivating and made me even more passionate about continuing my work in this field."

The awarded project aims to use advanced machine learning techniques to model "the complex physiological processes involved in diabetes, particularly in response to exercise."

"The LTC neural networks are designed to capture the temporal dynamics of glucose levels in the body, providing real-time predictions and personalized insights. This model could significantly improve the management of T1D by predicting how different factors, like exercise, impact blood glucose levels, and integrate with the MPC controller," explained Anurag.

"Diabetes research fascinates me because of its direct impact on people's lives," he continued. "The complexity of managing Type 1 Diabetes, especially with variables like exercise, diet, insulin, and others, poses significant challenges. Developing models that can help predict and manage these factors has the potential to drastically improve quality of life for patients. The integration of technology and physiology in diabetes management presents an exciting intersection of my interests in machine learning, healthcare, and human physiology."

He described his internship with Cescon, which facilitated the project, as "incredibly enriching".

"I was involved in cutting-edge research that combined machine learning with physiological modeling, specifically in the context of diabetes. Dr. Cescon's guidance was invaluable, and I gained hands-on experience in developing and testing models that could predict glucose levels. She is always very humble and helpful, whatever the case may be – be it related to the project or college administration."

Anurag further highlighted the ways that this project has shaped his academic journey and research interests.

"Working on the Predictive Digital Twin has solidified my passion for combining machine learning with healthcare applications. My time at the University of Houston, especially under the mentorship of Dr. Cescon, has been pivotal in developing my skills and knowledge. I'm excited about the future of this research and the potential it has to contribute to better management strategies for Type 1 Diabetes."

Anurag

FOUR MAE STUDENTS RECOGNIZED FOR CAPSTONE PROJECT

BY STEPHEN GREENWELL

Group members work on their capstone project device.

A team of graduates at the Mechanical Engineering Department at the Cullen College of Engineering are being recognized for the work done on their capstone project on rupture disk devices.

Johan John finished his final semester and graduated in Fall 2024. His teammates – **Rushil Mehta**, **Chris Bridges** and **Shan Pappa** – graduated in Spring 2024. Together, they created a device to help with safety issues for rupture disk devices, which are used to protect piping and other tubing from overpressure and vacuums. **Ashutosh Agrawal**, associate professor of Mechanical & Aerospace Engineering, noted that they created an exceptional project.

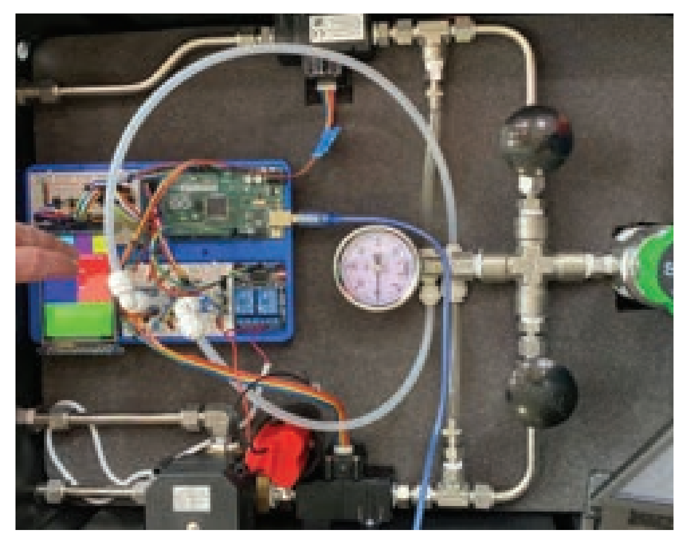
"Our project was to create a device to pneumatically test rupture disk devices," John said. "Rupture disks will burst at a negative pressure differential, where pressure on the downstream is greater than the upstream leading to a dangerous situation that prevents testing for proper upstream installation of these devices. Our device combines a mixture of automated and manual safety features with the ASME pneumatic test process, that is used in industry, to optimize safety for the user."

John noted that Bridges, a nontraditional student with more than 15 years of industry experience, came up with the idea based on his work experience.

"He pitched a concept to the team of an idea he would want to see utilized in industry, and we combined our different talents and education to produce a functional prototype," John said.

Bridges is now a maintenance superintendent for OxyVinyls. Mehta has recently passed the FE mechanical exam and is looking for opportunities in the mechanical engineering field. Pappa and John are also exploring their career options.

> "HE PITCHED A CONCEPT TO THE TEAM OF AN IDEA HE WOULD WANT TO SEE UTILIZED IN INDUSTRY, AND WE COMBINED OUR DIFFERENT TALENTS AND EDUCATION TO PRODUCE A FUNCTIONAL PROTOTYPE."
>
> – JOHAN JOHN



9 CULLEN STUDENTS HONORED AT ASIE HOLIDAY DINNER

Eleven different University of Houston students were honored with scholarships at the annual American Society of Indian Engineers and Architects holiday dinner, including nine from the Cullen College of Engineering.

ASIE is a Houston-based non-profit with the specific objective of supporting engineers, architects, engineering technicians, and related professionals and students, in their fields. The organization celebrated its 30th year in 2024.

THIS YEAR'S SCHOLARSHIP RECIPIENTS FROM CULLEN AND THEIR FIELDS OF STUDY ARE:

Hariharan Annadurai, Ph.D. in Chemical and Biomolecular Engineering
Vraj P. Chauhan, Ph.D. in Chemical and Biomolecular Engineering
Bhanu Rama Ravi Teja Gonugunta, Masters in Engineering Data Science
Venkat Chary Guntoju, Master's in Industrial Engineering
Chirag Goel, Ph.D. in Material Science and Engineering
Sreyashi Ghosh, Ph.D. in Chemical and Biomolecular Engineering (Chad Patel Scholarship)
Deepank Singh, Ph.D. in Civil Engineering (Swarajyam & Rangayya Gunda Memorial Scholarship)
Srihitha Varagam Reddy, Masters in Construction Management (Tanwani Family Scholarship)
Sree Chakra Kulkarni, Masters in Construction Management (ASIE Volunteer Appreciation Scholarship)

OTHER UH SCHOLARSHIP RECIPIENTS ARE:

Neha Kulkarni, Interior Architecture (MS Baroda scholarship)
Prabhakaran Elangovan, Master of Architecture (Wadhwa Family Scholarship)

Congratulations to all of this year's honorees! For more information about the ASIE, visit ASIEhouston.org.

IE'S ALJAHMI CITES CHALLENGES, CONNECTIONS AMONG MEANINGFUL CULLEN EXPERIENCES

BY ALEX KEIMIG

As industrial engineering undergraduate student **Abdulrahman Aljahmi** prepared to graduate last December, he took a moment with us to reflect on his time in the Cullen College of Engineering – his personal and professional accomplishments, his pursuit of academic success as a transfer student, and how his world-class engineering education at UH has prepared him for the future.

