PARAMETERS

Cullen College of Engineering Magazine • Spring 2023

MAKING A DIFFERENCE:

SPOTLIGHT ON

ST. ELMO BRADY Academy

Cullen College of Engineering
UNIVERSITY OF HOUSTON


WE KNOW WHAT
NEEDS TO BE DONE.
AND WE'RE DOING IT.
ENGINEERED FOR
WHAT'S NEXT.

MAKING A DIFFERENCE: PG. 50

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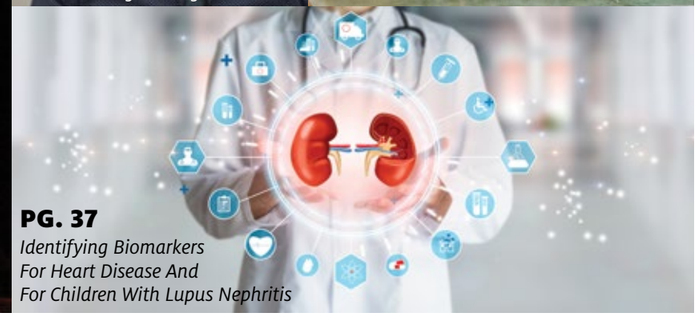
Rajashekara Named Global Energy Prize Laureate
PG. 60



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Identifying Biomarkers For Heart Disease And For Children With Lupus Nephritis

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Cullen College of Engineering

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PARAMETERS

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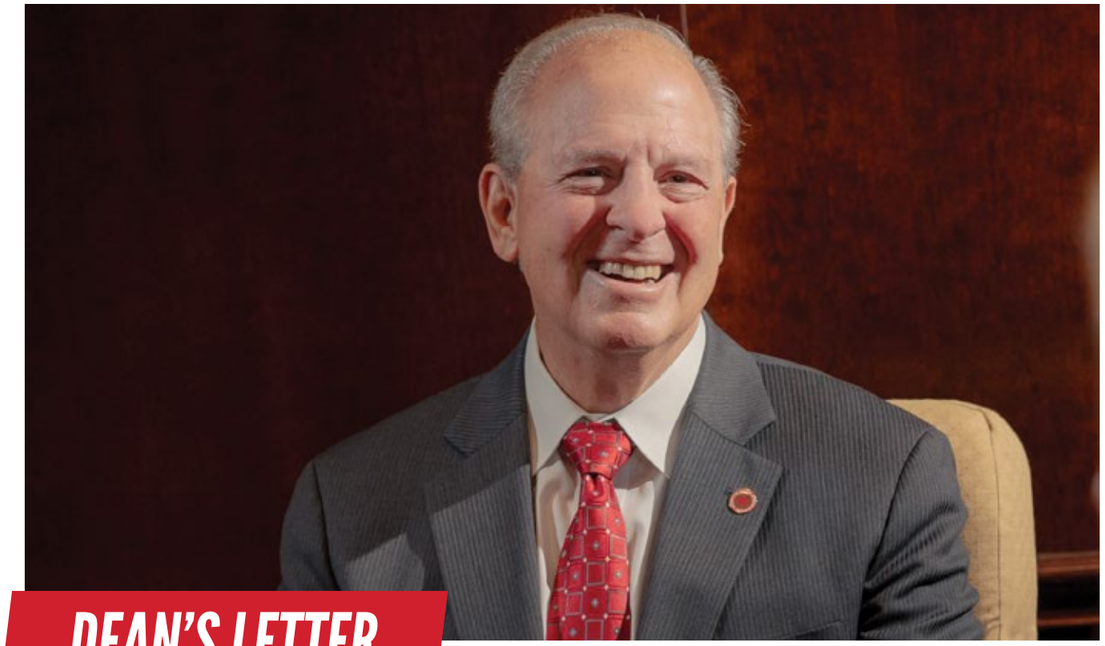


DEAN'S LETTER

Imagine a world without engineers, scientists, or researchers. How the world functions as we know it would be different. We would be without homes to live in, cell phones to communicate, computers to process complicated equations, or the internet to access our favorite social media platform. Most of our everyday technologies now come from modern sciences, technology, engineering, and math (STEM) innovations.

As the Cullen College continues to grow its student body, it's essential to look for ways to engage and cultivate STEM opportunities that will ensure the next generation of engineers are ready to tackle both the technical challenges and the broader issues that Houston and the society will face.

With the rapid growth of STEM jobs and a steady stream of interest in establishing K-12 STEM outreach programs, the challenge of engaging the youth from underrepresented communities remains. Creating pathways for underrepresented minority students to become involved in STEM education early on is critical in pursuing secondary education and a successful STEM career path.

One way our college meets this challenge is through STEM academies. In this issue of Parameters, we highlight the St. Elmo Brady STEM Academy, which is now in its 10th year of operation for the program overall and seven in Houston. St. Elmo Brady leaders Rick Greer, a K-12 education specialist, and Jerrod Henderson, now an Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, inspires the next generation of engineers and provides UH student volunteers with a valuable experience working in a classroom and networking with corporate sponsors.

Every day, I'm inspired by our college community's transformational effort to address our society's issues. I'm pleased by how we are reimagining the fundamentals of our curriculum to tackle these problems head-on to provide a pathway for future generations. I hope you enjoy reading through these stories and find the exciting potential in them, as I did.

Here at the Cullen College, our mission is to empower today's bright minds so that we can power a new possible together. This is how through it all, we are engineered for what's next.

Warm regards,

Joseph W. Tedesco

Joseph W. Tedesco, Ph.D., P.E.
Elizabeth D. Rockwell Dean and Professor

ENGINEERING SNAPSHOTS

PARAMETERS ON THE FIVES

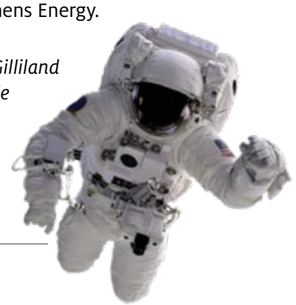
BY STEPHEN GREENWELL

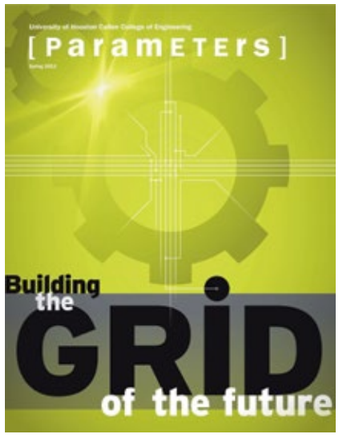
A look back at past **PARAMETERS** stories and interview subjects, and what those Cougars are up to now.

FIVE YEARS BACK...

The Spring 2018 edition profiled several Cullen researchers and students finding "The Next BIG Thing," in the fields of space architecture, big data, biomedical engineering and robotics. Several of the students profiled at the time are now making their way through their respective fields. **Tyler Gilliland** has been an aerospace engineer at Intuitive Machines for more than five years, after earning his M.S. in Aerospace, Aeronautical and Astronautical Engineering from UH in 2018. **Thomas Lagarde** earned his M.S. that year as well, and recently took on a new role as Director of Digitalization for Siemens Energy.

Left to Right: Tyler Gilliland and Thomas Lagarde

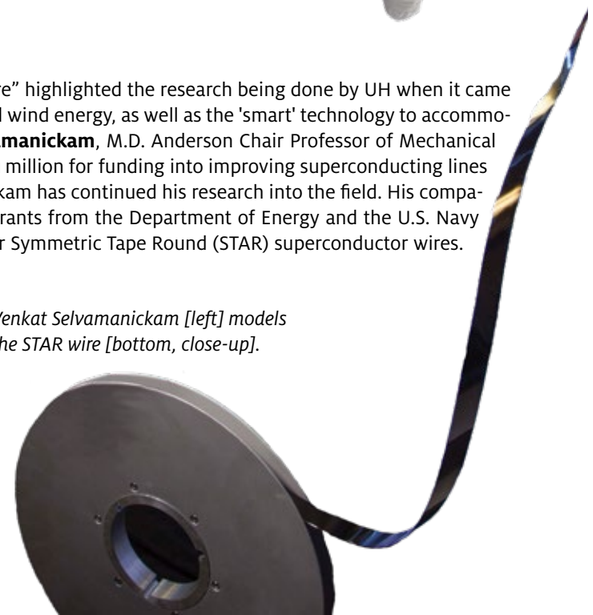


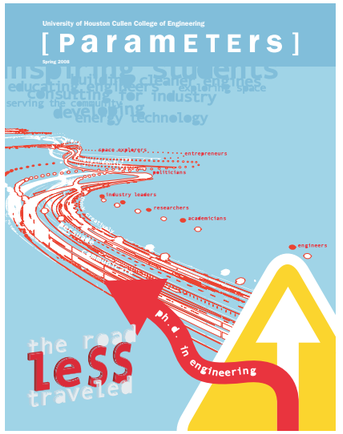


TEN YEARS BACK...

"Building the Grid of the Future" highlighted the research being done by UH when it came to superconductivity, solar and wind energy, as well as the 'smart' technology to accommodate it. **Venkat "Selva" Selvamanickam**, M.D. Anderson Chair Professor of Mechanical Engineering, had received $2.1 million for funding into improving superconducting lines for wind turbines. Selvamanickam has continued his research into the field. His company, AMPeers, received three grants from the Department of Energy and the U.S. Navy in 2021 totaling $1.6 million for Symmetric Tape Round (STAR) superconductor wires.

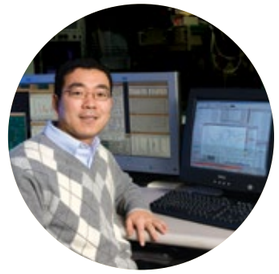
Venkat Selvamanickam [left] models the STAR wire [bottom, close-up].





FIFTEEN YEARS BACK...

The path to a graduate degree in engineering is seldom a straight line from high school to an undergraduate degree and beyond. "The Road Less Traveled: Ph.D. in Engineering" allowed seven prominent doctoral graduates of the Cullen College of Engineering to talk about their journey when it came to higher education. The subjects profiled, and where they are now:



Left to Right: Patrick Fink, Xiuli Wang, and Feng Zhang

Bonnie Dunbar, Biomedical Engineering, '83. Dunbar completed her degree while working for NASA, and on five different missions, she logged more than 50 days in space. She retired from the organization in 2005. On terra firma, she served as the president and CEO of the Museum of Flight in Seattle until 2010. Dunbar was a member of the Cullen faculty until 2015. She is now a professor at Texas A&M.

Patrick Fink, Electrical Engineering, '02. Fink is now the Chief Technologist for the Wireless and Communication Systems Branch of NASA. A 20-year veteran of the organization, he has worked extensively in the areas of antenna design and development, computational electromagnetic simulations and radio frequency identification systems. In 2020, he was selected for the NASA Inventors Hall of Fame.

Ven Pinjala, Chemical Engineering, '85. After a 24-year career at Aspen Technology – also known as AspenTech, an asset optimization software company – Pinjala retired in the summer of 2021. For his last seven years there, he served as Regional Business Director for the company, which has close to 1,500 employees nationally and more than $600 million in yearly revenue.

Xiuli Wang, Chemical Engineering, '00. Wang is now a consultant with more than 20 years of experience in the oil and gas industry, thanks to long stints at industry leaders like Baker Hughes and BP. In addition to being a past lecturer at UH, Wang also served as the associate editor-in-chief of *The Journal of Natural Gas Science and Engineering*.

Daniel Wong, Civil Engineering, '88. Wong is President and CEO of Tolunay-Wong Engineers, Inc., which is headquartered in Houston and has 10 offices in Texas and Louisiana. The firm employs hundreds of engineers, scientists and other professionals, and consults on a variety of projects in the Gulf Coast region. Wong has given generously to the College, establishing an Endowed Professorship in 2020, and he was named the 2022 Houston Engineer of the Year.

Victor Zaloom, Industrial Engineering, '70. Zaloom was named Associate Dean of Engineering at Lamar University in 2006, and served in that role until 2010, as well as a tenured professor. Since then, he has also served as an Interim Dean of the school's Graduate School, as well as the College of Engineering, through 2019. He is currently the Interim Chairman of the Department of Industrial Engineering.

Feng Zhang, Mechanical Engineering, '05. After four years as a research engineer for Ford and two years for an automotive company in Shanghai, Zhang transitioned into the energy industry. After seven years working for Envision Energy, digitizing aspects of the wind turbine industry and dealing with product engineering, he became a product director for Utopus Insights. His work focuses on wind, solar, battery and hybrid renewable energy farms.

IN THE MEDIA **SPOTLIGHT**

NASA PARTNERSHIP MAKES HEADLINES

ABC13 KTRK-TV and Houston CultureMap recently spotlighted the expansion of the longtime partnership between the University of Houston System and Johnson Space Center. The partnership will center on research and projects focused on human and robotic spaceflight missions across relevant disciplines in engineering, science, business and technology.

VIEW ONLINE AT:

ABC 13
https://abc13.com/university-of-houston-nasa-agreement-johnson-space-center-uh-students/11958828/

Culturemap Houston
https://houston.culturemap.com/news/innovation/06-14-22-university-of-houston-johnson-space-center-nasa-partnership/

ROBOTIC REHABILITATION FOR STROKE RESEARCH

Houston InnovationMap featured the work of **Jose Luis Contreras-Vidal**, Hugh Roy and Lillie Cranz Cullen Distinguished Professor and Director of the NSF IUCRC BRAIN Center. The article features a next-generation robotic arm that can be controlled by the user's brainwaves to aid in stroke rehabilitation. Contreras-Vidal developed the brain-computer interface (BCI) used by the arm. The device is now undergoing patient trials.

READ MORE ONLINE AT:

https://houston.innovationmap.com/university-of-houston-stroke-robotics-jose-luis-contreras-vidal-2657582417.html

LA TIMES FEATURES **BEACH AND DUNE LOSS STUDY**

The Los Angeles Times Daily Pilot e-newspaper featured the work between **Pietro Milillo**, an assistant professor of civil and environmental engineering at UH, and researchers at UC Irvine. They are working together to develop monitoring techniques to track erosion at local beaches and dunes by satellite. The results gathered will be used to strengthen protections for these resources.

LEARN MORE AT:

https://www.latimes.com/socal/daily-pilot/news/story/2022-07-09/nasa-grant-to-go-toward-uci-led-project-studying-beach-dune-loss

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

SPOTLIGHT ON **GEN Z AND THE ENERGY** INDUSTRY

Forbes.com reached out to **Ramanan Krishnamoorti**, Vice President for Energy and Innovation and professor of chemical & biomolecular engineering, petroleum engineering and chemistry, to discuss the energy industry transition and whether or not Gen Z simply cares about its future, as well as ways the industry is evolving to attract and retain young talent.

COVERED BY:

https://www.forbes.com/sites/uhenergy/2022/07/22/does-gen-z-care-about-the-energy-industry/?sh=406d8cf82e76

HONORING CONTRIBUTORS WITH **SPACE BOUND MICROCHIPS**

ABC13 and KHOU11 featured the work of **Long Chang**, a research associate professor at the Cullen College of Engineering, and his efforts to honor those who worked on the latest Artimes 1 mission to the moon. The unmanned spacecraft carried the names of thousands of workers engraved on microchips as a tribute to their efforts. Upon return, the microchips will be used as mementos of the historic mission.

LEARN MORE AT:

ABC 13
https://abc13.com/artemis-i-moon-mission-microchips-made-at-the-university-of-houston-long-chang/12183408/

KHOU 11
https://www.khou.com/article/tech/science/space/nasa-us-artemis-team-microchips/285-974a599c-83fe-422b-a8a9-e1d54043bab9

Photo Credits: NASA/Eric Bordelon

EXTRACTING LITHIUM FROM SHALE OIL WASTEWATER

FOX26 highlighted the work of **Kyung Jae Lee**, assistant professor of petroleum engineering, a new process to extract lithium from shale oil wastewater. The research spurred from Lee's desire to support the clean energy transition and supporting the renewable energy supply. Use of the extraction process from fracking wastewater could potentially double the U.S.'s needed supply of lithium.