"One of my biggest challenges was transferring to the University of Houston from out of state," Aljahmi said. "Moving from Michigan to Texas was initially difficult, as I didn't know anyone on campus or in the area. Another obstacle was transferring my credits, as some of the required electives in Texas delayed my graduation. Looking back, I'm grateful for these challenges, as they shaped my journey and contributed to my personal growth in ways I hadn't anticipated."

"I take pride in my academic performance and the knowledge I've gained, which has prepared me for the next stage of my career," he added. "The coursework at UH has provided me with a foundation in critical thinking, technical skills, and problem-solving, all of which are essential for any career. The internship and co-op opportunities I pursued during my studies were invaluable, allowing me to apply my knowledge in real-world settings and gain practical experience."

Beyond academics, he also cites forming "meaningful connections" with professors and fellow students as one of his greatest accomplishments in his time at the University of Houston.


Abdulrahman Aljahmi

"Serving as president of the IISE chapter was a highlight of my time at UH, offering me the chance to make a lasting impact on the student community while enhancing my leadership skills," Aljahmi said.

"My leadership experience as president of the IISE chapter helped me develop key skills such as communication, collaboration, and decision-making. These experiences taught me how to manage teams, handle challenges, and adapt to new situations - skills that are invaluable in both professional environments and leadership roles. I feel that my time at UH has provided me with the skills and connections needed to thrive in any professional environment."

"Success, to me, is about self-discipline and commitment in pursuing what is meaningful in life," he continued. "I feel successful when I can make an impact on the lives of others and be useful to those around me. Having a good reputation and excelling in what I do is a great start on this journey."

Aljahmi offers this wisdom to the students who follow behind him: "I know this journey can be tough, and there will be times when you want to give up, but please keep pushing forward. Trust me, you will get there. Everyone has felt that way at some point. Keep in mind that the value of education extends beyond financial gain; the journey of being a student and the friendships you make along the way are incredibly meaningful. Embrace the challenges - they contribute to your growth and enrich your life in ways that money alone cannot."

> **SUCCESS, TO ME, IS ABOUT SELF-DISCIPLINE AND COMMITMENT IN PURSUING WHAT IS MEANINGFUL IN LIFE**
>
> – ABDULRAHMAN ALJAHMI

TECH DIVISION'S ALANAZI EXCELS IN TPM

BY ALEX KEIMIG

Jamaan Alanazi, a Technology Project Management graduate student, came to the University of Houston to study project management in 2022 after bouncing between home and abroad due to the initial COVID-19 outbreaks. His experiences and his time in the Technology Division have had a profound impact not only on his professional development, but on his daily habits, too.

"I grew up in AlUla, a city in northwestern Saudi Arabia with many resources and tourist attractions, but it didn't receive much attention until 2017. Around the same time as the launch of Saudi Vision 2030, which focuses on diversifying the country's economy, the Royal Commission for AlUla—my scholarship sponsor—was established, focusing on transforming AlUla into a global cultural, historical, and tourism destination by highlighting its rich heritage and natural beauty," said Alanazi.

"The Royal Commission for AlUla's transformational projects were initiated all around me, and I didn't know anything about them—their environment, how projects work. Seeing that happening in my hometown, I didn't want to be someone who just sat back and watched from the sidelines."

Alanazi's scholarship journey began in 2019, and he first found himself in New York. When COVID hit, he returned to Saudi Arabia for a year before making his way back to Houston instead of New York.

"I hate cold weather," he laughed.

"They advised me to go to Houston, and I really liked it. I like the culture, the people; here in Houston, I feel as much at home as in Saudi."

Alanazi has taken advantage of some of the unique opportunities that the city and the University of Houston has to offer, including PMI Houston – the first and one of the largest Project Management Institute chapters in the world and the site of the first-ever PMI Student Venue, founded in 2022.

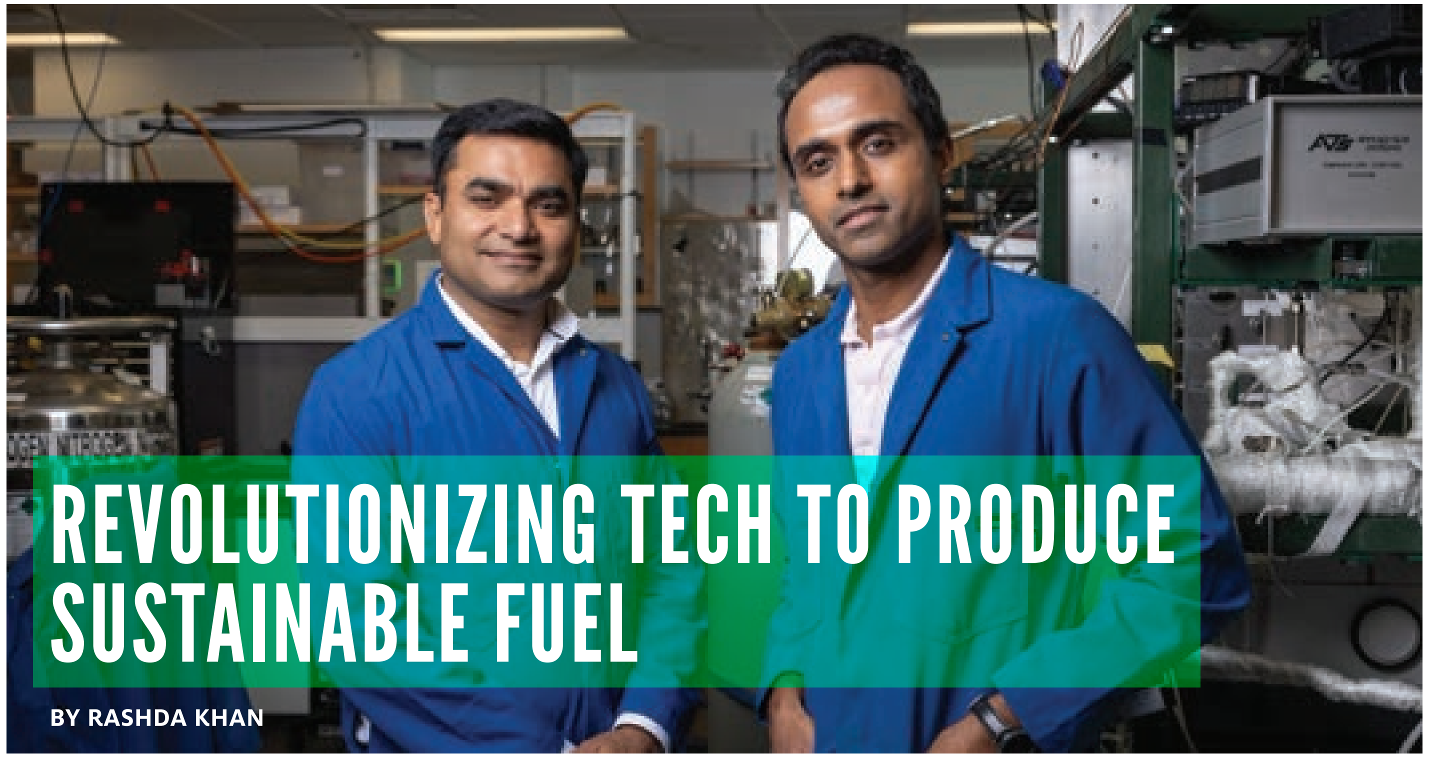
"I've gained a lot of experience. Meeting and socializing with different people and personnel from the industry is really building on the knowledge that I've gained from this program," Alanazi said. "In these classes, you have so many different students with such a wide range of experience, from entry level to senior level. As a person who really didn't have practical experience in project management, some concepts were challenging for me to understand. I've had to really push myself to grasp the structure and the environment of project management. Not until I led my own project – my capstone project – did I really feel confident in that."