READ MORE ONLINE AT:

https://www.fox26houston.com/news/uh-professor-develops-process-to-extract-lithium-from-shale-oil-wastewater

DISMISSING **ONE-SIZE-FITS-ALL** PROTOCOLS

Houston InnovationMap featured **Mehmet Orman**, assistant professor of chemical and biomolecular engineering, in its online article discussing safety protocols in the lab. Orman detailed some of the steps taken to keep safety measures in place in his lab, which focuses on combating drug resistant bacteria. In the article, Orman describes his best practices for lab safety, including tailoring safety protocols to suit the environment of the lab.

VIEW ONLINE AT:

https://houston.innovationmap.com/university-of-houston-big-idea-lab-safety-2657975442.html?rebelltitem=6#rebelltitem6

UH System Partners With NASA To Help 'Advance Human Spaceflight'

BY CHRIS STIPES

A Boeing Delta II lifts off at 8:52 p.m. Wednesday, Oct. 25 from Launch Pad 17B at Cape Canaveral Air Force Station, Florida. Payload for the mission was NASA's STEREO spacecraft, two NASA observatories on a two-year mission to study solar flares. The 45th Space Wing's support helped ensure public safety and mission success via radar, telemetry, communications and meteorological systems.

Photo Credit: pexels.com

The University of Houston System and NASA's Johnson Space Center (JSC) are expanding a longtime partnership to work collaboratively on joint research, technology development, technology transfer, training and educational and outreach initiatives.

As NASA endeavors to travel deeper into space, these efforts will be carried out through the undergraduate, graduate, and joint research programs at the four UH System universities: University of Houston, University of Houston-Downtown, University of Houston-Clear Lake and University of Houston-Victoria.

University of Houston System Chancellor Renu Khator attended a signing ceremony at Johnson Space Center on June 10 where she met with JSC Director Vanessa Wyche to discuss the partnership. Loren Blanchard and Richard Walker, presidents of UH-Downtown and UH-Clear Lake, respectively, were also in attendance, as well as **Joseph W. Tedesco**, Elizabeth D. Rockwell Dean of the Cullen College of Engineering.

"Houston is 'Space City,' so it's important for students and faculty in relevant disciplines across the UH System to have opportunities to engage in and be exposed to real world space flight-related research and technology development with NASA," said Khator. "These are the kinds of projects that shape lives and create innovations for the greater good."

Areas of interest for this partnership encompass science, engineering, technology and business disciplines that are vital for human and robotic spaceflight missions, aerial and ground-based research, including data analytics, cybersecurity and other emerging technologies.

UH System Chancellor Renu Khator and JSC Director Vanessa Wyche sign an extension of a longtime partnership.

Engaging in this partnership with the UH System will enable Johnson Space Center to reduce gaps in mission relevant technology development essential for future human spaceflight missions and inspire and engage students in aeronautics, space and science, according to Wyche.

"NASA's Johnson Space Center has a long history of working with colleges and universities since the early days of Mercury, Gemini, and Apollo programs to help us achieve our human spaceflight missions," said Wyche. "We are eager to partner and collaborate with the University of Houston system in vital research and technology development initiatives that will enable us to meet our nation's exploration goals and advance human spaceflight as we work to land the first woman and first person of color on the Moon under Artemis."

Dean Tedesco, Chancellor Khator and Director Wyche with other NASA and UH System officials after the partnership signing.

UH System universities have collaborated with NASA for more than a half century on various educational and outreach endeavors, most recently with UH's Subsea Systems Institute, but this renewed focus will broaden the scope of opportunities across the UH System.

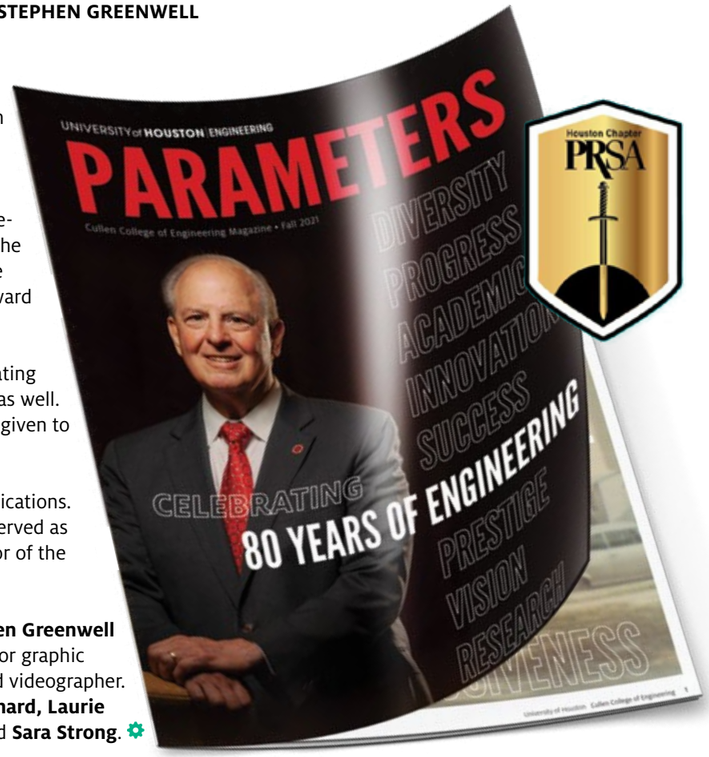
The NASA Office of STEM Engagement will work with UH-Downtown, for example, to target students (pre-service teachers) primarily in the College of Public Service's Department of Urban Education to identify learning opportunities and provide connections to NASA's missions and work through seminars, campus-wide open houses, classroom visits and more.

UH-Clear Lake and NASA, given their close geographic proximity, have had a symbiotic relationship ever since the Manned Spacecraft Center (now Johnson Space Center) was formed in 1961. Collaboration on academic programming and research will only expand under the new system-wide agreement

AWARD SEASON

COMMUNICATIONS WINS TWO GOLD EXCALIBUR AWARDS

BY STEPHEN GREENWELL



A pair of items from the Communications Team at the Cullen College of Engineering have been recognized with gold from the Houston chapter of the Public Relations Society of America at their yearly Excalibur Awards.

In the Magazine category, the Fall 2021 edition of Parameters, "Celebrating 80 Years Of The Cullen College," won the gold award. The Spring and Fall 2021 magazines from the University of Houston took the silver award. A bronze award was not given out.

For the Social Media category, the campaign for "Celebrating 80 Years of the Cullen College" received the gold award as well. A silver award was not given out. The bronze award was given to Felicia Renee Griffin of Executive Social Media.

Rachel Knudsen was the Executive Director of Communications. **Inez Hutchinson** - now Director of Communications - served as Communications Manager. She also is the primary creator of the College's social media campaigns.

For "Celebrating 80 Years Of The Cullen College," **Stephen Greenwell** was senior writer and editor, with **Dana Johnson** as senior graphic designer and **Jeffrey Lautenberger** as photographer and videographer. Contributing writers included **Jeannie Kever, John Lienhard, Laurie Fickman, Chris Stipes, Sara Tubbs, Nicole Johnson** and **Sara Strong**.

Pictured left to right: Miranda Vernon-Harrison, Robert Dial and Ralph Brown

THREE CULLEN EMPLOYEES HONORED WITH UH AWARDS

BY STEPHEN GREENWELL

In two separate announcements, three staffers at the Cullen College of Engineering have been recognized and awarded for their exemplary work as employees by the University of Houston.

Miranda Vernon-Harrison, the Director of Graduate Student Affairs, is one of eight people and organizations receiving one of the inaugural Staff Council Awards. **Robert Dial** and **Ralph Brown** of the Electrical Engineering Department received President's Excellence Awards in the area of Technical, Service & Craft.

The Staff Council Awards recognize employee excellence at the University of Houston. According to the nominating criteria, recipients must demonstrate a positive attitude that encompasses qualities in alignment with Staff Council values: service, training, advocacy, networking, diversity and sustainability (STANDS). Vernon-Harrison will receive an engraved award and a special acknowledgment at a Staff Council General Meeting. In addition, recipients will be featured in the Staff Connect newsletter and spotlighted on Staff Council social media.

The President's Excellence Awards recognizes a select group of employees from a qualifying group with service longevity of 10 years or more, every five years. Dial and Brown were honored with 13 other award recipients at a luncheon in September.

The College extends its congratulations to Miranda, Robert and Ralph!

SUPPORTING LONG-DURATION **GRID-SCALE ENERGY STORAGE**

BY KARN DHINGRA

Yan Yao's research student working on his studies about sodium batteries.

Lithium-ion batteries are currently the preferred technology to power electric vehicles, but they're too expensive for long-duration grid-scale energy storage systems, and lithium itself is becoming more challenging to access.

While lithium does have many advantages – high energy density and capacity to be combined with renewable energy sources to support grid-level energy storage – lithium carbonate prices are at an all-time high. Contributing to the rising cost are pandemic-related supply-chain bottlenecks, the Russia-Ukraine conflict and increased demand from businesses. Additionally, many governments are hesitant to green light lithium mines because of the high environmental costs and the potential of human rights violations.

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

Yan Yao, Cullen Professor of Electrical and Computer Engineering, and his colleagues developed a homogeneous glassy electrolyte that enables reversible sodium plating and stripping at a greater current density than previously possible.

"The quest for new solid electrolytes for all-solid sodium batteries must concurrently be low cost, easily fabricated, and have incredible mechanical and chemical stability," said Yao, who is also principal investigator of the Texas Center for Superconductivity at the University of Houston (TcSUH). "To date, no single sodium solid electrolyte has been able to achieve all four of these requirements at the same time."

The researchers found a novel form of oxysulfide glass electrolyte that has the potential to satisfy all of these requirements at the same time. A high-energy ball milling process was used to create the electrolytes at room temperature.

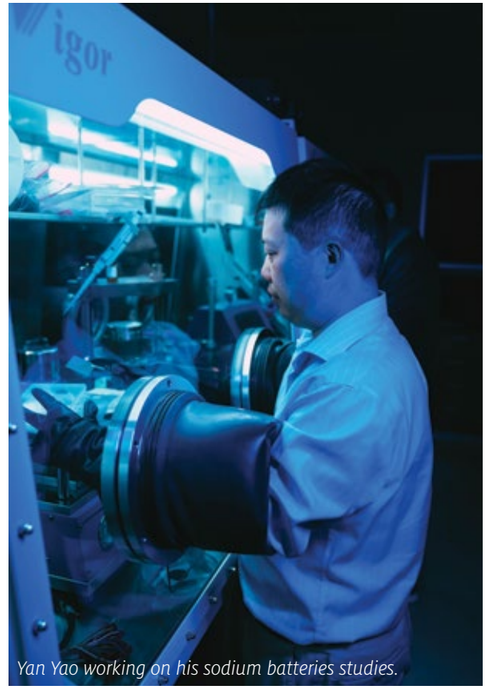
"The oxysulfide glass has a distinct microstructure, resulting in a completely homogeneous glass structure," said **Ye Zhang**, who works as a research associate in Yao's group. "At the interface between sodium metal and the electrolyte, the solid electrolyte forms a self-passivating interphase that is essential for reversible plating and stripping of sodium."

It has proven difficult to achieve stable plating and stripping of sodium metal using a sulfide electrolyte.

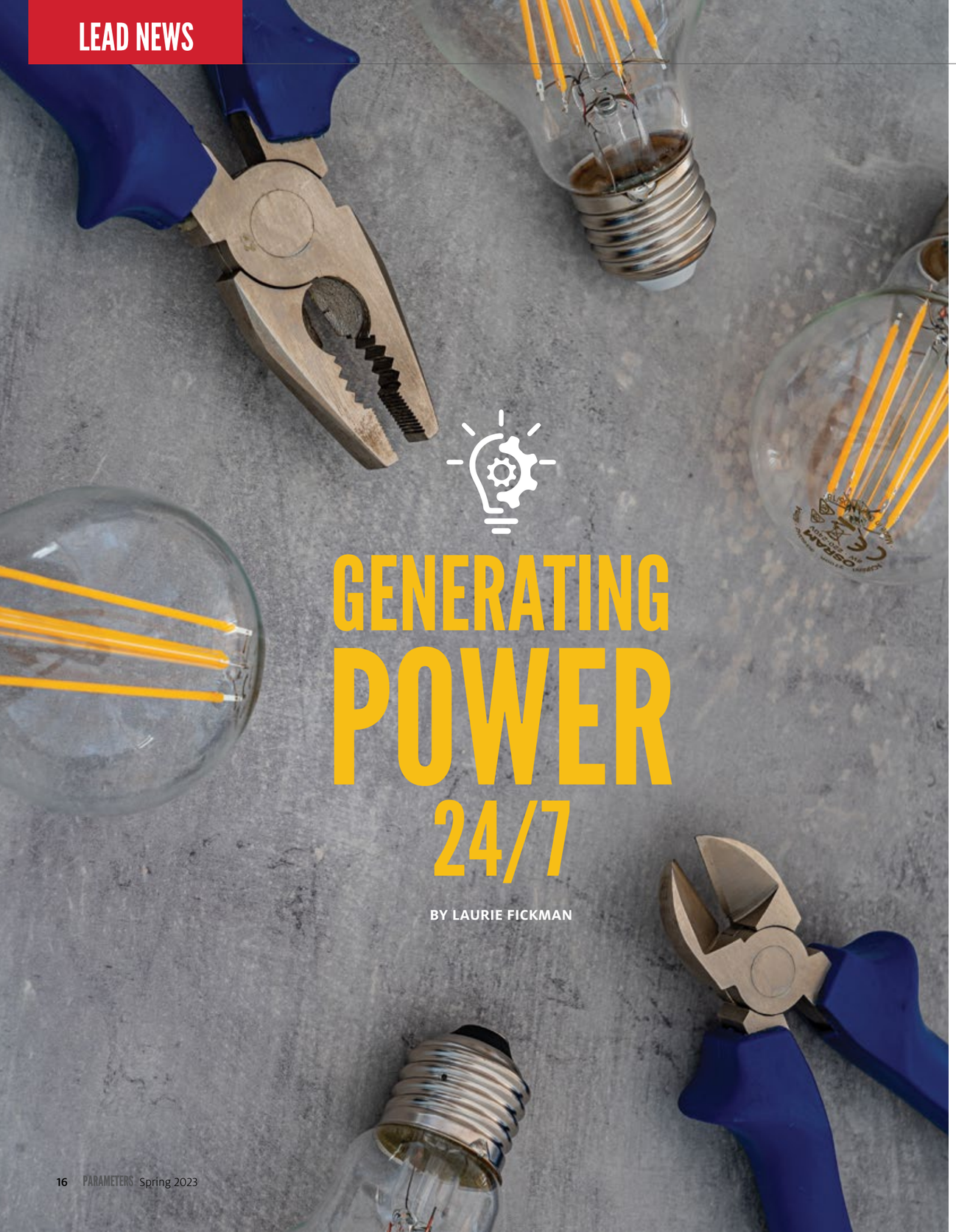
"Our study overturned this perception by establishing not only the highest critical current density among all Na-ion conducting sulfide-based solid electrolytes, but also enabling high-performance ambient-temperature sodium-sulfur batteries," Yao explained.

"The new structural and compositional design strategies presented in this work provide a new paradigm in the development of safe, low-cost, energy-dense, and long-lifetime solid-state sodium batteries," Zhang added.

In addition to Yao and Zhang, co-authors of the study include co-first authors **Xiaowei Chi** and **Fang Hao** of UH; and **Steven Kmiec** and co-corresponding author **Steve Martin** of Iowa State University. Rice University, Purdue University, and UC Irvine are all collaborators on this project. This research was funded by the U.S. Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E).



Yan Yao working on his sodium batteries studies.



GENERATING POWER 24/7

BY LAURIE FICKMAN

Thomas Edison once said, "So long as the sun shines, man will be able to develop power in abundance."

His wasn't the first great mind to marvel at the notion of harnessing the power of the sun; for centuries inventors have been pondering and perfecting the way to harvest solar energy.