Jamaan Alanazi

Alanazi credits instructional assistant professor of technology project management **Dennis Sherman**, Ph.D., with offering invaluable support for himself as well as his fellow students, while Sherman himself considers Alanazi to be "a true testimony to our excellent [TPM] program."

"Seeing Dr. Sherman really proud of that accomplishment and complimenting my work definitely boosted my confidence," Alanazi said. "Starting without prior experience was a challenge, but the professors really helped. I really appreciate all of the professors who passed along their knowledge in each of the different courses that I took, from leadership and team building to risk analysis and assessment.

"Managing a project is a skill I've developed and continue to practice, not just in projects or the industry, but in daily life. Time management, problem-solving, and managing stakeholder expectations have become daily habits for me, and I'm very grateful for that."



REVOLUTIONIZING TECH TO PRODUCE SUSTAINABLE FUEL

BY RASHDA KHAN

SRI AND UNIVERSITY OF HOUSTON TO RECEIVE $3.6M TO DEVELOP A MICROREACTOR TO CONVERT CARBON DIOXIDE TO METHANOL USING RENEWABLE ENERGY

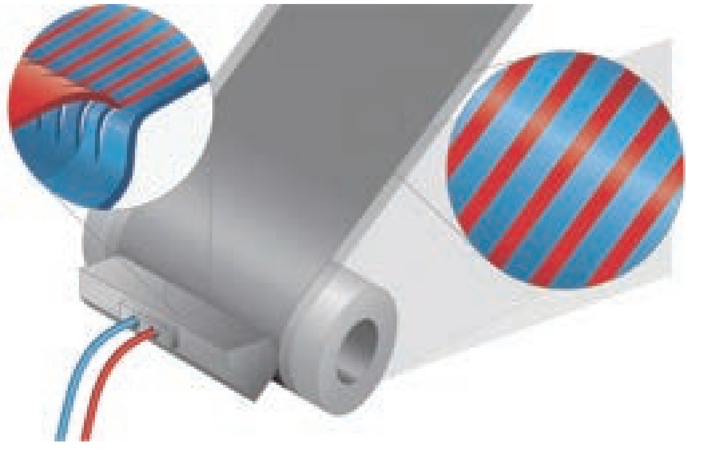
A University of Houston-affiliated project that has the potential to transform sustainable fuel production was selected to receive $3.6 million from the U.S. Department of Energy's Advanced Research Projects Agency-Energy. Led by SRI, a leading nonprofit research institute, the project titled "Printed Microreactor for Renewable Energy Enabled Fuel Production" or PRIME-Fuel, aims to develop a modular microreactor technology that converts carbon dioxide into methanol using renewable energy sources. UH, a Carnegie-designated Tier One public research institution, is contributing essential research needed for the project.

This is part of ARPA-E's $41 million Grid-free Renewable Energy Enabling New Ways to Economical Liquids and Long-term Storage program, otherwise known as the GREENWELLS program, which includes 14 projects to develop technologies that use renewable energy sources like wind and solar to produce sustainable liquid fuels or chemicals, which can be transported and stored similarly to gasoline or oil. Selected teams will develop systems that use electricity, carbon dioxide and water at renewable energy sites to produce renewable liquid renewable fuels that offer a clean alternative for sectors like transportation.

"Renewables-to-liquids fuel production has the potential to boost the utility of renewable energy all while helping to lay the groundwork for the Biden-Harris Administration's goals of creating a clean energy economy," said U.S. Secretary of Energy Jennifer M. Granholm in an ARPA-E press release.

Low-carbon fuels cost about $10 per gallon, but using cheaper electricity from sources like wind and solar can lower production costs. It will also create opportunities for smaller communities with renewable resources to invest in affordable and cleaner long-term energy storage solutions.

"We believe that PRIME-Fuel will play a critical role in the transition to sustainable energy solutions," said Rahul Pandey, senior scientist with SRI and principal investigator on the project. "By harnessing renewable energy to produce methanol, we can help combat climate change while providing valuable resources for various industries by leading to cost-effective and sustainable methanol production."



Vemuri Balakotaiah and **Praveen Bollini**, faculty members of the William A. Brookshire Department of Chemical and Biomolecular Engineering, are co-investigators on the project. Pandey, a University of Houston alumnus, earned his Ph.D. from the department in 2015. This shared connection played an integral role in bringing the three together on this project.

"As a proud UH graduate, I have always been aware of the strength of the chemical and biomolecular engineering program at UH and kept myself updated on its cutting-edge research," Pandey said. "This project had very specific requirements, including expertise in modeling transients in microreactors and the development of high-performance catalysts. The department excelled in both areas. When I reached out to Dr. Bollini and Dr. Bala, they were eager to collaborate, and everything naturally progressed from there."

SUSTAINABLE PRODUCTION OF METHANOL

While methanol can be harmful if misused, its sustainable production offers significant benefits. Methanol can serve as a versatile energy carrier and high-energy density liquid fuel, potentially replacing fossil fuels in various applications. It is also a valuable chemical feedstock that is easily stored and transported.

"The technology developed here will provide a means for the distributed, low-cost production of methanol using stranded renewable sources of energy, including those in underdeveloped countries." Praveen Bollini, associate professor of chemical engineering at UH

"Methanol is a platform chemical, meaning a lot of the chemicals and products you see in your everyday life could actually be produced starting from methanol," said Bollini, an associate professor of chemical engineering at UH. "An important example would be food packaging that helps enhance shelf life at the grocery store."

The PRIME-Fuel project will leverage cutting-edge mathematical modeling and SRI's proprietary Co-Extrusion printing technology to design and manufacture the microreactor. One of the most remarkable features of this innovative technology is its ability to continue producing methanol even when the renewable energy supply dips as low as 5% capacity.

"This ensures a consistent output while optimizing energy consumption through advanced control algorithms and real-time monitoring systems," Bollini said. "The technology developed here will provide a means for the distributed, low-cost production of methanol using stranded renewable sources of energy, including those in underdeveloped countries."

"Right now, we are aiming to produce methanol, but this technology can actually be applied to a much broader set of energy carriers and chemicals." Rahul Pandey senior scientist with SRI and principal investigator on the project Balakotaiah, whose research involves mathematical modeling and analysis of the interactions between transport processes and chemical reactions, will use reduced-order mathematical models of microreactors to guide the microreactor's design and real-time simulations of transient-state operations. Bollini, whose research focuses on improving the catalytic process critical to carbon mitigation, will work to develop novel catalysts for improving carbon dioxide conversion and methanol yield.

MAKING AN IMPACT ON CLIMATE AND SUSTAINABILITY

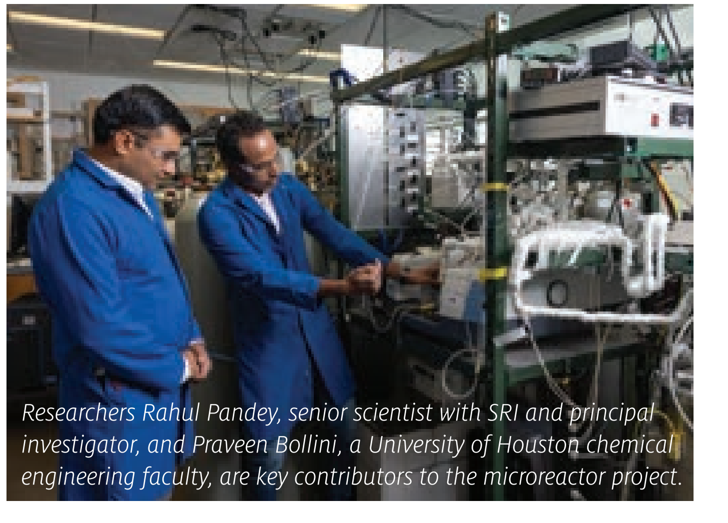
During this three-year project, the researchers will develop a microreactor prototype capable of producing 30 MJe/day of methanol while meeting energy efficiency and process yield targets. When scaled up to a 100 MW electricity capacity plant, it will be capable of producing 225 tons of methanol per day at a low cost, while reducing associated emissions by more than 88%.

A figure showing CoExtrusion printing, where thin-lines of two different material compositions are printed side-by-side to produce structured films resulting in high aspect ratio microstructures.

"What we are building here is a prototype or proof of concept for a platform technology, which has diverse applications in the entire energy and chemicals industry," Pandey said. "Right now, we are aiming to produce methanol, but this technology can actually be applied to a much broader set of energy carriers and chemicals."

Throughout the project, the team will look for opportunities to collaborate with others from the chemical and renewable fuels sectors to enhance development.

"After successfully completing the prototype, we plan to scale up and commercialize the technology in collaboration with SRI and other industrial partners," he added. "While it's challenging to provide an exact timeline for market availability, a reasonable expectation would be around five years."



Researchers Rahul Pandey, senior scientist with SRI and principal investigator, and Praveen Bollini, a University of Houston chemical engineering faculty, are key contributors to the microreactor project.

IE ALUM MOONSAMMY LEVERAGES CULLEN BACKGROUND FOR SUCCESS

BY ALEX KEIMIG

*Recent graduate **Sharon Moonsammy** collected quite a few accomplishments over the course of earning her Bachelor of Science in Industrial Engineering, including being named an outstanding senior in spring 2024, serving as an Institute of Industrial and Systems Engineers officer and a teaching assistant for the IE department, and receiving multiple internship and full-time offers for employment.*

Moonsammy shares a bit more about her experiences at the University of Houston in her own words below.

I immigrated with my family from Venezuela to Houston back in January of 2017. I enrolled in ESL classes at Lone Star College -Cy Fair to learn English and prepare for my academic endeavors. After a year and a half of language studies, I was able to enroll in college courses and successfully obtained my Associate of Science from Lone Star College - Cy Fair with Summa Cum Laude honors in the Spring of 2021. By the following Fall, I transferred to the Cullen College of Engineering at the University of Houston to pursue my Industrial Engineering degree. The reason I chose the University of Houston for my education was that it allowed me to stay close to my family while still attending a great and highly rated university.

I chose to pursue a degree in engineering at University of Houston – specifically, Industrial Engineering – because it is a degree that offers a unique blend of technical skills and business insights. Industrial engineers are trained to improve efficiency, reduce waste, and enhance productivity across various industries, including manufacturing, healthcare, logistics, finance, and consulting. This versatility opens a wide range of career opportunities; with a strong foundation in both engineering principles and management practices, industrial engineers are well-positioned to lead and innovate in diverse professional settings.

My time at the Cullen College of Engineering was instrumental in shaping my professional career. The curriculum and hands-on projects provided a solid foundation in engineering and problem-solving skills. The collaborative environment encouraged teamwork and communication skills, which are crucial in any professional setting. Additionally, the opportunities to find internships and networking with industry professionals in career fairs and student organization events gave me practical experience and connections that have been invaluable in my career.

One of the most significant experiences was my capstone project, where my team and I collaborated with Siemens Energy to implement laser scanning technology in their service centers globally. This project allowed us to apply our technical knowledge to a real-world application, enhancing efficiency and accuracy in their operations.

The faculty in the Industrial Engineering department were always incredibly supportive, offering guidance and mentorship that went beyond the classroom.

During my time at the University of Houston, I had the opportunity to be the Activities Coordinator for the Institute of Industrial and Systems Engineers (IISE). It was a fulfilling experience organizing events and getting everyone involved. I also spent two years as a Teaching Assistant for Engineering Statistics I, where I enjoyed helping students by answering their questions and clarifying difficult concepts.

One of the highlights for me was being recognized as the Outstanding Junior (2023) and Senior (2024) in Industrial Engineering. It felt amazing to have my hard work acknowledged. These experiences were incredibly rewarding and helped me grow both personally and professionally.

As a Manufacturing Engineer Intern at Powell Industries, I used Power Platform to digitize and automate daily timesheet entries, streamlining the process and benefiting many departments in the organization. I identified the necessary resources and created detailed work instructions for training and implementation of the new tool. This project ultimately saved the company a considerable amount of time. This role allowed me to enhance my technical skills and contribute to operational efficiency.

I also interned and accepted a full-time job with KPMG in their Economic and Valuation services practice. In my current role as an Associate in Tangible Assets Valuations at KPMG, I conduct appraisals of fixed assets for financial and tax reporting purposes utilizing desktop modeling tools and conducting online research. Having an engineering background is helpful in this role because we value industrial machinery and equipment in different industries. This role allows me to combine analytical skills with financial and industry specific knowledge making it a highly enriching experience.