They've done an amazing job with photovoltaic cells which convert sunlight directly into energy. And still, with all the research, history and science behind it, there are limits to how much solar power can be harvested and used – as its generation is restricted only to the daytime.

A University of Houston professor is continuing the historic quest, reporting on a new type of solar energy harvesting system that breaks the efficiency record of all existing technologies. And no less important, it clears the way to use solar power 24/7.

"With our architecture, the solar energy harvesting efficiency can be improved to the thermodynamic limit," reports **Bo Zhao**, Kalsi Assistant Professor of Mechanical Engineering and his doctoral student **Sina Jafari Ghalekohneh** in the journal *Physical Review Applied*. The thermodynamic limit is the absolute maximum theoretically possible conversion efficiency of sunlight into electricity.

Finding more efficient ways to harness solar energy is critical to transitioning to a carbon-free electric grid. According to a recent study by the U.S. Department of Energy Solar Energy Technologies Office and the National Renewable Energy Laboratory, solar could account for as much as 40 percent of the nation's electricity supply by 2035 and 45 percent by 2050, pending aggressive cost reductions, supportive policies and large-scale electrification.

How Does It Work?

Traditional solar thermophotovoltaics (STPV) rely on an intermediate layer to tailor sunlight for better efficiency. The front side of the intermediate layer (the side facing the sun) is designed to absorb all photons coming from the sun. In this way, solar energy is converted to thermal energy of the intermediate layer and elevates the temperature of the intermediate layer.

Bo Zhao and his doctoral student Sina Jafari Ghalekohneh

ENERGY

But the thermodynamic efficiency limit of STPVs, which has long been understood to be the blackbody limit (85.4 percent), is still far lower than the Landsberg limit (93.3 percent), the ultimate efficiency limit for solar energy harvesting.

"In this work, we show that the efficiency deficit is caused by the inevitable back emission of the intermediate layer towards the sun resulting from the reciprocity of the system. We propose nonreciprocal STPV systems that utilize an intermediate layer with nonreciprocal radiative properties," Zhao said. "Such a nonreciprocal intermediate layer can substantially suppress its back emission to the sun and funnel more photon flux towards the cell.

We show that, with such improvement, the nonreciprocal STPV system can reach the Landsberg limit, and practical STPV systems with single-junction photovoltaic cells can also experience a significant efficiency boost."

Besides improved efficiency, STPVs promise compactness and dispatchability (electricity that can be programmed on demand based on market needs).

In one important application scenario, STPVs can be coupled with an economical thermal energy storage unit to generate electricity 24/7.

"Our work highlights the great potential of nonreciprocal thermal photonic components in energy applications. The proposed system offers a new pathway to improve the performance of STPV systems significantly. It may pave the way for nonreciprocal systems to be implemented in practical STPV systems currently used in power plants," Zhao said.

CRYSTAL GROWTH & DESIGN PICKS RYOU RESEARCH GROUP WORK FOR COVER

BY STEPHEN GREENWELL

LOOK FOR THIS COVER TO READ THE FULL ARTICLE!

CRYSTAL GROWTH & DESIGN: Thermodynamic Analysis of Hybrid Chemical Vapor Deposition of Transition-Metal-Alloyed Group-III-Nitride ScAlN Piezoelectric Semiconductor Films

Authored by Mina Moradnia, Sara Pouladi, Jie Chen, Nam-In Kim, Onosetale Aigbe and Jae-Hyun Ryou.

A paper from the research group of **Jae-Hyun Ryou**, Associate Professor of Mechanical Engineering, was chosen for the cover of *Crystal Growth & Design*.

"Thermodynamic Analysis of Hybrid Chemical Vapor Deposition of Transition-Metal-Alloyed Group-III-Nitride ScAlN Piezoelectric Semiconductor Films" was published in the journal earlier this year, with one of five cover options focusing on the work of Ryou's group.

Listed authors for the research include Ryou, doctoral students **Mina Moradnia** and **Nam-In Kim**, postdoctoral research **Sara Pouladi**, and Master's student **Onosetale Aigbe**. **Jie Chen**, a doctoral graduate of Ryou's, also contributed to the research and is now at Applied Optoelectronics, Inc. Moradnia described the work that the group did.

"We developed a new synthesis method to improve the piezoelectricity of non-hazardous piezoelectric material, to compete against commonly used hazardous PZT," she said. "The replacement of PZT with lead-free materials has historically resulted in inferior final products, which were used in smartphone devices, mechanical energy harvesting applications and sensors, especially wearable sensors in healthcare applications."

"Our innovation addresses the health threading concern of using hazardous lead-based materials by introducing a novel method to produce a superior piezoelectric material that is lead-free and performs higher. The advantage of our technique over the existing methods is the precise control over the composition of the material, which is very critical in enhancing the quality of the final product. This is potentially paving the way for great innovations in sensor and wireless communication technologies."

Moradnia detailed the group's efforts, noting that they worked on the paper and research for more than a year.

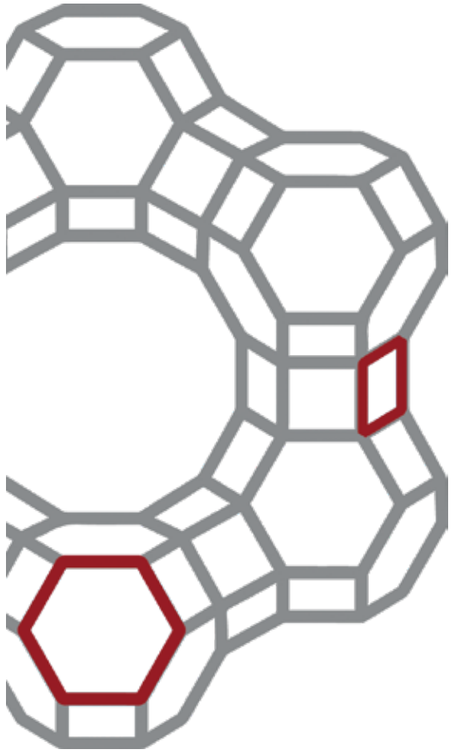
"The idea of the work comes from serious concerns about the performance of piezoelectric material for sensor devices, especially for biomedical and personal healthcare applications," she said. "Our effort has been focused on the enhancement of piezoelectricity of the material to be used in motion-sensing applications. The sensor devices based on this material should offer several advantages of high sensitivity, rapid response time, simple structure, reliable operation, be lightweight, and provide low power consumption."

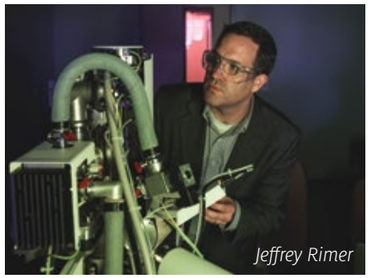
Ryou identified Moradnia as doing strong work on this paper, and in 2021, she likewise was one of the primary authors for research on semiconductor improvement. She earned her doctorate in December 2022. She is still open to a variety of career options going forward, although she'd like to continue in a research role.

"This is my last year of Ph.D. study," she said. "While I am still evaluating my career options, my goal is to continue working on leading-edge research of high-tech semiconductors, either in an industry or academic position."

BUILDING THE BEST ZEOLITE

BY LAURIE FICKMAN




Jeffrey Rimer


Natural zeolite mineral

Review Concludes Big Data Rocks, Pushing Formation of Crystals Forward

If science and nature were to have a baby, it would surely be the zeolite. This special rock, with its porous structure that traps water inside, also traps atoms and molecules that can cause chemical reactions. That's why zeolites are important as catalysts, or substances that speed up chemical reactions without harming themselves. Zeolites work their magic in the drug and energy industries and a slew of others. With petrochemicals, they break large hydrocarbon molecules into gasoline and further into all kinds of petroleum byproducts. Applications like fluid catalytic cracking and hydrocracking rely heavily on zeolites.

So important is the use of zeolites that decades ago scientists began making them (synthetic ones) in the lab with the total number of crystal structures exceeding 250.

Now, an undisputed bedrock in the global zeolite research community, **Jeffrey Rimer**, Abraham E. Dukler Professor of chemical and biomolecular engineering at the University of Houston, has published a review in the *Nature Synthesis* journal summarizing methods over the past decade that have been used to prepare state-of-the art zeolites with nano-sized dimensions and hierarchical structures.

The findings emphasize that smaller is better and structure is critical.

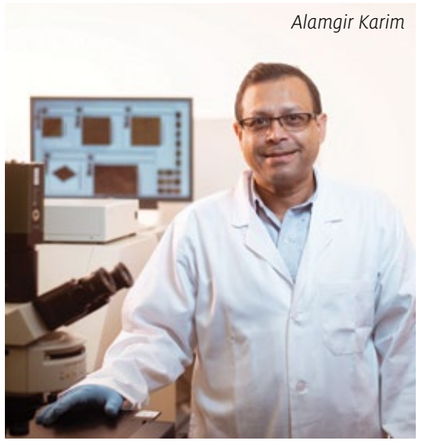
"These features are critical to their performance in a wide range of industrial applications. Notably, the small pores of zeolites impose diffusion limitations for processes involving catalysis or separations where small molecules must access pores without obstruction from the accumulation of residual materials like coke, which is a carbonaceous deposit that blocks pores," reports Rimer. "This calls for new methods to prepare zeolites with smaller sizes and higher surface area, which is a challenging task because few zeolites can be prepared with sizes less than 100 nanometers."

The review article summarizes advanced methods to accomplish this goal, including work from Rimer's own group on finned zeolites, which he invented. Zeolites with fins are an entirely new class of porous catalysts using unique nano-sized features to speed up the chemistry by allowing molecules to skip the hurdles that limit the reaction.

Rimer also examines how the emergence of data analytics and machine learning are aiding zeolite design and provides future perspectives in this growing area of research. That helps make up the "new methods" that Rimer suggests as imperative, resulting in major advantages of infusing computational and big data analyses to transition zeolite synthesis away from trial-and-error methodologies.

Besides, speeding up the process of crystallizing zeolites, and speeding up the reactions of the zeolites themselves, will result in many socioeconomic advantages, according to Rimer.

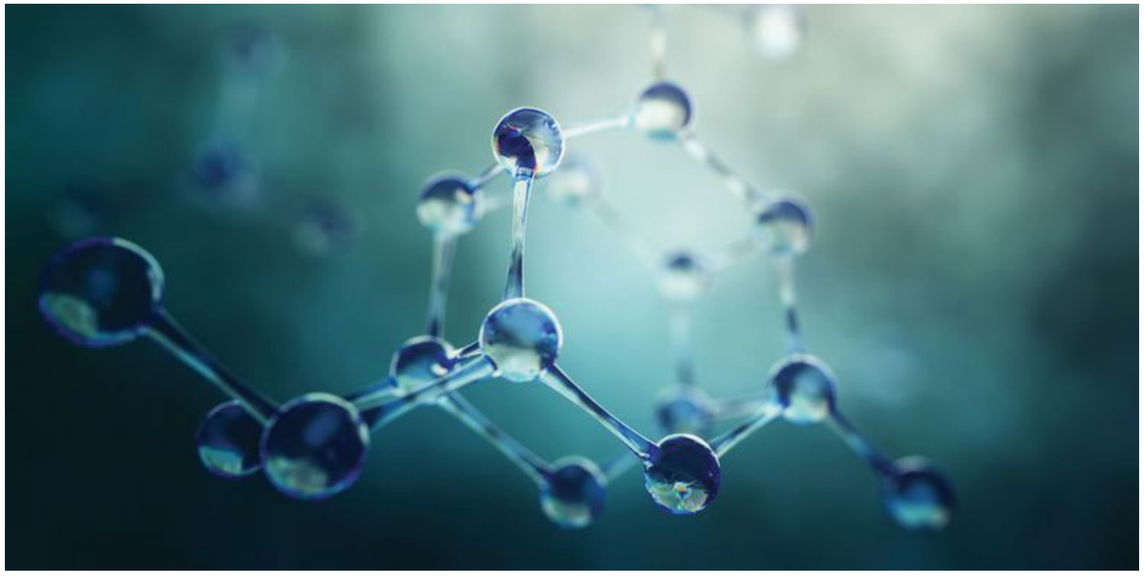
"Improved zeolite design includes the development of improved catalysts for energy applications (including advancements in alternative energy), new technologies for regulating emissions that impact the environment and separations to improve industrial processes with impact on petroleum refining, production of chemicals and water purification," he said.


Alamgir Karim


Aman Agrawal

STUDYING THE ELECTRODYNAMIC RESPONSE AND MANIPULATION OF BIOLOGICAL MATERIALS

BY STEPHEN GREENWELL



Manipulating solid particles of a few micrometers in size using an electric field has been of great interest to physicists. These controllable particles can be assembled into dynamic chains that can effectively control the flow of liquids in thin tubes like capillaries. Replacing these solid particles with liquid droplets would allow for previously unachievable electrorheology applications in biotechnology, as liquid droplets can store and utilize various biomolecules such as enzymes. Until now, it was not possible to use liquid droplets for electrorheology, as they tend to coalesce or deform, rendering them ineffective as electrorheological fluids.

New research led by the University of Houston Cullen College of Engineering* in collaboration with the National Institute of Standards and Technology (NIST) and the University of Chicago, has shown a simple pathway for stabilizing polyelectrolyte coacervate droplets that do not coalesce or deform under an electric field. The study was recently published in the *Proceedings of the National Academy of Sciences of the United States of America (PNAS)*.

Enabled by the high polarizability and residual surface charge, these "stabilized" droplets can be programably steered in an aqueous environment using a low voltage source, e.g. 9V battery. Known as coacervates, these droplets contain charged polymers that enable the encapsulation of biologically relevant charged species such as proteins and genes. Thus, they have the potential to transport and deliver a variety of cargo useful in the manufacturing and medical industries.

Coacervate droplets form when two oppositely charged polymers, also called polyelectrolytes, co-assemble into a condensate state in a salt solution. More specifically, the solution often converts quickly to a two-phase system, with the polymer-rich coacervate droplets suspended in the surrounding solution. The droplets are of the size of tens of microns, about the size of typical biological cells. In fact, these droplets have been demonstrated to perform various biologically relevant reactions. However, coacervate droplets have a major drawback – they merge with each other to form larger and larger droplets by coalescing until all the droplets merge to form a macroscopic settled layer due to settling by gravity.


Alamgir Karim leading class research.

"Think of mixing a spoon of olive oil in a cup of water and shaking it vigorously. Initially, you will see small droplets that make the mixture cloudy, but over time these droplets merge to form separate oil and water layers. Likewise, droplet bioreactors or electrorheological fluids made out of coacervates fail over time when the droplets coalesce to form layers," said **Alamgir Karim**, Dow Chair and Welch Foundation Professor of the University of Houston, who led the research project, working with **Jack F. Douglas**, a long-time colleague and polymer physicist at NIST, with insights provided by polyelectrolyte coacervate expert, **Matthew Tirrell**, the dean of the Pritzker School of Molecular Engineering at the University of Chicago.

"Scientists solved the problem of oil-droplet coalescence by adding surfactant molecules that go to the interface of oil droplets, prohibiting the oil droplets from merging," said Douglas. He continued, "Recently, similar technology was applied to coacervate droplets where specialized polymer chains were used to coat the droplet interface, effectively prohibiting their coalescence. However, such molecular coatings prohibit material transport in and out of the droplets, making them ineffective for bioreactor applications."

"I wanted to stabilize these droplets without introducing any additional molecule," said **Aman Agrawal**, the graduate student in the Karim Research Group leading the project. After months of research, Agrawal found that "when coacervate droplets are transferred from their original salt solution to distilled water, their interface tends to acquire a strong resilience against coalescence." The researchers propose that this stability of droplets is due to a loss of ions from the droplet interface into the distilled water driven by an abrupt change in ion concentration. Agrawal then studied these stable droplets under an electric field, demonstrating how to form droplet chains under an AC field and then moving them around with a DC field.

"This new development in the coacervate field," said Tirrell, "has potential applications in drug delivery and other encapsulation technologies. In basic biology, this mechanism may explain why intracellular organelles and biological condensates, and prebiotic protocells (possible agents in the origin of life) have the stability that they do." Recent measurements have shown that cells of various types can be manipulated rather similarly to the stabilized coacervate droplets with the application of electric fields, suggesting that the polarizability of the coacervate droplets might have significant ramifications for the manipulation of numerous biological materials composed of charged polymers.

*This research was supported by the Welch Foundation through Grant No. E-2105-20220331.

CONTINUING FLOOD ANALYSIS WORK ALONG ASIA'S MEKONG RIVER

BY STEPHEN GREENWELL

Asia's Mekong River flood in 2012. Photo Credit: KY Geologist / Flickr

An Illustration of Asia's Mekong River.

A professor at the Cullen College of Engineering will continue serving as the lead PI for a NASA project that examines land subsidence, flood forecasting and groundwater management in the Mekong region of Southeast Asia.

Hyongki Lee, Associate Professor of Civil Engineering, has received $692,410 in additional funding for a three-year extension of his research work, "Strengthening Regional and National Capacity for Operational Flood and Drought Management Services for Lower Mekong Nations via Mekong River Commission and SERVIR-Mekong."

Faisal Hossain, John R. Kiely Endowed Professor in Civil and Environmental Engineering at the University of Washington, and Thanapon Piman, a Senior Research Fellow at the Stockholm Environment Institute, are Lee's co-PIs on the project. Their project was one of 20 chosen, from a field of Step-2 49 proposals.

According to the proposal summary submitted by the group, this builds on research done the past three years, which has resulted in the developed of two systems to monitor flooding in Mekong.

The first tool, the Operational Reservoir Assessment Tool (RAT)-Mekong system, was officially adopted by the Mekong River Commission (MRC) to support their Strategy on Flood Management and Mitigation (FMM) 2021 to 2030 and Drought Management Strategy (DMS) from 2020 to 2025. RAT-Mekong is now operational in MRC's portal over 13 selected reservoirs in MRC countries, providing bi-weekly reservoir states including reservoir inflow, storage change and outflow observed from space.

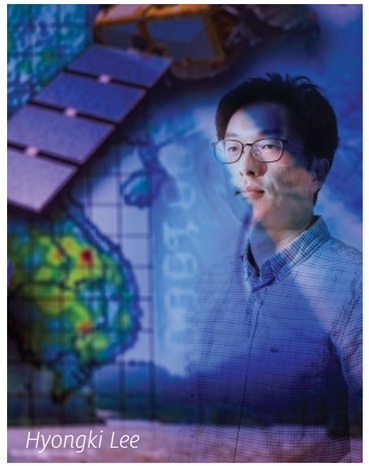
The second tool, Operational Forecasting Inundation Extents using REOF analysis (FIER)-Mekong system, is as a timely tool for 2-D (inundation extents) and 3-D (inundation depths) flood management service needs. FIER-Mekong provides daily hindcast and forecast (up to 18-day lead time) of inundation extents and depths in about 20 seconds over Lower Mekong. Their recent study found that FIER-Mekong tool could have prevented rice damages due to floods up to $87 million and $53 million U.S. dollars during the harvest time of 2020 and 2021, respectively.

"These recent successes have identified more time-sensitive institutional and societal priorities of Lower Mekong countries when it comes to floods and droughts in the context of an increasingly impounded Mekong river," the researchers wrote.

The research team has proposed four more areas of improvement for evaluating flood risks.

"We propose to expand and integrate the skills of current RAT-Mekong and FIER-Mekong as an individual and integrative operational decision support systems. Our proposed services are expected to be a unique and highly scalable decision support system for holistic water management with and without existing and planned upstream reservoir operation, and provide important recommendations for basin-wide reservoir operation policies toward sustainable allocation and management of water resources across time, space, and sectors of water-energy-food nexus. We will work closely with the SERVIR-Mekong Hub and various stakeholders in Mekong including MRC to build their capacity toward operational usage of the tools for better water resources management and disaster prevention."

The extension of the work will cover another three years of research. Funding will also be provided for a graduate student at the University of Houston and the University of Washington.

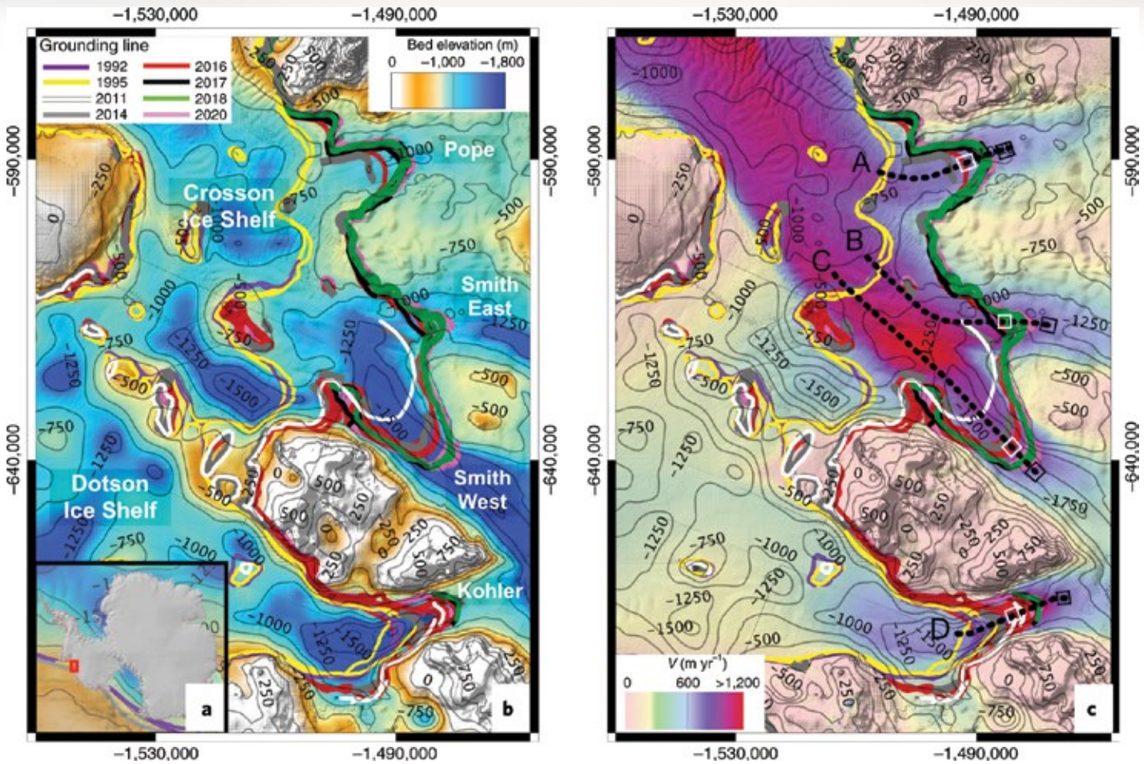


Hyongki Lee

ASSESSING FLOOD RISKS USING RADAR TECHNOLOGIES

BY STEPHEN GREENWELL

Pietro Milillo's satellite images of his Antartica projections.



With a $675,000 grant from NASA, researchers at the University of Houston's Cullen College of Engineering and the University of California, Irvine are launching a new flood risk assessment project focusing on sandy beaches and dunes.

Pietro Milillo, Assistant Professor of Civil and Environmental Engineering, will work on the research with **Brett Sanders**, UCI Professor of Civil and Environmental Engineering. Together, they will develop new observational strategies and techniques to measure sandy beaches and dunes, and use technologies like interferometric synthetic aperture radar and lidar, which involves targeting an object with laser light to obtain precise size and distance measurements.

In an early phase of the project, the team will data provided by the German Aerospace Center's TanDEM-X and NASA's IceSAT-2 satellites with surface elevation models and lidar observations at four beach/dune sites in Southern California. The researchers will conduct measurements on a monthly and in some cases sub-monthly basis for three years.

"Our first goal is document surface elevation changes in very high resolution and to verify if our satellite-based approach can match the accuracy we can achieve with proven ground-based and aerial sensors," said Milillo, who is a past associate project scientist in UCI's Department of Earth System Science. "If this proves successful, we'll be positioned to document surface elevation along all coasts every month, with better coverage and at lower costs to coastal communities than has ever been possible before."

Sanders described some of the reasoning for why this research is so important.

"Some of the most densely populated parts of the world are adjacent to low-lying coastal terrain," he said. "Scientists are predicting that flood risks will increase tenfold in these regions over the next 30 years based on sea level rise, but these numbers could be much higher or lower depending on how beaches respond."

Sanders emphasized that coastal topography, including beaches and the contour of the ocean floor in shallow water near the coast, is a primary contributor to coastal flood risk. "Sea level rise presently amounts to several millimeters per year, but beach topography can change by more than a meter in a single year. We won't have good estimates of future flood risks along wave-dominated coasts like those found in Southern California without better data characterizing changes in topography."

This work could lead to improved understanding of sand movement, identification of hot spots of sand depletion, and early detection of beach thinning that could help to trigger early action on adaptation projects.

The NASA-funded project also will include modeling of coastal flood risks based on the observed changes in beach topography along with data characterizing coastal waves, tides and sea level changes.

"We know future flood risks are increasing, but it's been difficult to say exactly by how and when. This work will increase our confidence in flood risk estimates for the next several decades," Sanders said.

The team will seek answers to several key questions, including: How can large-scale geological hazards be accurately forecast in a socially relevant timeframe? How will local sea level change along coastlines around the world in the next decade to century? And what processes and interactions determine the rates of landscape change?

"Much of our work will revolve around choosing the right tools for any given type of measurement, considering their effectiveness and relative cost," Sanders said. "The ultimate goal is to help the planning and public policy communities come up with sound strategies and infrastructure answers to deal with coastal flooding in the future."

> "The ultimate goal is to help the planning and public policy communities come up with sound strategies and infrastructure answers to deal with coastal flooding in the future."
>
> - PIETRO MILILLO

Pietro Milillo

PIONEERING IMAGING TECHNIQUES OF FETAL BRAIN AND CORNEA

BY LAURIE FICKMAN

Under the direction of **Kirill Larin**, high resolution optical coherence tomography (OCT) is having an extended moment. During the past 20 years, the University of Houston professor of Biomedical Engineering has masterminded its growth from a tool that examines only the retina to one that can measure an incredibly large variety of internal organs, ranging from fetal hearts to neural tubes.

With OCT, no biopsies are needed; no invasive measures are taken. Instead, the imaging technique uses light waves to take cross-section pictures and deliver 3D images.

And though Larin has been pushing the limits of OCT's capabilities for more than two decades, he is just getting started.

More than $5 million in new investments in his work set him up to develop OCT to peer into the fetal brain to assess how it is impacted by maternal drinking and smoking. He is also bringing the technology into clinical settings to diagnose and prevent eye disease.

Preventing, Reversing Impact of Alcohol and Nicotine on the Fetal Brain

Though the cause of congenital brain growth anomalies is complex, prenatal alcohol, ethanol and nicotine exposure (PEE/PNE) are known to be factors leading to such defects. Until now a lack of sensitive, high-resolution tools to visualize dynamic changes in fetal physiology has existed.

With a $3.2 million grant from the Eunice Kennedy Shriver National Institute Of Child Health & Human Development, Larin and his team will develop a new sensitive, high-resolution imaging platform for in utero imaging of the fetal brain that will fill a significant gap in the understanding of the genesis of brain growth deficits due to PEE/PNE.

Larin previously reported that prenatal ethanol exposure produces rapid and sustained decreases in blood flow through the middle cerebral artery and pial, peri-neural vascular plexus, which supplies blood to the fetal brain. Now he will explore this even further.

"We will develop a new imaging platform combining the complementary benefits of OCT and two-photon light-sheet microscopy (2pLSM) for in utero imaging of the fetal brain. The tools will enable us — for the first time — to get dynamic, time-resolved assessment of capillary permeability and monocyte precursor invasion," said Larin.

"These studies will also position us to begin assessing the efficacy of new pharmacological intervention strategies targeted to prevent or reverse the effects of alcohol, ethanol and nicotine exposure on fetuses."

Insights into the Cornea

With a $2.9 million grant from the National Eye Institute, Larin will take OCT in yet another direction, creating a version of it that can easily be adapted into a clinician's office.

"We propose a novel method for a 'no touch' assessment of corneal elastic properties. Such a technology, termed heart-beat optical coherence elastography (hbOCE), could revolutionize methods for routine corneal examination, bringing additional mechanical information and warrant rapid clinical adaptation," said Larin. "We will implement high-speed volumetric phase-sensitive OCT scans of the cornea during multiple phases of the heartbeat to measure corneal deformations and, thus, biomechanics."

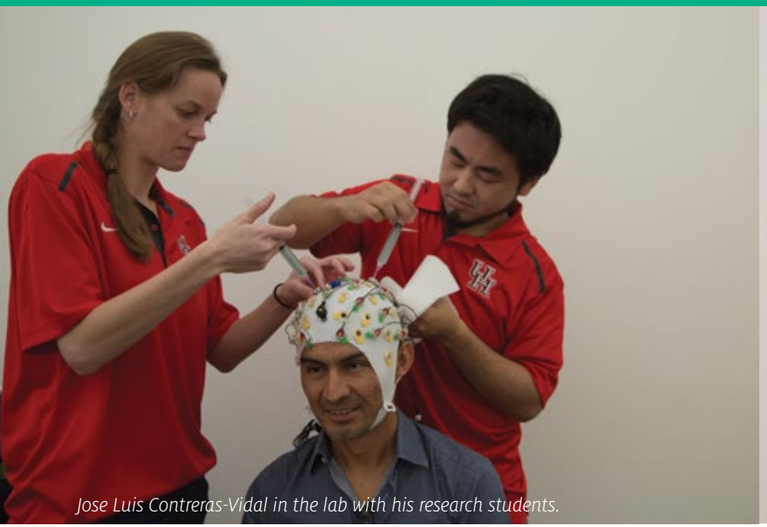
Accurate measurement of corneal biomechanics with high spatial resolution would not only influence the clinical interpretation of diagnostic tests, for example, by measuring intraocular pressure or assessing effects of drug therapies, but also predict the development of posterior eye diseases like glaucoma. Currently, there is no available, reliable method for performing quantitative measurement of corneal elasticity in vivo and with high resolution.

"Our studies will accelerate the transition of ocular elastography into clinics, influence our selection and application of corneal surgical treatments, and help us understand the structural consequences of corneal diseases and wound healing," said Larin.

Larin calls his work "frontier technology," as he stretches the bounds of OCT, allowing a greater view into the human body.

INVESTING IN BRAIN RESEARCH AND NEUROENGINEERING

BY LAURIE FICKMAN



Jose Luis Contreras-Vidal in the lab with his research students.

NSF, Industry Partners Fund Phase 2 of BRAIN Center at the University of Houston, NIH Funds Workforce Grant

On any given day inside the BRAIN Center at the University of Houston, you might encounter visual artists, dancers and musicians, or even paralyzed individuals – all wearing brain caps to teach researchers about what they are thinking, creating or feeling while they move expressively, or try to regain movement.

Machines and researchers copiously chart the electrical brain signals of the artists moving fluidly through their activities. Those living with paralysis who are re-learning essential movement skills, from young children to older adults, are wearing prosthetics with brain-machine interfaces designed to interpret their thoughts, to help make them move as soon as they think of moving.

Orchestrating all the activity and watching as fellow researchers put his discoveries into practice is **Jose 'Pepe' Contreras-Vidal**, the neural engineer and "brains" behind the Industry-University Cooperative Research Center (IUCRC) for Building Reliable Advancements and Innovations in Neurotechnology (BRAIN). The partnership between UH and Arizona State University includes industry and world-class academic teams.

"Our team of multi-disciplinary industrial and clinical partners, from the humanities to artificial intelligence, continue developing practical neural prostheses and brain-to-brain interfaces — devices that read brain signals and use them to restore movement or communication in those who have been paralyzed through injury or illness, or to neuromodulate neural signals to restore or extend brain function and/or human performance," said Contreras-Vidal, who is also the Hugh Roy and Lillie Cranz Cullen Distinguished Professor of electrical and computer engineering at UH and a Fellow of the IEEE and the AIMBE.