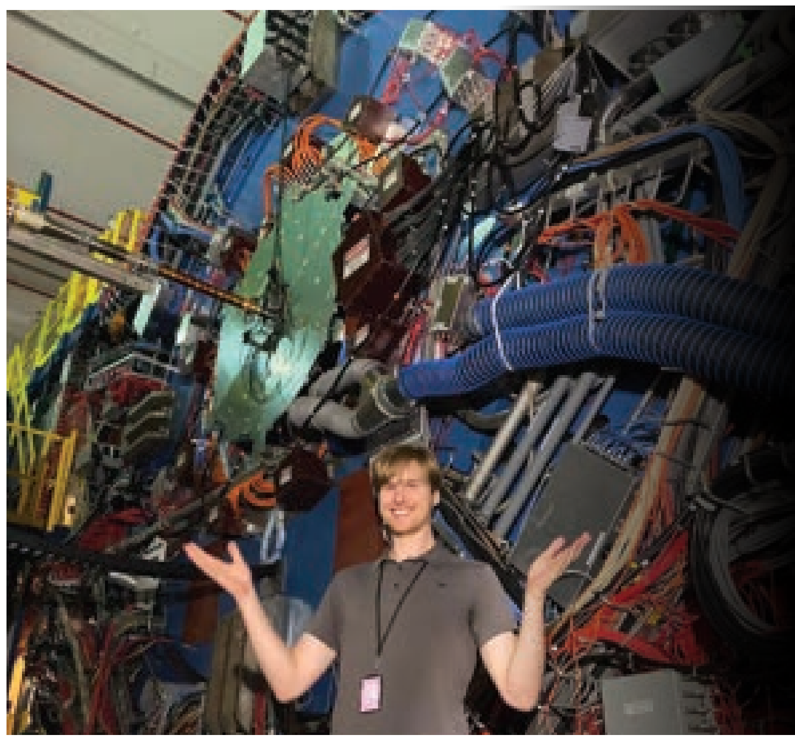
Moonsammy offers the following advice to her fellow Coogs and emerging professionals:

> “I WOULD ADVISE STUDENTS TO START BUILDING THEIR PROFESSIONAL NETWORK EARLY. CONNECT WITH ALUMNI, ATTEND NETWORKING EVENTS, AND JOIN STUDENT ORGANIZATIONS. THE CONNECTIONS THEY MAKE CAN OPEN DOORS AND PROVIDE VALUABLE INSIGHTS. LASTLY, MAKE THE MOST OF INTERNSHIPS. THEY OFFER HANDS-ON EXPERIENCE AND HELP YOU FIGURE OUT WHAT YOU ENJOY AND WHAT YOU DON'T, WHICH IS CRUCIAL FOR YOUR FUTURE CAREER.”

SEEKING ANSWERS ABOUT THE STATE OF MATTER

Ph.D. Student Caleb Broodo is Analyzing High-Energy Particle Collisions at Brookhaven National Lab

BY JEANNIE KEVER



WE LEARN MORE EVERY DAY, AND EXAMINING ITS BEHAVIOR HELPS US SOLVE THE RIDDLE OF THE UNIVERSE ONE MEASUREMENT AT A TIME.

– CALEB BROODO

Learning more about the properties of extreme matter – created through high-energy particle collisions approaching the speed of light and analyzed with the help of sophisticated advanced computing – might seem the stuff of science fiction, but it's Caleb Broodo's day job.

Physics Ph.D. student **Caleb Broodo** studies the trajectories of particles emitted from two billion collisions of atomic nuclei at Brookhaven National Laboratory's Relativistic Heavy-Ion Collider. As a member of the STAR collaboration, he uses a bus-sized detector to examine thousands of particles produced inside the collisions.

Broodo, a physics Ph.D. student at the University of Houston's College of Natural Sciences and Mathematics, is spending a year at Brookhaven National Laboratory in New York as part of the Department of Energy Office of Science Graduate Student Research Program, a selective award giving graduate students access to state-of-the-art facilities and resources at DOE national laboratories.

"We're looking at matter that's pushed to its absolute limits," Broodo said. "Once you figure that out, you have potentially the entire knowledge base of how matter behaves. This is matter that exists on such a small time scale – on the order of microseconds – but its behavior has astronomical implications."

At Brookhaven, located on Long Island, Broodo works with the Solenoidal Tracker, known as STAR, and part of the Relativistic Heavy Ion Collider (RHIC). STAR is capable of tracking thousands of particles produced by collisions inside the collider.

His goal is to extract the speed of sound in a high-temperature, high-density nuclear medium to determine the physical characteristics of extreme matter and, ultimately, to increase the scientific understanding of the so-called equation of state, or the relationship between pressure, volume, and temperature of a quantity of these particles.

Broodo said that measuring the compressibility of high temperature, high density matter for select collisions at BNL's Relativistic Heavy-Ion Collider breaks new ground in the field.

The results could yield valuable insights into quark gluon plasma – physicists know the universe was in a quark gluon plasma phase in the microseconds after the Big Bang – as well as providing more information about the matter inside neutron stars.

ACCESS TO EXPERTISE

At Brookhaven, Broodo spent a week in the control room, recording collisions of gold particles. Most of his work, however, involves data analysis of information from the collisions of these gold atoms.

To better understand what happens to these particles inside the collider, he is writing code to record various parameters, including how many particles were measured, their momentum and other data points.

"It's possible when these heavy ions collide, if the circumstances are right, you get this new phase of matter that is characterized by matter pushed to its absolute limit in terms of density and temperature, which is known as the quark gluon plasma," said Broodo, whose research focuses on heavy ion nuclear physics.

Rene Bellwied, M.D. Anderson Professor of Physics and Broodo's advisor at UH, said the award offers a valuable opportunity. "Caleb is one of our best students, and the opportunity to not only experience the collection of data firsthand but also to work for an extended period of time in the multi-national research environment with top rated scientists at BNL really allowed him to come into his own as a physicist," he said.

Bellwied is just one of the people Broodo credits with helping him along the way. Others include Lijuan Ruan, his mentor at Brookhaven and co-spokesperson for STAR; **Prithiwish Tribedy**, an expert in the STAR collaboration; **Rutik Manikandhan**, a UH graduate student and a member of the STAR collaboration; and **Omar Vasquez-Rueda**, a postdoctoral researcher at UH who works with a collaboration at the ALICE detector on the Large Hadron Collider at CERN in Switzerland.

"The great thing about this whole opportunity is resources," Broodo said. "It's not necessarily access to the collider, to computers and whiteboards, although all of that is great. It's the people. You have these technical issues you're trying to overcome, and it's one thing to email someone or get on a Skype call. It's completely different to go into somebody's office and go to the whiteboard and deliberate."

The DOE program even allowed him to meet with Barry Barish, now on the faculty at Stony Brook University, who shared the 2017 Nobel Prize in physics for the observation of gravitational waves with the historic Laser Interferometer Gravitational-wave Observatory (LIGO) experiment.

Barish's career involved other fields of experimental physics. "He helped me understand that the analysis and design skills you learn in one field are translatable to others," Broodo said. "I look forward to working in the nuclear field later on, but I take comfort in knowing that the frontiers of experimental physics are always accessible to me as long as I am willing to work for it."