A Global Hub Draws a Crowd

A lot has happened within the BRAIN Center since Phase 1 was initially funded by the National Science Foundation in 2017. As the center emerged to become an international hub for emergent neurotechnologies, more members came to join. New international partners – Universidad Miguel Hernandez de Elche (Spain) and Tecnologico de Monterrey (Mexico) – have come aboard. The U.S. Food and Drug Administration (FDA) has joined as an affiliate member along with additional industry members and three new academic sites (Georgia Tech, West Virginia University and University of Maryland Baltimore County), scheduled to join in summer 2023.

And the latest news – the BRAIN Center Phase 2 (2022-2027) has been funded by the NSF with $758,331 going to UH and $240,000 to Arizona, plus another $2 million from industry partners, and the National Institutes of Health (NIH) has bestowed a workforce development grant for $768,135. It will provide specialized training in innovative neurotech, computational tools and neuroengineering techniques to complement and enhance the training and career of therapists, clinical fellows and orthotics and prosthetics professionals.

"The IUCRC program funded by NSF generates breakthrough research by enabling close and sustained engagement between industry innovators, world-class academic teams and government agencies," said Behrooz Shirazi, program director for the IUCRC program and acting deputy division director of the NSF's Division of Computer and Network Systems.

Since its inception, the center has attracted 20 industry partners, including companies Medtronic, the CORE Institute, Indus Instruments, Brain Products, as well as medical institutions such as UTHealth Houston and TIRR Memorial Hermann Hospital, ranked No. 2 among the country's top rehabilitation hospitals in the U.S. News & World Report "Best Hospital" rankings for 2020-2021.

"The active collaboration of TIRR Memorial Hermann and UTHealth Houston with the BRAIN Center in identifying, developing and validating innovative neurotech solutions to pressing neurorehabilitation challenges is not only rewarding but critical for improving the quality of life of millions of persons with cognitive and motor disabilities," said Gerard E. Francisco, M.D., Chief Medical Officer and director of the NeuroRecovery Research Center at TIRR Memorial Hermann and Chair and Professor in the Department of Physical Medicine and Rehabilitation at McGovern Medical School at UTHealth Houston.

The BRAIN Center is also actively engaged in the development of standards for brain-machine interface systems, trustworthy AI applications, use-inspired roadmaps for emergent neurotechnologies, and convergent research at the nexus of the arts, science and medicine. In March, Contreras-Vidal co-chaired the 2022 International Workshop on the Social and Neural Basis of Creative Movement at the Wolf Trap National Center for the Performing Arts sponsored in part by NSF, the National Institutes of Health (NIH), the National Education Association (NEA) and BRAIN.

"The BRAIN Center is advancing national health by transferring neurotechnology to end users and promoting access for underrepresented minorities in science, technology, engineering and math," said **Amr Elnashai**, vice president for research and technology transfer at the University of Houston. "They continue to accelerate the progress of science by broadening new participation and retaining current participants."

If You Think It, It Will Happen

When he's training patients to walk or move again with the aid of an exoskeleton, Contreras-Vidal encourages them to focus on their end game, or where they want to go. Approximately 5.4 million people in the U.S. are living with paralysis, or one in 50 individuals.

He employs much the same philosophy about the BRAIN Center.

HEALTH & MEDICINE

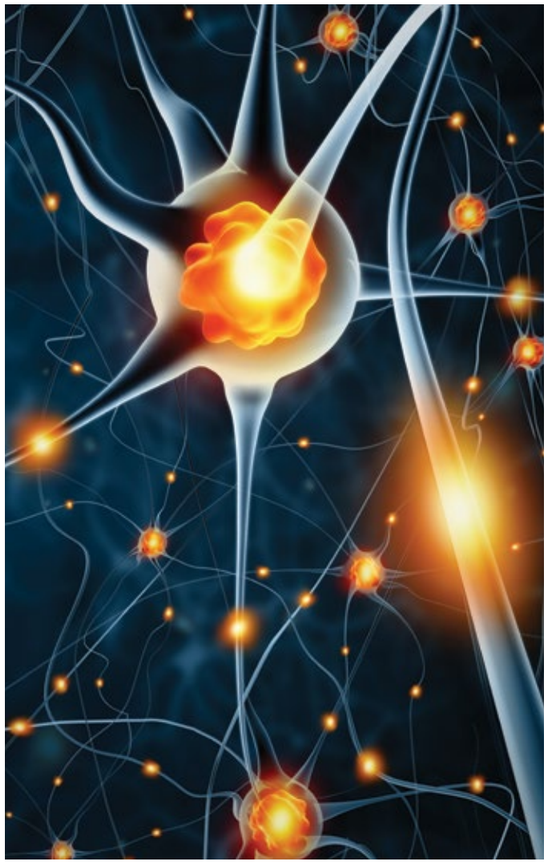
"As we continue to move the needle in brain technology, our center's mission is being fulfilled, to become a neurotechnology hub by creating a pipeline from discoveries to solutions, while helping students, scientists, engineers and humanists solve one of the greatest unmet medical and health care needs of our time," said Contreras Vidal, who adds that disability is becoming a leading health care concern because of the increase in survivable trauma and an aging population.

> "There is critical need for accessible technologies that can more effectively address the care and rehabilitation needs of these patients. Through collaboration and with support from our industry partners, the neurotechnology solutions being developed in the BRAIN Center are making substantial strides to address this need."
>
> - MARCO SANTELLO
> ASU SITE DIRECTOR AND CO-FOUNDER OF THE BRAIN CENTER

Jose Luis Contreras-Vidal conducting tests with brain-body imaging technology.

DEEP NERVE STIMULATION CONSISTENTLY REDUCES BLOOD PRESSURE

BY LAURIE FICKMAN



A University of Houston biomedical engineer is expanding the study of wireless electrodes to treat hypertension and is reporting that blood pressure and renal sympathetic nerve activity (RSNA) is controlled by bioelectronic treatment. RSNA is often increased in hypertension and renal disease.

Using a custom-wired electrode, **Mario Romero-Ortega**, Cullen Endowed Professor of Biomedical Engineering, previously reported that deep peroneal nerve stimulation (DPNS) elicits an acute reduction in blood pressure. The current study, published in *Frontiers in Neuroscience*, advances that work, focusing on his development of a small implantable wireless neural stimulation system and exploration of different stimulation parameters to achieve a maximum lowered response.

Romero-Ortega integrated a sub-millimeter nerve stimulation circuit with a novel nerve attachment microchannel electrode that facilitates implantation into small nerves and allows external power and DPNS modulation control.

Using this implantable device, his team demonstrated that systolic blood pressure can be lowered 10 percent in one hour and 16 percent two hours after nerve stimulation.

“Our results indicate that DPNS consistently induces an immediate and reproducible arterial depressor effect in response to electrical stimulation of the deep peroneal nerve,” reports Romero-Ortega.

Hypertension is often called the ‘silent killer,’ but it speaks loudly in statistics. In the United States, it is the number one cause of death. Globally it is the number one risk factor for death, impacting more than 1 billion people and is to blame for about half of all stroke and heart related deaths. The American College of Cardiology/American Heart Association 2018 guidelines classified average systolic blood pressure as greater than 130 mmHg and diastolic BP greater than 80 mmHg, on at least two separate occasions, as hypertension.

While pharmacological treatments are effective, blood pressure remains uncontrolled in 50 percent to 60 percent of resistant hypertensive subjects. Unfortunately, despite the use of multiple anti-hypertensive drugs in combination, blood pressure remains poorly controlled in 50 percent to 60 percent of the hypertensive population and approximately 12 percent to 18 percent of them develop resistant hypertension, defined as blood pressure greater than 140/90 mmHg despite the use of antihypertensive drugs.

“In this study, DPNS induced an initial increase in RSNA during the first two to three seconds, followed by a reduction in renal activity and mean arterial pressure, despite the increase in heart rate,” said Romero-Ortega. "The observed activation of the RSNA during the DPNS was not expected since its activity is associated with hypertension.”

Tianfu Wu

HEALTH & MEDICINE

RESEARCH SHOWS PROGRESS ON EARLY ALZHEIMER’S DISEASE

BY LAURIE FICKMAN

Inside the body, some seemingly harmless proteins have sinister potential. In the case of Alzheimer’s disease, the amyloid-beta (Aβ) protein, which is vital for brain growth, can become tainted and destroy cells, which leads to forgetfulness and memory loss. Proteins are neat little things that can only perform their functions if folded properly. Thus, the misfolding and deposition of amyloid beta in the brain is the main hallmark of Alzheimer’s disease.

“One of the drivers of Alzheimer’s pathogenesis is the production of soluble oligomeric Aβ, which could potentially serve as a biomarker of Alzheimer’s disease,” said **Tianfu Wu**, an Associate Professor of Biomedical Engineering at the Cullen College of Engineering. Oligomeric proteins are comprised of several protein chains or subunits packed tightly together.

Since 1959, the fluorescent dye thioflavin-T (ThT) has been a widely used “gold standard” for selectively staining and identifying amyloid fibrils, which result from the self-assembly of proteins into those large groups. However, due to the charge and emission wavelength (less than 650 nm) of ThT, the in-vivo use is limited. In addition, ThT can detect only the fibrillar form of Aβ, but not the oligomeric forms.

That’s why a new probe for in-vivo detection of the oligomeric form of Aβ is highly desirable for the early diagnosis of Alzheimer’s disease, and that’s what Wu and collaborators have been creating.

“We synthesized a near-infrared fluorescence-imaging probe to detect both soluble and insoluble Aβ. It not only binds oligomeric Aβ but also interposes self-assembly of Aβ,” reports Wu in the journal *Alzheimer’s and Dementia*. “This work holds great promise in the early diagnosis of Alzheimer’s and may provide an alternative way to prevent and intervene in Alzheimer’s disease and other amyloidosis.”

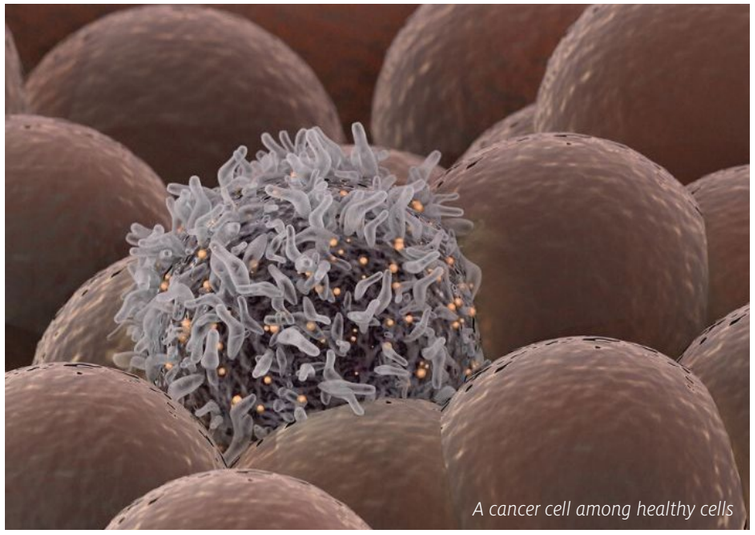
That couldn’t come a moment too soon. According to the Alzheimer’s Association, more than 6 million Americans are living with Alzheimer’s. By 2050, this number is projected to rise to nearly 13 million.

No real prevention and treatment of this chronic, degenerative brain disease exists. only five drugs are approved by the U.S. Food and Drug Administration to treat it, and they are all palliative. Unfortunately, these medications are not able to alleviate pathological changes or delay disease progression.

“It is notable that the lack of early and accurate diagnosis of Alzheimer’s disease and disease surveillance further hinders the development of therapeutic drugs,” said Wu. “Our hope is this new probe will help us detect the disease early and form targets for prevention and progression.”

TECHNOLOGY DEVELOPED AT UH COULD **ADVANCE TREATMENT OF LYMPHOMA**

BY LAURIE FICKMAN



A cancer cell among healthy cells

Navin Varadarajan

In the war against cancer, one of the most critical battles is waged on a cellular level as T cells from the immune system are altered in the lab to attack cancer cells. This form of immunotherapy, called chimeric antigen receptor (CAR) T-cell therapy, can be a life-saving treatment resulting in tumor control lasting ten years or longer.

Now an engineer at the University of Houston has found a way to determine which patients are likely to respond to CAR T-cell therapy, saving precious time in treating lymphoma, which is most responsive to this form of immunotherapy. It's valuable knowledge to have since not all patients respond to the therapy, and some experience severe side effects.

To determine the best patient prospects, **Navin Varadarajan**, M.D. Anderson Professor of Chemical and Biomolecular Engineering, studied the dynamic interactions between T cells and tumor cells. His findings, reported in the Journal of Clinical Investigation, point to the relationship between a ligand molecule on a cancer cell (CD58) and a protein on a T cell (CD2) which work together to communicate and activate the CD2, turning it into a cancer cell killer.

"The ligand for CD2, CD58 is expressed at higher levels in the tumors of lymphoma patients who respond better to CAR T-cell treatment. We identified that CD2 on T cells is associated with directional migration and that the interaction between CD2 on T cells and CD58 on lymphoma cells accelerates killing and serial killing," reports Varadarajan.

Varadarajan and his partners at The University of Texas MD Anderson Cancer Center profiled the dynamic interactions between T cells that comprise patient infusion products and tumors, using the TIMING (Timelapse Imaging Microscopy In Nanowell Grids) method, developed in Varadarajan's lab at UH. TIMING is high-throughput single-cell technology that merges artificial intelligence with a nanowell imaging platform to simultaneously evaluate how individual cells move, activate, interact, kill and survive.

By interrogating thousands of individual interactions between T cells and tumor cells, the research team identified the important interaction between CD2 and CD58. To translate the results back to the clinic, Varadarajan and Dr. Sattva Neelapu from MD Anderson, stained the tumors obtained before initiation of treatment. That's how the group was able to show that patients whose tumors expressed CD58 are much more likely to respond to CAR T cell therapy compared to patients whose tumors did not express CD58.

Growing and incubating at Technology Bridge

The University of Houston has obtained a patent on the TIMING process and Varadarajan co-founded the company, CellChorus, to commercialize it. CellChorus is housed at the UH Technology Bridge, which provides space to startup and spin out companies from UH and nurtures their growth.

"We are so lucky to have the Technology Bridge as our incubator space in Houston, near the greatest medical center in the country, with unique access to the centers of medicine difficult to replicate in most other places in the country," said Varadarajan.

Currently, CellChorus receives target cells from customers and conducts TIMING tests, providing comprehensive dynamic analysis of single cells. Eventually they will be able to send the technology to clinicians, in a piece of equipment like a box so they can perform their own assessments.

Additional research collaborators include Kite Pharma and CellChorus.

BRAIN-CONTROLLED EXOSKELETON IN CLINICAL TRIALS

BY LAURIE FICKMAN

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

Reedus was lucky to live in Houston and have access to this futuristic-looking, portable device - an invention of Cullen College of Engineering professor **Jose Luis Contreras-Vidal**, an international pioneer in noninvasive brain-machine interfaces and robotic device inventions. His team developed the portable brain-computer interface (BCI) exoskeleton to restore upper limb function.

It's the next generation of stroke rehabilitation, and now Reedus' name will forever be associated with it. "If I can pass along anything to help a stroke person's life, I will do it. For me it's my purpose in life now," said Reedus, whose determination sharpened after his mother and younger brother both died of strokes.

> "If I can pass along anything to help a stroke person's life, I will do it. For me it's my purpose in life now."
>
> - OSWALD REEDUS

Reedus realized he had lost the use of his left arm the night he had the stroke. His wife roused him from sleep, asking him to get up because he was mumbling, and she couldn't understand his words. He tried but couldn't use his left arm to help him rise. The stroke also caused Reedus to suffer aphasia, a difficulty with speech, barely noticeable now. "I don't know why God spared me, but I want to leave here helping someone," he said.

Now he's helping usher in a pivotal moment in stroke rehabilitation and medical science. Goal achieved.

Using the Robot

Most neuro technologies are limited to the lab or clinic and are very expensive and hard to operate. This brain-controlled robotic arm requires no surgery and is accessible to robotically guide stroke rehabilitation both in clinic and at home. Reedus' use of it in his Houston home follows clinical trials at TIRR Memorial Hermann.

"The broader impact and commercial potential of this project is to advance national health by accelerating development, efficacy and use of brain-controlled robotic rehabilitation after stroke by capitalizing on the benefits of non-invasive brain interfaces that extract information about the patient's motor intent and the real-time assessment of impairment and recovery of motor function," said Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen Distinguished Professor of Electrical and Computer Engineering at UH.

"Brain-machine interfaces based on scalp electroencephalography (EEG) have the »

potential to promote cortical plasticity following stroke, which has been shown to improve motor recovery outcomes."

Neuroplasticity is the brain's ability to modify, change, adapt and recover itself. Like a plastic material, which can be stretched and shaped to a desired design, there are certain properties in the brain that induce flexibility to recover even decades after a stroke or brain injury.

Advancing National Health

The promise of advancing national health is no understatement. Stroke is the leading cause of neurological disability in the United States and arm paresis is a primary cause of physical disability, yet only 31 percent of stroke survivors receive outpatient rehabilitation.

"Our project addresses a pressing need for accessible, safe and effective stroke rehabilitation devices for in-clinic and at-home use for sustainable long-term therapy, a global market size expected to currently be $31 billion. Unfortunately, current devices fail to engage the patients, are hard to match to their needs and capabilities, are costly to use and maintain, or are limited to clinical settings," said Contreras-Vidal.

His brain-controlled robotic devices are excellent candidates for engaging patients and delivering the repetitive and intensive practice stroke survivors require for rehabilitation.

> "THIS IS MY DREAM, FOR MY STUDENTS, TOO. TO TAKE A FINDING FROM THE LAB AND TRANSLATE IT TO THE END USER WHO BENEFITS WITH BETTER QUALITY OF MOVEMENT, A BETTER QUALITY OF LIFE."
>
> - JOSE LUIS CONTRERAS-VIDAL

It's a medical milestone that certainly takes a village.

The project is funded by an $813,999 grant from the National Science Foundation's newly created Division of Translational Impacts, TIP Directorate for Tech, Innovation, & Partnerships. Contreras-Vidal is director of the NSF-funded IUCRC BRAIN Center and the Laboratory for Noninvasive Brain-Machine Interface Systems at UH where he developed the device. Gerard E. Francisco, M.D., chair and professor in the Department of Physical Medicine and Rehabilitation at McGovern Medical School at UTHealth Houston and chief medical officer and director of the Neuro Recovery Research Center at TIRR Memorial Hermann, is leading the clinical trials.

"This is truly exciting because what we know now is there are so many ways we can induce neuroplasticity or how we can boost recovery," said Francisco, who said TIRR is wise to partner with engineering schools such as the Cullen College of Engineering at UH and others around the nation. "That collaboration is going to give birth to many of these groundbreaking technologies and innovations we can offer our patients."

Francisco, a member of the National Academy of Medicine, noted that the robotic arm is of particular interest to patients at TIRR, because many patients say recovering the use of their hands is even more critical than walking.

"If they cannot walk, they can be in a wheelchair, but if they cannot use their hands there are so many things that they will not be able to do," said Francisco.

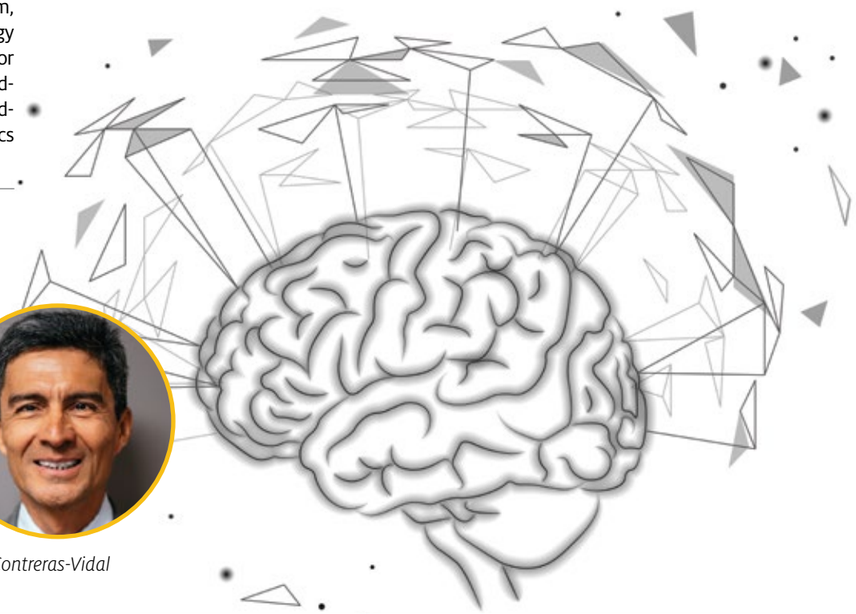
If You Think It, It Will Move

Once a patient straps into the robotic arm, the noninvasive brain-robot technology translates the user's brain activity into motor commands to drive powered, assist-as-needed, upper-limb robotics. Performance feedback is stored for monitoring and diagnostics through a user interface that also serves to provide engaging real-time feedback of task and associated completion performance.

"The device recruits the brain and depends on brain activity to initiate the robotic movement," said Contreras-Vidal. When you perform the robotic movement, there is feedback from the body coming back to your brain, so we have top-down information from the brain and bottom-up information from the arm and that leads to neuroplasticity."

As he watches Reedus' progress, Contreras-Vidal thinks less about science and more about people.

Oswald Reedus, the first stroke patient in the world to use a robotic arm controlled by his brainwaves - at home - to recover the use of a limb.



UH PROFESSORS AWARDED $768K NIH GRANT TO DEVELOP EXTENSIVE NEUROMOTOR TRAINING

BY JILL HOLDEN

Pictured: Pranav J. Parikh and Jose Luis Contreras-Vidal

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

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

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

Trainees will be recruited nationally through announcements and advertisements sent to organizations for groups that are underrepresented in clinical and biomedical research. A group of 10 trainees in the science, bioengineering, neuroscience or medical fields at the postbaccalaureate level will be recruited to participate 10+ weeks in the summer months in workshops and seminars, didactic work and immersive collaborative and personalized research experiences.

Experts at Texas Medical Center (TMC) institutions, including Texas Woman's University, The University of Texas Medical Branch, TIRR Memorial Hermann and the faculty from the NSF BRAIN Center at the University of Houston will work together on NSAP. Leveraging these unique facilities and their extensive expertise and mentoring experience will provide state-of-the-art training in neuroimaging, neuromodulation, and neurorehabilitation engineering.

In addition, faculty mentors of the NSAP program represent leading researchers in the fields of neurorehabilitation and neuroengineering. Contreras-Vidal and Parikh are the primary investigators for this project. Other faculty mentors include **Stacey L. Gorniak**, Ph.D.; **Shih-Chiao Tseng**, PT, Ph.D.; **Jinsook Roh**, Ph.D.; **Charles S. Layne**, Ph.D.; **Luca Pollonini**, Ph.D.; **Christina Bickley**, PT, Ph.D., BOCO, C/NDT **Shuo-Hsiu Chang**, PT, M.S., Ph.D.; and **Gerard E. Francisco**, M.D.

IDENTIFYING BIOMARKERS FOR HEART DISEASE AND FOR CHILDREN WITH LUPUS NEPHRITIS

BY LAURIE FICKMAN

Two separate findings by a University of Houston nationally recognized expert in systemic lupus erythematosus (SLE or lupus), a chronic autoimmune disease that affects multiple organs including the kidneys, skin, joints and heart, are being reported in scientific and medical journals.

Chandra Mohan, M.D., Ph.D., Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering in the UH Cullen College of Engineering, has identified blood biomarkers that predict which lupus patients will develop heart disease in the future and found new urine biomarkers for diagnosing lupus nephritis (LN) in children with lupus.

Lupus and Cardiovascular Disease

Lupus is associated with an increased incidence of acute and chronic cardiovascular disease as compared to the general population.

Mohan's team, in collaboration with Dr. Maureen McMahon at UCLA, used a comprehensive metabolomic screen of baseline sera from lupus patients to identify metabolites that predict future carotid plaque progression, following eight to nine years of follow-up. Nine patients had SLE without plaque progression, eight had SLE and went on to develop atherosclerotic plaques, and eight patients were controls who did not have SLE.

"The arachidonic acid pathway metabolites, leukotriene B4 (LTB4) and 5-hydroxyeicosatetraenoic acid (5-HETE), and the oxidized lipids 9/13-hydroxyoctodecadienoic acid (HODE) were found to be significantly altered ($p < 0.05$ and fold-change >2) in SLE patients compared to SLE patients without plaque progression," reports Mohan in *Frontiers in Cardiovascular Medicine*. "SLE patients also exhibited significantly altered levels of branched chain amino acid (BCAA) metabolites and plasmalogens compared to the non-SLE controls."

Taken together with the rich literature on these metabolites, the findings suggest that the identified metabolites may not only be prognostic of cardiovascular disease development in SLE patients, but they may also be active drivers of atheroma formation. Early identification of these high risk SLE patients may help institute preventive measures early in the disease course.

The first author, **Sahar Baig**, is an undergraduate student at UH.

Children and Lupus Nephritis

Lupus nephritis, or inflammation of the kidneys, is one of the most severe complications for SLE patients. Kidney disease is a leading cause of death among SLE patients – roughly a quarter of all lupus patients succumb to end-stage renal disease.

Mohan's team, on a mission to discover non-invasive biomarkers of LN to replace painful serial kidney biopsies in children, is reporting his recent findings in *Frontiers in Immunology*.

Together with collaborator, Dr. Scott E. Wenderfer at Texas Children's Hospital, Mohan's team evaluated the performance of ten urine protein markers of diverse nature including cytokines, chemokines and adhesion molecules in distinguishing disease activity in childhood SLE among 84 pediatric patients.

"Urine concentrations of ALCAM, KIM-1, PF4 and VCAM-1 were significantly higher in active LN patients compared to active non-renal SLE, inactive SLE and healthy controls, with strong diagnostic "potential" Mohan reports.

"Urinary ALCAM, PF4, and VCAM-1 are potential biomarkers for predicting kidney disease activity in cSLE and hold potential as surrogate markers of nephritis flares and prognosis in these patients," he said.

The lead author on this paper was Dr. Samar Soliman at Minia University in Egypt. Other clinical contributors were Dr. Larry A. Greenbaum, Emory University and Dr. Sherene Mason, University of Connecticut School of Medicine.

Chandra Mohan

MODELING SAFER HURRICANE EVACUATIONS

BY SARAH HILL

Houston knows how deadly hurricanes can be, but evacuating large amounts of people from the city can also be extremely dangerous. A Cullen College of Engineering professor is looking to mathematical models for solutions to safer and more efficient evacuations.

If you have ever needed to evacuate Houston during a hurricane event, you know how congested the roadways are. **Gino Lim**, the R. Larry and Gerlene (Gerri) R. Snider Endowed Chairman of Industrial Engineering, spent a grueling 14 hours in a car trying to outpace Hurricane Rita. He says he still remembers the ordeal of trying to leave Houston for San Antonio.

"During the evacuation, I realized that there should be a better solution to evacuating people from such a large metropolitan city," he said. "When I returned from San Antonio, I immediately started reading literature on evacuation." he said.

The reading provided him with an idea.

"I thought the evacuation process was very similar to a network flow model I teach my students in transportation, supply chain, and oil and gas pipelines. So, I started working on developing some mathematical models," said Lim. Then, he published several papers to recommend zone-based evacuation planning and management in the case of hurricanes.

Gino Lim

Lim is the first to admit that he was not an expert in evacuation planning, at first. What he is an expert in – and what he is trained to do – is taking real life problems, converting them into a mathematical model and then solving for optimal solutions.

Evacuation events are highly complex because they involve human behavior and unforeseen circumstances. The equations Lim created were highly sophisticated and sometimes required high-performance computers to work out the numbers – Lim used both the UH HPE Data Science Institute's computer clusters and his own server network.

Many entities, like the Texas Department of Transportation, may find Lim's research helpful in the planning of evacuation routes for upcoming weather events. Lim would be open to helping governmental agencies in their difficult undertaking of improving evacuation routes out of the city because, as he says: "I want to minimize the casualties and maximize the benefits in any problem I approach," said Lim.

> "During the evacuation, I realized that there should be a better solution to evacuating people from such a large metropolitan city."
>
> - GINO LIM

Photo Credit: pexels.com

RESEARCHERS REPORT MAJOR ADVANCE IN SEMICONDUCTOR MATERIALS

BY JEANNIE KEVER

High Carrier Mobility in Cubic Boron Arsenide Offers Promise for Next-Gen Electronics

Researchers have for the first time experimentally discovered that a cubic boron arsenide crystal offers high carrier mobility for both electrons and holes – the two ways in which a charge is carried in a semiconducting material – suggesting a major advance for next-generation electronics.

While earlier predictions had theorized that the crystal could exhibit simultaneously high electron and hole mobility, one of two papers published July 22 in the journal *Science* shows that researchers were able to experimentally validate the high carrier mobility at room temperature, expanding its potential use in commercial applications. Researchers from across the United States, including the University of Houston, the Massachusetts Institute of Technology, the University of Texas at Austin and Boston College, were involved in the work.

An accompanying paper in the July 22 edition of *Science* describes the use of transient reflectivity microscopy to measure the crystal, demonstrating the high mobility and in some cases, when a higher-energy laser beam was used, exceeding previous predictions. That work was done by researchers from UH and from the National Center for Nanoscience and Technology in Beijing, along with several other institutions in China.

Zhifeng Ren, director of the Texas Center for Superconductivity at UH and a corresponding author on both papers, said the work has important implications for a range of electronic and optical applications, similar to the advances that followed the advent of silicon wafers, which are widely used in all kinds of electronics.

Some semiconductor applications require a material with both high thermal conductivity – which measures how effectively a material conducts heat – and high electron and hole mobility. Earlier research had demonstrated cubic boron arsenide has high thermal conductivity, making the high ambipolar mobility a crucial advance.

Zhifeng Ren

"The potential of this material is tremendous," said Ren, who is also M.D. Anderson Chair Professor of physics at UH. While work to consistently produce larger crystals with uniform properties is ongoing, the result could have an even bigger impact on the field than the silicon wafer, he said.

That's because semiconductors require that current be carried both through electrons and holes, but most known materials offer high mobility only for one type of carrier. The overall efficiency of the semiconductor is determined by the lower value.

"If both are high, the device will be more efficient," Ren said. "That's what makes this material unique."

Ren was among a group of researchers who reported in Science in 2018 that the crystal – grown from boron and arsenic, two relatively common mineral elements – demonstrated far higher thermal conductivity than traditional semiconductors. This work builds on that, using crystals grown in Ren's lab to demonstrate that theoretical predictions about the substance's high mobility can be shown experimentally.

Carrier mobility is measured in the unit of cm2V-1s-1; the researchers reported mobility of 1,600 cm2V-1s-1. That portion of the work was led by Gang Chen, Carl Richard Soderberg Professor of Power Engineering at MIT and co-corresponding author of the paper, using an optical transient grating method to measure both electrical mobility and thermal conductivity.

In the second paper, researchers led by Ren and **Jiming Bao** of UH and Xinfeng Liu at the National Center for Nanoscience and Technology in Beijing, reported a range from about 1,500 cm2V-1s-1 to as high as 3,000 cm2V-1s-1.

Measuring carrier mobility was complicated by the fact that the crystal wasn't large and uniform, meaning traditional measurement methods such as the Hall effect couldn't accurately determine its properties. The researchers said that ionized impurities weakened the material's performance by strongly scattering the charge carriers, although other impurities – described in the paper as "neutral impurities" – had less of an impact.

"The sample was not uniform, but you can see the potential locally," Ren said. "If you had a crystal free of defects, mobility could be potentially much higher than predicted. We are in continuous research to figure that out."