A SLIGHT SHIFT IN FOCUS

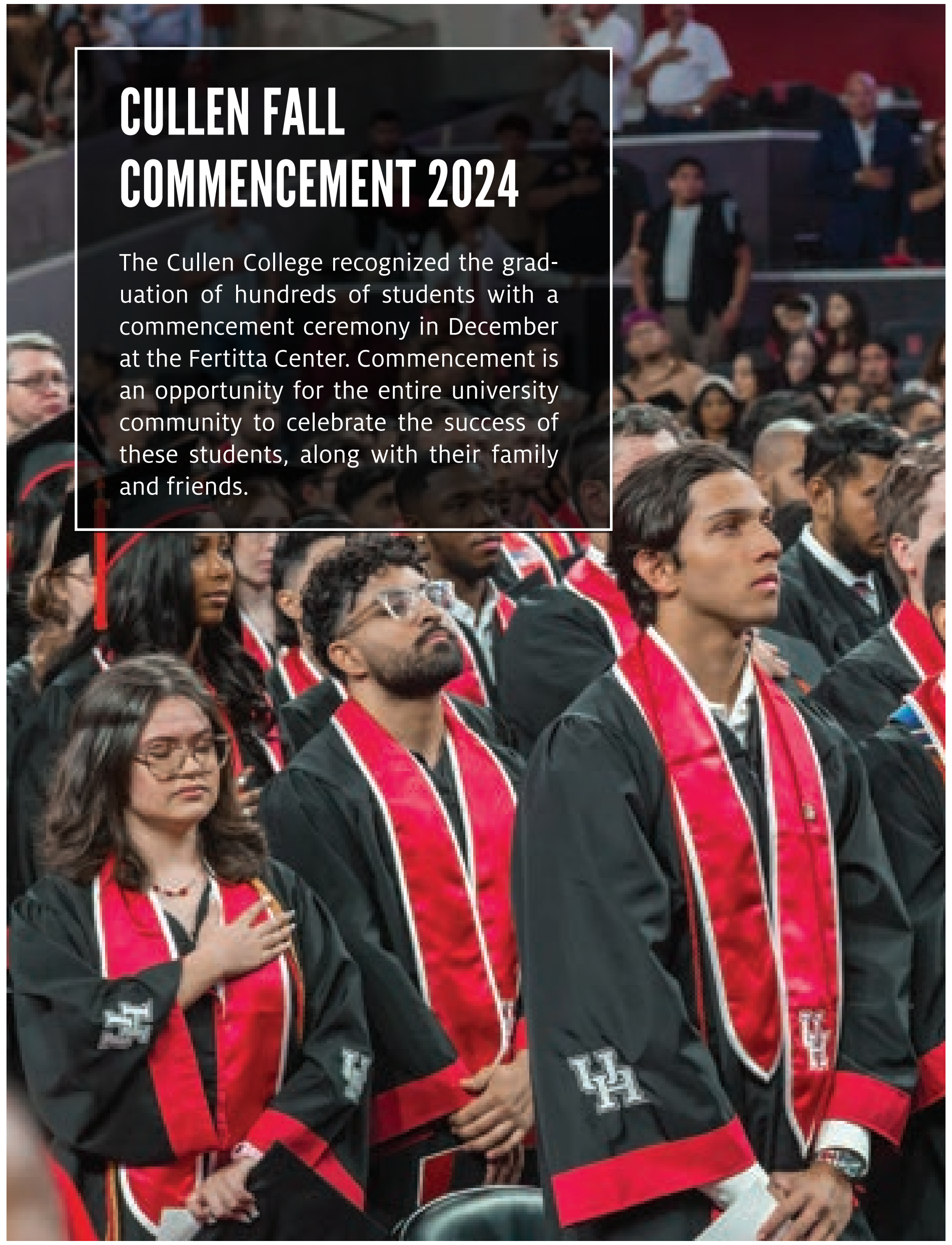
Broodo graduated from UH in 2022 with a degree in electrical engineering – he played center as a walk on for the Cougar basketball team, scoring the first points of his college career during the 2019 NCAA tournament – before pivoting to particle physics for graduate school.

It's not really such a change in direction, he said. "I work in experimental physics, and there is so much overlap between that and electrical engineering. It was always something that was of interest to me."

Engineering, of course, is generally focused on solving specific problems, while experimental physics aims for something bigger.

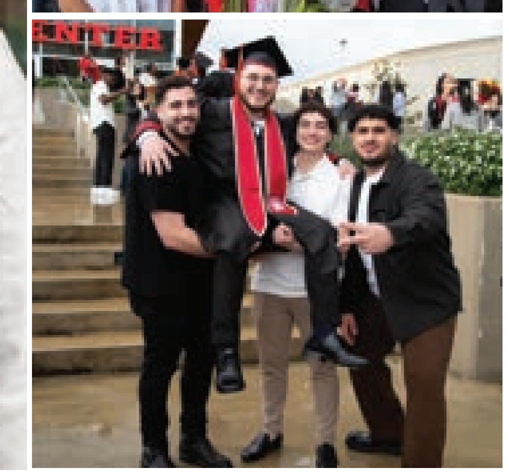
While Broodo's project could lead to a better understanding of the formation of the universe, it's also about expanding fundamental knowledge. "Its technological capacity, if any, will not be realized for another century. We're somewhat like Michael Faraday in the early 1800s, a (British) physicist who explored the nature of electric charges and fields, decades before the onset of the lightbulb or the radio would show its potential."

It's hard to see now, he said, "but perhaps someday, the topic of quarks and gluons will be as trivial as electricity is to us. We learn more every day, and examining its behavior helps us solve the riddle of the universe one measurement at a time."

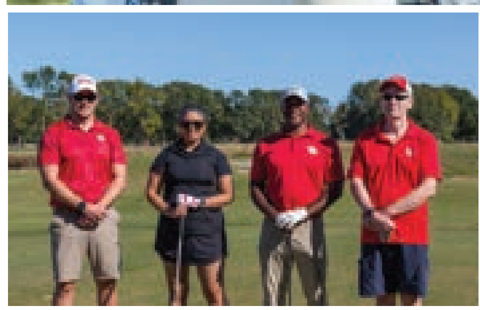
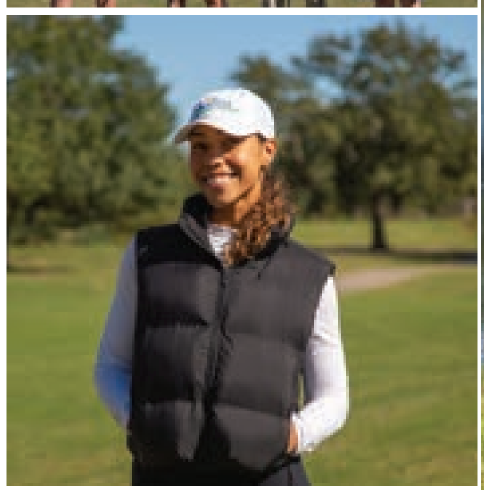