The measurements were performed using different methods in labs at UH and MIT.

Jiming Bao

MATERIALS

Boron Arsenide Single Crystals

In the second paper, researchers from UH and six Chinese universities and institutions describe the use of transient reflectivity microscopy to measure the electron and hole mobility.

Bao, professor of electrical engineering at UH and a principal investigator with the Texas Center for Superconductivity, said researchers used laser pulses to excite carriers in the sample to monitor their diffusion and, in the process, discovered a key difference between the cubic boron arsenide crystal and most semiconducting materials. In silicon, for example, he said electrons move about four times more quickly than holes.

"In this case, the holes move more quickly than electrons," he said. But both electrons and holes exhibited unusually high mobility, improving the material's overall performance.

Bao attributed the highest measurements, which detected mobility far higher than 1,600 cm2V-1s-1, to "hot electrons," which maintained heat, or energy, generated by the laser pulse longer than they do in most other materials. The same was true of holes in the material, Bao said.

The structure of the cubic boron arsenide crystal makes it more difficult for the charge carriers to cool, meaning they maintain the heat – and the resulting high mobility – for longer. The researchers reported mobility similar to the predicted levels and those found by Chen's lab but noted that additional experiments revealed a mobility of more than 3,000 cm2V-1s-1, which they attributed to the hot electrons.

The findings depended in part on measuring a section of the crystal with few or no impurities, Bao said. "The sample was not uniform, and we found the highest mobility at spots with the fewest impurities."

In addition to Ren and Chen, researchers involved in the work to demonstrate high mobility include **Geethal Amila Gamage** and **Fei Tian** of UH; Jungwoo Shin, Zhiwei Ding, Ke Chen, Xin Qian, Jiawei Zhou, Aaron Schmidt, Thanh Nguyen, Fei Han and Mingda Li of MIT; Hwijong Lee, Li Shi and Jianshi Zhou of the University of Texas at Austin; and David Broido of Boston College.

Bao's collaborators, in addition to Ren and Liu, include **Shuai Yue**, **Fei Tian**, **Mohammadjavad Mohebinia** and **Tian Tong**, all with UH; Xinyu Sui and Xianxin Wu, with the National Center for Nanoscience and Technology and the University of Chinese Academy of Sciences; Zhiming Wang with the University of Electronic Science and Technology of China; Bo Wu of South China Normal University; and Qing Zhang of Peking University.

A NEW ICE-SHEDDING COATING IS 100X STRONGER THAN OTHERS

BY LAURIE FICKMAN


Hadi Ghasemi


Sina Nazifi


Testing the new elemental coating.

A University of Houston Mechanical Engineering professor has developed a sprayable ice-shedding material that is 100 times stronger than any others. The new durable coating material has been tested by Boeing under erosive rain conditions at 385 miles per hour and has outperformed current state-of-the-art aerospace coating technologies.

The principle of the new "fracture-controlled material" lies in the fact that for detachment of any external solid object from a surface (like ice from an airplane wing), force must be applied, and that force will inevitably lead to formation of some cracks at the interface. These cracks, or fractures, grow until full detachment of the object from the surface.

Through a new concept developed by **Hadi Ghasemi**, Cullen Associate Professor of Mechanical Engineering, detachment can be accurately controlled and accelerated.

"We developed a new concept in which, through material design, you can significantly accelerate the crack formation and growth and easily remove external objects from the surface. This concept is implemented to develop materials that are highly durable, and ice does not attach to these materials," reports Ghasemi in the cover article of *Materials Horizons*. Ghasemi's research team includes his doctoral student, **Sina Nazifi**.

"Fracture-controlled surfaces provide a rich material platform to guide future innovation of materials with minimal adhesion while having very high durability," said Ghasemi.

A Necessary Solution

From 1990 to 2000, 12 percent of all weather-related air disasters were due to icing. In the power industry, icing in transmission systems can lead to collapse of poles and towers, rupture of conductors and flashover of insulators.

To combat the dangers of icing, a wide range of materials with ice-shedding characteristics have been developed, but many tend to have very low durability, limiting their effectiveness.

"The primary challenge in developing ice-shedding materials is finding materials with both low ice adhesion and good durability," said Ghasemi.

His new material offers both.

This new fundamental concept of fracture-controlled materials paves the way for innovations in materials for aerospace, wind energy and other industrial and commercial applications where icing is an issue. Ice buildup on wind turbines could lead to an 80 percent drop in power generation, which could be avoided through these new coating materials, according to the researchers.

BOLSTERING UNDERREPRESENTED STUDENT ENGAGEMENT IN STEM

BY STEPHEN GREENWELL

A team from the University of Houston and the University of Michigan have received an additional grant from the National Science Foundation to further their collaborative research into improving underrepresented student engagement in STEM.

The team includes **Jerrod A. Henderson** (PI), Assistant Professor at the Cullen College of Engineering in the William A. Brookshire Department of Chemical and Biomolecular Engineering, and **Rick Greer**, the project co-developer and program manager. The co-PIs are **Virginia Snodgrass Rangel**, Associate Professor at the College of Education in the Educational Leadership & Policy Studies Department; and James Holly Jr., Assistant Professor of Mechanical Engineering at the University of Michigan.

The grant, "Enhancing Underrepresented Student Engagement in STEM through Mentoring and Family Involvement," is for $739,486. Research started in June and is estimated to run through May 2027. The authors note the need for the research via four questions in the grant's abstract.

"The research questions that will guide this mixed-methods project will include: 1) What strategies help conceptualize STEM knowledge in a manner that affirms students' racial identity and cultural ways of knowing? 2) How do students' STEM identity and awareness of and interest in STEM change over time? 3) How do families engage in their children's STEM learning in out-of-school STEM communities, and 4) how does family participation shape students' interest in STEM and their STEM identity?"

Henderson said their goal would be to use data from interviews, observations, and questionnaires to more deeply probe participants' stories and experiences.

STEM academy students working through activity assessments.

"What we've seen is that much [research] work has been done, but many times the voices, stories, and perspectives of learners from diverse backgrounds are not foregrounded, left out altogether, or are framed from a deficit perspective," he said. "This grant will address many of these gaps."

This research builds on earlier work from Henderson, Rangel and **Mariam Manuel**, a Science Master Teacher for *teach*HOUSTON Instructional Assistant Professor in the College of Natural Sciences and Mathematics Department of Mathematics. The previous grant, "Enhancing Underrepresented Boys' Engagement in STEM through Mentoring and Father Involvement," totaled $1.10 million and ran from February 2018 through July 2022.

This is the third grant that Henderson and Rangel have received together. In Sept. 2021, they received a planning grant from the NSF for an Engineering Research Center. Henderson noted that ultimately, all three grants build upon each other.

"The first project only included boys, but now girls are also included," he said. "The ERC birthed from this and other work. The ERC will allow us to build upon this work by including more researchers and addressing some of the challenges of students' pathways to and through engineering using a more systemic, engineered systems approach."

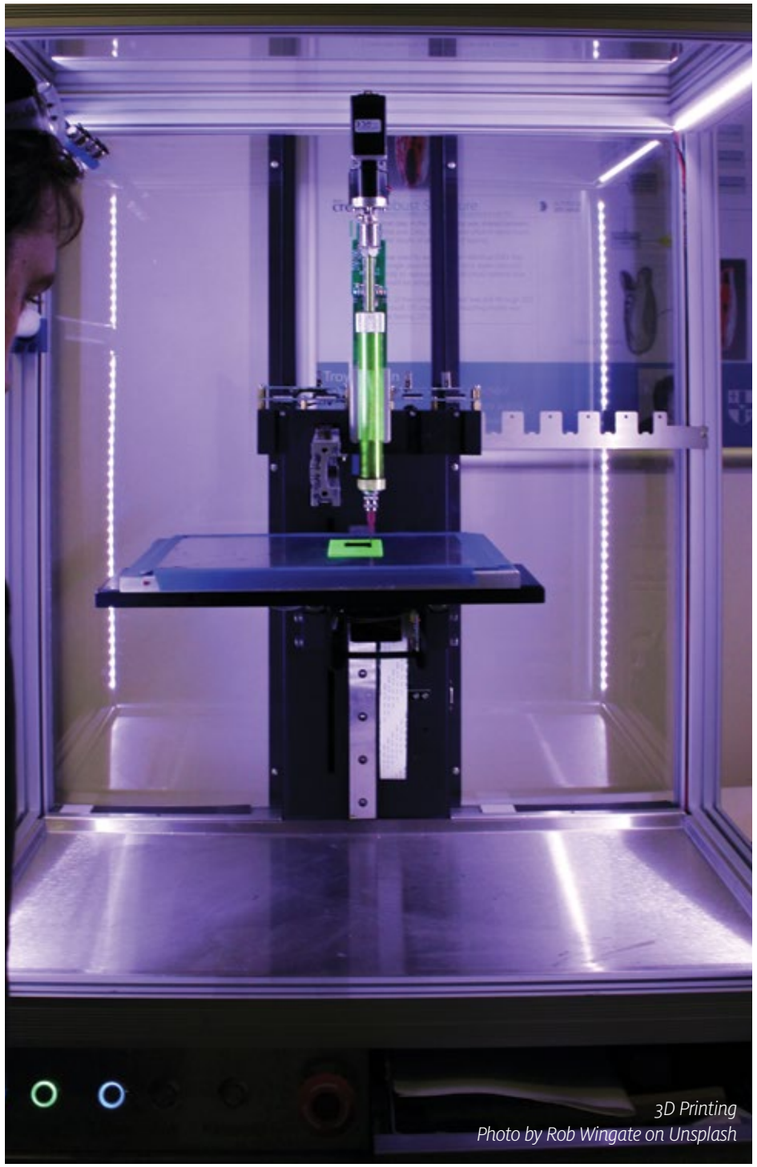
The research enabled by the grants takes place via the St. Elmo Brady STEM Academy (SEBA), which introduces underrepresented fourth and fifth grade students to a variety of STEM topics, from the physics of catapults to the properties of polymers. Henderson said Blackshear, Burnet, and Cage elementary schools were partnering with SEBA for this research, with a potential fourth school to be named later.

Students working on a project during PROMES summer camp.

Pictured from left to right: Jerrod A. Henderson, Rick Greer, Virginia Snodgrass Rangel

3D PRINTING
of 'Organic Electronics'

BY STEPHEN GREENWELL



3D Printing
Photo by Rob Wingate on Unsplash

When looking at the future of production of micro-scale organic electronics, **Mohammad Reza Abidian** – Associate Professor of Biomedical Engineering at the Cullen College of Engineering – sees their potential for use in flexible electronics and bioelectronics, via multiphoton 3D printers.

Over the past few years, 3D printing of electronics have become a promising technology due to their potential applications in emerging fields such as nanoelectronics and nanophotonics. Among 3D microfabrication technologies, multiphoton lithography (MPL) is considered the state-of-the-art amongst the microfabrication methods with true 3D fabrication capability, excellent level of spatial and temporal control, and the versatility of photosensitive materials mostly composed of acrylate-based polymers/monomers or epoxy-based photoresists.

"In this paper we introduced a new photosensitive resin doped with an organic semiconductor material (OS) to fabricate highly conductive 3D microstructures with high-quality structural features via MPL process," Abidian said.

They showed that the fabrication process could be performed on glass and flexible substrate poly(dimethylsilosane). They demonstrated that loading as low as 0.5 wt% OS into the resin remarkably increased electrical conductivity of printed organic semiconductor composite polymer over 10 orders of magnitude.

"The excellent electrical conductivity can be attributed to presence of OS in the cross-linked polymer chains, providing both ionic and electronic conduction pathways along the polymer chains," Abidian said.

To demonstrate the potential electronic applications based on the OS composite resin, his team fabricated various microelectronic devices, including micro-printed circuit board, which comprises various electrical elements, and an array of microcapacitors.

Three dimensional bioprinting of organic semiconductor microdevices based on MPL has potential in biomedical applications including tissue engineering, bioelectronics and biosensors. Abidian's team successfully incorporated bioactive molecules such as laminin and glucose oxidase into the OS composite microstructures (OSCMs). To confirm that the bioactivity of laminin was retained throughout the entire MPL process, primary mouse endothelial cells were cultured on OS composite microstructures. Cells seeded on laminin incorporated OSCMs displayed evidence of adherence to substrate, proliferation, and enhanced survival.

"We also assessed the biocompatibility of the OS composite structures by culturing lymphocytes, namely splenic T-cells and B-cells, on the fabricated surfaces and compared them with control surfaces. After seven days of culture, OS composite polymers did not induce cell mortality with approximately 94 percent cell viability compared to the control surfaces," Abidian said. "In addition, the potential effect of OS composite polymers on cell activation was also studied. After seven days of culture, there was no significant difference in the expression of activation markers on the lymphocytes between OS composite structures and control surfaces."

Finally, Abidian proposed a maskless method based on MPL for fabrication of bioelectronics and biosensors. They fabricated a glucose biosensor similar to Michigan style neural electrodes. Glucose oxidase, an enzyme for the specific recognition of glucose, was encapsulated within the solidified OS composite microelectrodes via the MPL process. The biosensor offered a highly sensitive glucose sensing platform with nearly 10-fold higher sensitivity compared to previous glucose biosensors. In addition, this biosensor exhibited excellent specificity and high reproducibility.

"We anticipate that the presented MPL-compatible OS composite resins will pave the path towards production of soft, bioactive, and conductive microstructures for various applications in the emerging fields of flexible bioelectronics, biosensors, nanoelectronics, organ-on-chips, and immune cell therapies." Abidian said.

Co-authors on the paper include former graduate students **Omid Dadras-Toussi** and **Milad Khorrami**; and postdoctoral researcher **Anto Sam Crosslee Louis Sam Titus**. Abidian praised the work of his students on this research and noted that Dadras-Toussi would be starting a new job with Medtronic, an S&P 100 company with $30 billion in yearly revenue, this month.

Sheereen Majd, Associate Professor of Biomedical Engineering, and **Chandra Mohan**, Hugh Roy and Lillie Cranz Cullen Endowed Professor of Biomedical Engineering, are also co-authors on the paper from the Cullen College of Engineering. Abidian said his colleagues were significant collaborators for the research.

> "The excellent electrical conductivity can be attributed to presence of OS in the cross-linked polymer chains, providing both ionic and electronic conduction pathways along the polymer chains"
>
> - Mohammad Reza Abidian

Mohammad Reza Abidian

3D Printing
Photo Credit by Tom Claes on Unsplash

The newest paper from his research group examines the possibility of that technology. "Multiphoton Lithography of Organic Semiconductor Devices for 3D Printing of Flexible Electronic Circuits, Biosensors, and Bioelectronics" was published online June 16 in *Advanced Materials*, which has an impact factor of 30.85 as of 2020.

Volume 34, Number 30

READ MORE ONLINE AT:

https://onlinelibrary.wiley.com/toc/15214095/2022/34/30

Image Credits: NASA/JPL-Caltech

NAMES OF ARTEMIS I TEAM MEMBERS HEADED TO SPACE ON

MICROCHIPS MADE AT UNIVERSITY OF HOUSTON

BY BRYAN LUHN

On July 20th, 53 years after Neil Armstrong took one small step for man and one giant leap for mankind, NASA announced target launch dates for the Artemis I mission, the agency's long-awaited first step to returning astronauts to the moon and eventually Mars. Even though there won't be people onboard the Orion spacecraft when it blasts off later this year, it will carry dozens of tiny tributes created at the University of Houston, to the Artemis team.

Long Chang, a Research Associate Professor in the Electrical and Computer Engineering Department at the Cullen College of Engineering and expert at the UH nanofabrication facility, answered the call when NASA was looking for a way to honor the thousands of people contributing to the Artemis I mission.

"NASA wanted microchips with everyone's name on them," Long said. "But I had some creative liberties in the design because they didn't really know what we were capable of."

After considering several options that would satisfy NASA's requirements, Long proposed a process that combines electron beam lithography and reactive ion etching to engrave the nearly 30,000 names onto each of the 80 microchips.

And he had a little surprise in store for NASA.