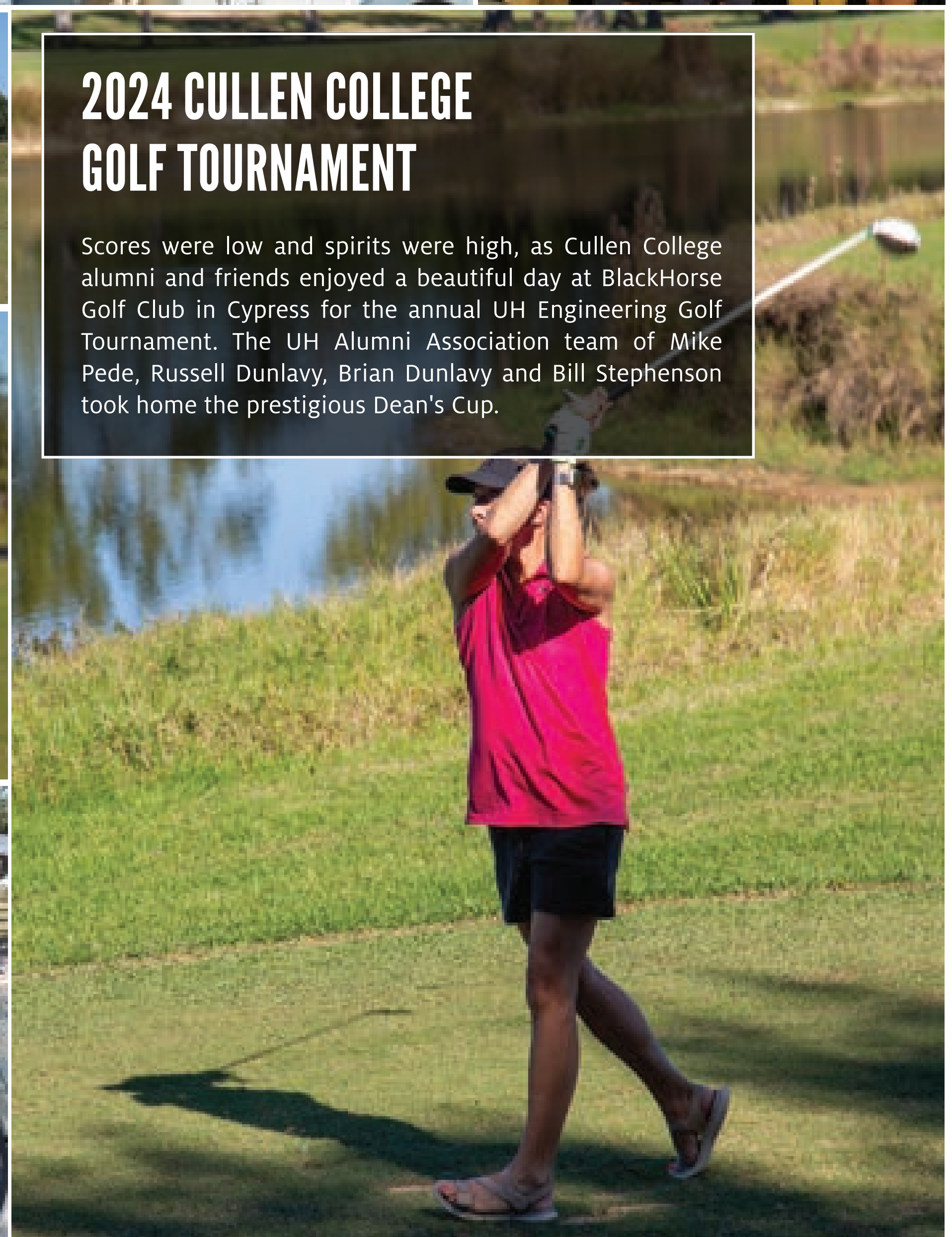
CULLEN FALL COMMENCEMENT 2024

The Cullen College recognized the graduation of hundreds of students with a commencement ceremony in December at the Fertitta Center. Commencement is an opportunity for the entire university community to celebrate the success of these students, along with their family and friends.







2024 CULLEN COLLEGE GOLF TOURNAMENT

Scores were low and spirits were high, as Cullen College alumni and friends enjoyed a beautiful day at BlackHorse Golf Club in Cypress for the annual UH Engineering Golf Tournament. The UH Alumni Association team of Mike Pede, Russell Dunlavy, Brian Dunlavy and Bill Stephenson took home the prestigious Dean's Cup.



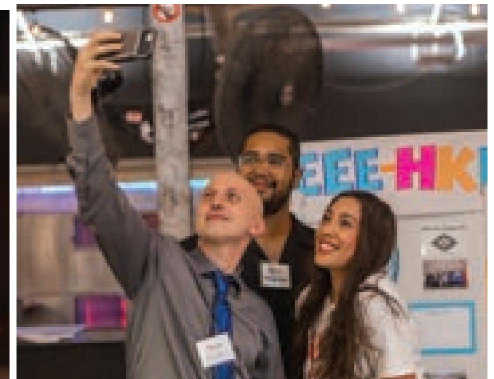
CULLEN COLLEGE OF ENGINEERING RECEPTION WITH RENU KHATOR

Staff and friends joined Renu Khator at her residence, the Wortham Home, for a reception during the last week of October 2024.

Khator, the Houston System Chancellor and the President of the flagship University of Houston campus, holds the event yearly as a way to strengthen the connection with the College and its supporters.

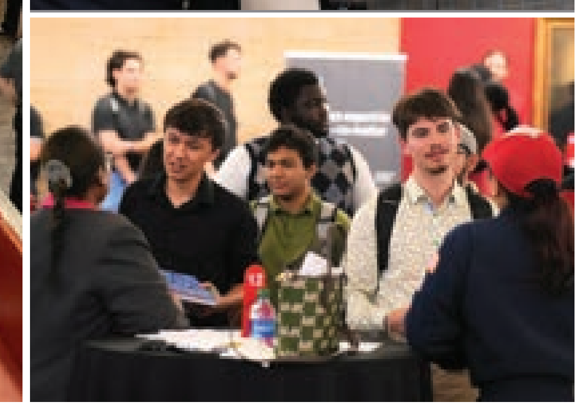

2024 EAA ANNUAL MEETING

Each year, the Engineering Alumni Association hosts an Annual Meeting and Networking Social for its members, the college and current students. It's a great way for attendees to network and to get an update on college initiatives and learn more about upcoming EAA activities and events. This year's meeting was held at Bad Astronaut Brewing Company and attended by Dean Pradeep Sharma.



FALL 2024 CULLEN NETWORKING SOCIAL

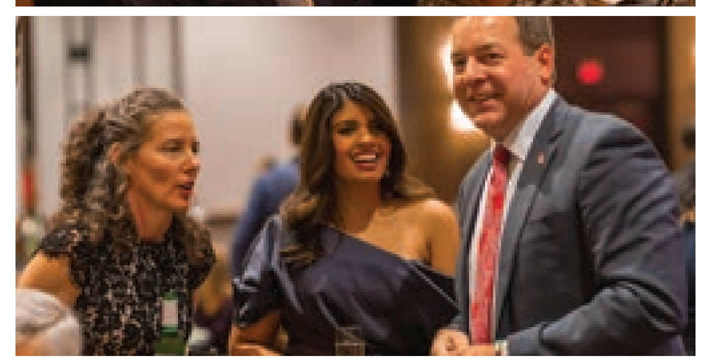
Hundreds of cougars turned out for the fall networking social, held in the Pit area of Engineering Building I on the University of Houston campus. Students got the opportunity to meet with employers from government entities and Fortune 500 companies in the Houston metro area.

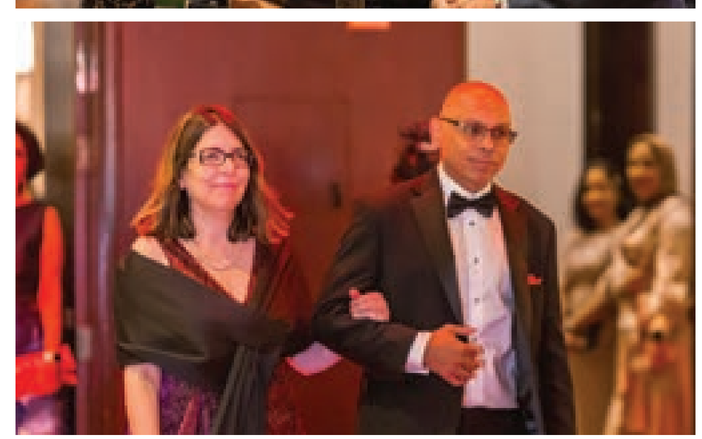


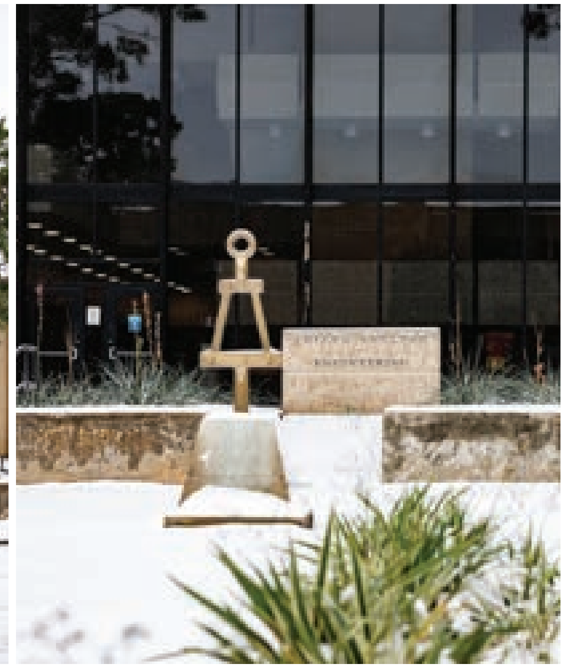
THE INAUGURAL CULLEN GALA

The first Cullen Gala was a roaring success, as a glamorous contingent representing the greater Houston Region and proud alumni highlighted what Coogs can achieve with a strong educational foundation.

Held at the Hilton Americas Hotel, the gala celebrated the recent merger of Cullen College of Engineering and Technology Division, its leadership, faculty and student body, and the impact this dynamic group of problem solvers has on our diverse economic region.







WINTER WONDERLAND

The University of Houston was closed for two days in January, thanks to Winter Storm Enzo, which left several inches of snow scattered across campus.

To learn more about events and outreach at the Cullen College,

visit **www.egr.uh.edu/events** or follow us on social media!

UHEngineering @uhengineering University of Houston Cullen College of Engineering @uhengineering @uhengineering

View more photos online at

www.flickr.com/photos/cullencollege/albums

AN INLAND SHIPPING PORT EXPANDS **OUR VISION OF SEAPORTS**

Today, an inland seaport. The University of Houston presents this series about the machines that make our civilization run, and the people whose ingenuity created them.

Seaports are wondrous places. Huge ships carry the stuff of dai-ly life to far-flung ports. They let us feel the presence of other lands and their needs. Our Port of Houston handles America's largest trade – a quarter-billion tons a year. And it spreads out over some 50 miles. But today, I'm drawn to another American port.

The twin port of Duluth and Superior, in Minnesota and Wis-con-sin. It's the furthest from any ocean. It lies at the west end of the world's largest fresh-water lake – Lake Superior. Minne-sotans know its Native American name of Gitchi-Gami – that means Great Sea. This port, unlike most other US ports, largely deals in raw materi-als. An iron ore called taconite accounts for over half its ship-ping. And its ships carry grain, coal, and limestone.

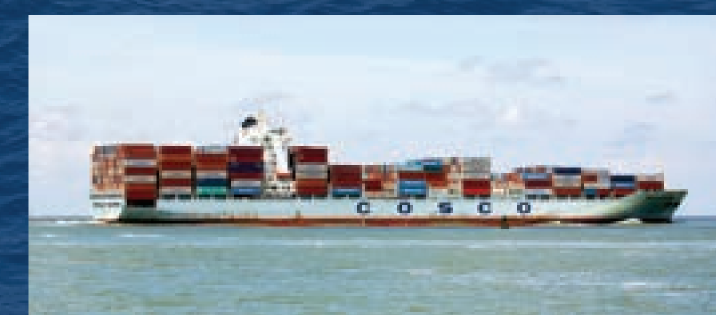
Those ships are unlike the so-called Salties that cross oceans. Fresh water is less dense than ocean water, and the ships dif-fer. Laker boats, as they're called, are huge. Some exceed a thousand feet. Few have the loading superstructures we see on ships that carry manufactured goods or containers. And here, shipping usually stops when the lake, and the locks on its east end, freeze over. That's in mid-January to late March.

A lake this large poses threats just as surely as an ocean does. One cold November in 1975, the ore boat Edmund Fitzgerald carried taconite to a steel mill in Detroit. It went down with its full crew in a terrible storm. Gordon Lightfoot's song about its sinking still echoes today.

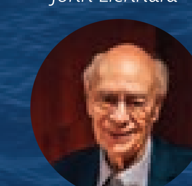
But that was just one ship out of some six thousand that lie on the bottom. For every wreck they've found, nine more are still lost. The Lake is most lethal in November, near the Soo Locks that connect with lake Huron. Those locks, by the way, are the first of many on the way to the Atlantic Ocean, twenty-four-hundred miles away.

Now AI locates shipping with pinpoint accuracy at all times. We have far better means for predicting weather. The ships are saf-er. The dangers, far less today. But new threats arrive with new tech-nology. Here, in the Gulf of Mexico, ships have to avoid thou-sands of abandoned oil well platforms. Some are visible. But some lurk unseen below the surface. Shipping will always turn-upon any-one who quits paying attention.

So I watch ships coming and going in our vast seaports. Great con-tainer ships – or those majestic ore boats, passing under Du-luth's lovely lift-bridge. And I hear an old Spanish song, Partens las Gal-eras. It tells of ships sailing off to far-away lands. And our longing for both repose and adventure out on those vast seas. Houston and Duluth are so different, yet so alike in that sense of connec-tion. In each, the edges of great waters become great market-plac-es – great agoras that help hold our splintered world together.



John Lienhard



The Engines of Our Ingenuity is a nationally recognized radio program authored and voiced by John Lienhard, professor emeritus of mechanical engineering and history at the University of Houston and a member of the National Academy of Engineering. The program first aired in 1988, and since then more than 3,000 episodes have been broadcast. For more information about the program, visit www.uh.edu/engines.

Watch this edition of Engines Of Our Ingenuity on our YouTube Channel:

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