"I figured out how to do this so quickly that I decided to position the names so when you see it, it looks like the NASA logo, the Artemis logo and the European Space Agency logo," Long said. "Each logo is made of those 30,000 names."

The names include those from NASA, the ESA, industry partners and suppliers who have contributed to the Artemis program by building hardware, developing systems and supporting mission operations. Similar microchips have flown on other NASA missions as part of outreach campaigns that allowed the public to fly their names in space, including *Orion's Exploration Flight Test-1* and *NASA's Perseverance Mars Rover*.

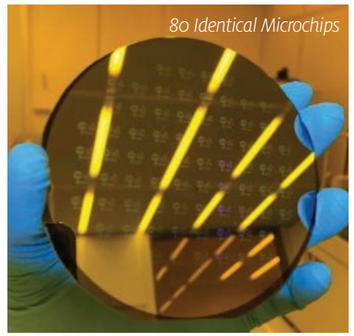
The 8mm x 8mm microchips will be packed in the Orion capsule's storage area for its unmanned test flight around the moon. NASA has set three tentative launch dates of Aug. 29, Sept. 2 and Sept. 5. When the spacecraft returns to Earth, the microchips will be given to key program stakeholders in the U.S. and Europe as a memento of the historic mission and an expression of gratitude for all of their hard work.

"By flying our names aboard the maiden Artemis flight to the Moon, a small part of each of us will be flying up there too," said Didier Radola, head of Moon programs at Airbus, the European Space Agency's lead contractor responsible for building the power system to propel the spacecraft in space.

AMRO Fabricating Corporation in California, which manufactures significant components of Orion's crew module as well as large structures for the Space Launch System (SLS), is another key partner.

"Our company has been involved in the Orion program from day one, and we are truly honored to see what it has evolved into," said Mike Riley, CEO of AMRO. "We are really excited to part of this critical and historic piece of hardware that will take humans back to the moon."

And Indiana-based Major Tool & Machine develops critical components for Orion and for the SLS solid rocket boosters and RS-25 engines.



80 Identical Microchips

"The excitement for our customers about NASA's return to the moon has trickled down to every one of our four hundred employees in Indianapolis," said Danny Antle, Major Tool & Machine's vice president of business development. "We're honored to be a part of the industry team."

Long hopes this project raises the visibility of the UH nanofabrication facility and brings the world of nanoscale research and engineering to a larger audience. His team of scientists, engineers and technicians provides a wide range of services and support to ensure anyone can use the lab and succeed.

"It's not just microchips were making here," Long said. "We have people working on solar cells, sensors for cancer diagnostics, microscopic electronic and mechanical devices, biocompatible materials and superconductor materials. There's a really wide application for this technology with no limit on the creativity of the person using it."

Shown above: Electron microscope inspecting the microchips.

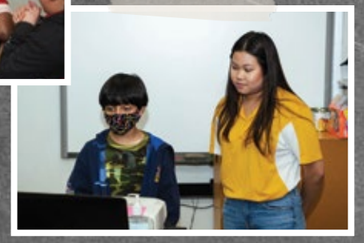
MAKING A DIFFERENCE:

SPOTLIGHT ON

ST. ELMO BRADY Academy

Bottom image, Pictured Left to Right: Rick Greer, Shaik Abdul Younus, Utienyin Pemu, Humberto Leal Acosta and Yolanda Perez.

As the St. Elmo Brady STEM Academy celebrates its 10th anniversary of improving outcomes for fourth and fifth graders, we look at the organizers, student volunteers and corporate sponsors that have made the program a success. »



ARE YOU SCIENTISTS LISTENING TO ME?

The question rings out at the front of the classroom from **Nghi Lam**, a Cullen College of Engineering junior majoring in Chemical and Biomolecular Engineering. Almost immediately, she's met with a chorus of "Yes!" from the 16 students participating in this eight-week session of the St. Elmo Brady STEM Academy at Cage Elementary School, located in Eastwood of the Greater Third Ward area. »

Three UH student volunteers [background, left to right – Alejandra Sanchez, Omar Sanchez and Nghi Lam] lead a group of young minds at Cage Elementary School through a discussion about the science they learned the previous week. For this session, Lam served as the main facilitator.

As part of this week's curriculum, the students are tasked with designing rescue baskets – constructed from pipe cleaners, toothpicks, tape and similar construction material – to be dangled from a helicopter (their hands) to retrieve someone from a snowy mountain crash. For the purposes of this activity, the "person" to rescue is a small potato.

Lam leads them through the scenario, while two other UH student volunteers – **Omar Sanchez** and **Alejandra Sanchez** – look on, occasionally nudging some of the students on task. When the students are told to break into groups, it's a cacophony of excitement as they set about their engineering task.

As the exercise is concluding, there is a similar energy in the air two miles away at Blackshear Elementary School on Holman Street, and about a mile and a half away at David G. Burnet Elementary School on Canal Street.

At Burnet, the group of about 20 young students is overseen by four UH student volunteers – **Umberto Leal, Utienyin Pemu, Shaik Younus** and **Yolanda Perez**.

Pictured:
Students in STEM academy working on their potato rescue baskets.

The young engineers frantically try to implement last second improvements to their rescue baskets as a countdown clock on the whiteboard ticks down, with Pemu finally telling everyone to stop what they're doing.

To get their attention, she uses a call-and-response.

"Solid, liquid..."

The classroom of students practically screams out,

"Gas!"

Over the next five minutes, each group tests their device – with varying levels of success – and each member of the winning group gets a small prize. They're reminded that their next class – the Thursday on the week before Thanksgiving – will be their last session of the semester, and to sign up for the next eight-week session in February.

All of this comes on the heels of the first portion of the day, when they had a 20-minute presentation followed by a Q&A with a computer scientist from the Chevron Phillips Chemical Company. And before each student leaves, they have to share one thing they learned with one of the UH student mentors as they're posted at the door. »

The Goal – Encouraging Science Careers Among Minority Students

For eight weeks in the fall and eight weeks in the winter, the St. Elmo Brady STEM Academy initiative from the University of Houston's Cullen College of Engineering will provide these students with 90 minutes of additional science education twice a week. It is now the 10th year of operation for the program overall, and seven in Houston.

The program was created by **Ricky Greer**, a K-12 education specialist employed by Cullen, and **Jerrod Henderson**, now an Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering. The idea came together when they were both working for the University of Illinois.

At the time, while there were STEM programs aimed at increasing general or female student participation, but not geared toward male, minority students. Greer and Henderson started SEBA in Spring 2013 to address this, developing it from an earlier program they did at a Boys and Girls Club in the area.

"What we personally saw was this kind of organic environment that students and their fathers were super excited about learning science, and I was so impressed by that," Greer said.

The program name comes from Saint Elmo Brady, an American chemist who was the first African American to obtain a doctorate in Chemistry in the United States. Greer noted that they chose the name because of Brady's multiple connections to their work.

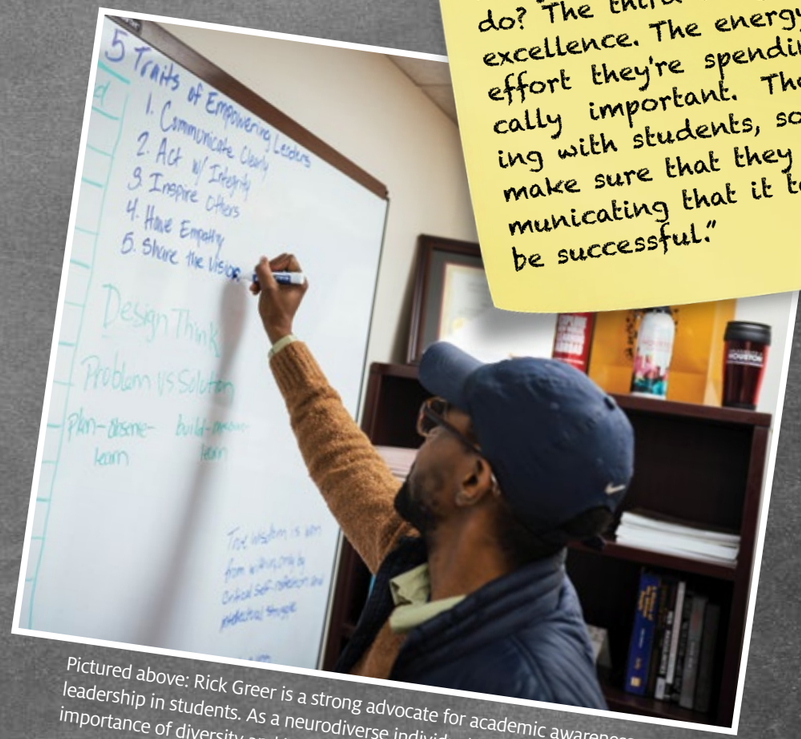
Left to Right: LeShorn Benjamin, Ph.D., Henderson Research Group postdoctoral fellow; Jerrod A. Henderson, Ph.D., SEBA co-founder and Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering; Melissa Abel, Chevron public affairs representative; Rick Greer, SEBA co-founder; and Ana Cantu, Burnet Elementary School principal.

Brady earned his doctorate from the University of Illinois – like Henderson – and Brady later taught at Tuskegee University – where Greer graduated from. Brady was also mentored by Booker T. Washington, and the first school SEBA was implemented at was named after Washington.

The program slowly grew over the next three years, and when Henderson received a job offer from UH, he moved SEBA to the Houston area with Greer. As of Fall 2022, it serves three HISD schools – Burnet, Cage and Blackshear – and about 70 students. In addition to the regular Tuesday and Thursday sessions, there are also Saturday courses offered for the students to participate with their parents present.

The program also gives the UH student volunteers valuable experience working in a classroom, and allows them to network with corporate sponsors Chevron and Chevron Phillips Chemical Company. Greer identified three vital traits for his volunteers – civic leadership, passion and academic excellence. »

"It's important to find students that have an interest in giving back to the community. Then, I look for passion. How passionate are you about the work that you do? The third thing is academic excellence. The energy, time and effort they're spending is critically important. They're working with students, so we want to make sure that they they're communicating that it takes work to be successful."



Pictured above: Rick Greer is a strong advocate for academic awareness and leadership in students. As a neurodiverse individual, he understands the importance of diversity and inclusion in all aspects of life.

A Measurable Effect

Given the age range of those involved – primarily, fourth and fifth grade students – some of the first students that went through SEBA in Illinois are now attending college. However, scale-up funding and grants are needed to more closely follow students as they move through their school systems. The program was also recently expanded to include girls as well as boys.

According to surveys done in the aftermath of the program though, as of 2018 about 96 percent of the students who participated in SEBA in Illinois were more interested in science. About 92 percent were more confident in their science and mathematics classes, and 88 percent participated more in their science and mathematics classes.

The program was also picked as one of the 2022 Inspiring Programs in STEM from *Insight Into Diversity*. In May 2022, SEBA received a $739,486 grant from the National Science Foundation to continue its efforts. Greer noted that the program does not cost participating students or participating schools anything out of pocket.

Pictured: Students brainstorm, collaborate and sculpt various parts of their weekly project. The St. Elmo Brady STEM Academy helps students build their science education with hands-on experimentation.

The Future

While Greer didn't have specific targets in mind for the program's size, he said their goal is to grow to more schools and to serve more students. He noted that the model they had in place could scale regionally, or even nationally, although a key principle going forward would be to keep it free for participants.

"We want to be sure that we're building out a robust program," he said. "And we want to be sure that we're building out a program that is sustainable. Ideally, I would love for the program to grow not only just throughout the City of Houston, but throughout the state of Texas, and hopefully at one point, it will become a national program. I know that's a big goal. But I think that we can definitely achieve it with the right resources, the right people involved, and the right attitude."

If you're interested in becoming a corporate sponsor or contributing to SEBA, please contact Jerrod Henderson, jahenderson5@uh.edu.

For more information on SEBA, visit their website. https://stelmobrady.egr.uh.edu/

RAJASHEKARA NAMED GLOBAL ENERGY PRIZE LAUREATE

BY LAURIE FICKMAN


Rajashekara with the GM Impact electric vehicle in 1993

UH Engineering Professor Kaushik Rajashekara, Fueled by Unrelenting Will to Achieve, is One of Three Recipients This Year

"Professor Rajashekara does not see limits, only possibilities. Electric vehicles are changing the way the world moves, and he has played a vital role in the exploration and improvement of this innovation." - Renu Khator - University of Houston president.

The most coveted prize in the field of international energy – the Global Energy Prize bestowed by the Global Energy Association – has been awarded to University of Houston Distinguished Professor of Engineering **Kaushik Rajashekara**. This is rarified air, indeed. Only three people in the world were selected for the honor this year out of a record 119 nominations from 43 countries.

Think Nobel Prize for science or Academy Award for film. That's the level of award Rajashekara, an Electrical and Computer Engineering Department member who humbly likes to be called "Raja," has taken home.

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

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

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

"Professor Rajashekara does not see limits, only possibilities. Electric vehicles are changing the way the world moves, and he has played a vital role in the exploration and improvement of this innovation," said Renu Khator, University of Houston president. "I congratulate him for this well-earned global distinction and for his role in positioning the University of Houston as the 'Energy University.'"

The Prize

Rajashekara is the winner in the New Ways of Energy Applications category for outstanding contributions to transportation electrification and energy efficiency technologies while reducing power generation emissions. He is engaged in power plants for electric, hybrid and fuel cell vehicles; electric and hybrid electric aircraft systems; hybrid flying vehicles and electric vertical takeoff and landing (eVTOL) vehicles. He is the owner of 36 U.S. patents and 15 foreign patents.

The prize honors "outstanding scientific research and scientific-technical developments in the field of energy which promote greater efficiency and environmental security for energy sources on Earth in the interests of all mankind."

He is joined as a 2022 laureate by Viktor Orlov, chief specialist of the Centre for Innovative Technologies (Rosatom in Russia) and pioneer in thermonuclear physics; and Mercouri Kanatzidis, professor of chemistry and materials science at Northwestern University and senior researcher at the Argonne National Laboratory. He is one of the most highly cited chemists, with more than 1,450 published scientific papers.

The laureates were selected by the international committee of scientists from 11 countries: the United States, Italy, China, Hungary, India, Japan, Singapore, South Africa, Switzerland, the United Arab Emirates (UAE) and South Korea. The awarding ceremony will be held during Russian Energy Week in Moscow, October 12-14.

"I have been working on transportation electrification for a long time, starting with Rail Transportation in ABB, then electric and hybrid vehicles in General Motors and Delphi, and then for Aircraft electrification in Rolls-Royce. At the University of Houston, I was able to continue to work in this area and advance the technologies for reducing emissions," Rajashekara said.

Even with that pedigree though, Raja was shocked when news of the award came.
"When I received the e-mail about my selection, I could not believe it for a moment. This award definitely shows the importance of energy efficiency improvement and reducing emissions, particularly in the area of transportation, which is responsible for a significant portion of global emissions," Raja said.

His awards are many. He has published more than 250 articles in international journals and conference proceedings, co-authored one book with IEEE Press, and has written six monographs and individual chapters for eight books. He was elected a member of the U.S. National Academy of Engineering in 2012, the Indian National Academy of Engineering in 2013 and the China National Academy of Engineering in 2021 for his contribution to development of the power conversion systems in transportation. He is a laureate of the IEEE Medal for Environmental and Safety Technologies (2021), the Richard Kaufman Award (2013) and several other prestigious awards.

"The Global Energy Prize is reserved for the best of the best in energy, and Professor Rajashekara is certainly that," said **Ramanan Krishnamoorti**, UH chief energy officer. "Since joining the University of Houston in 2016, Raja's vast knowledge and incredible research output has been instrumental in strengthening the intellectual base at UH and our strategic partnerships with the energy industry."

Amazing Journey

Rajashekara's history of becoming a giant in his field is even more impressive than his innumerable accolades. As a little boy growing up in a village in India with his parents and two brothers, he lived in a one room lean-to that he said was smaller than the office he now occupies at UH. He read by kerosene lamplight and though neither of his parents were educated, his mother was determined that her children would do better and be the best at whatever they pursued.

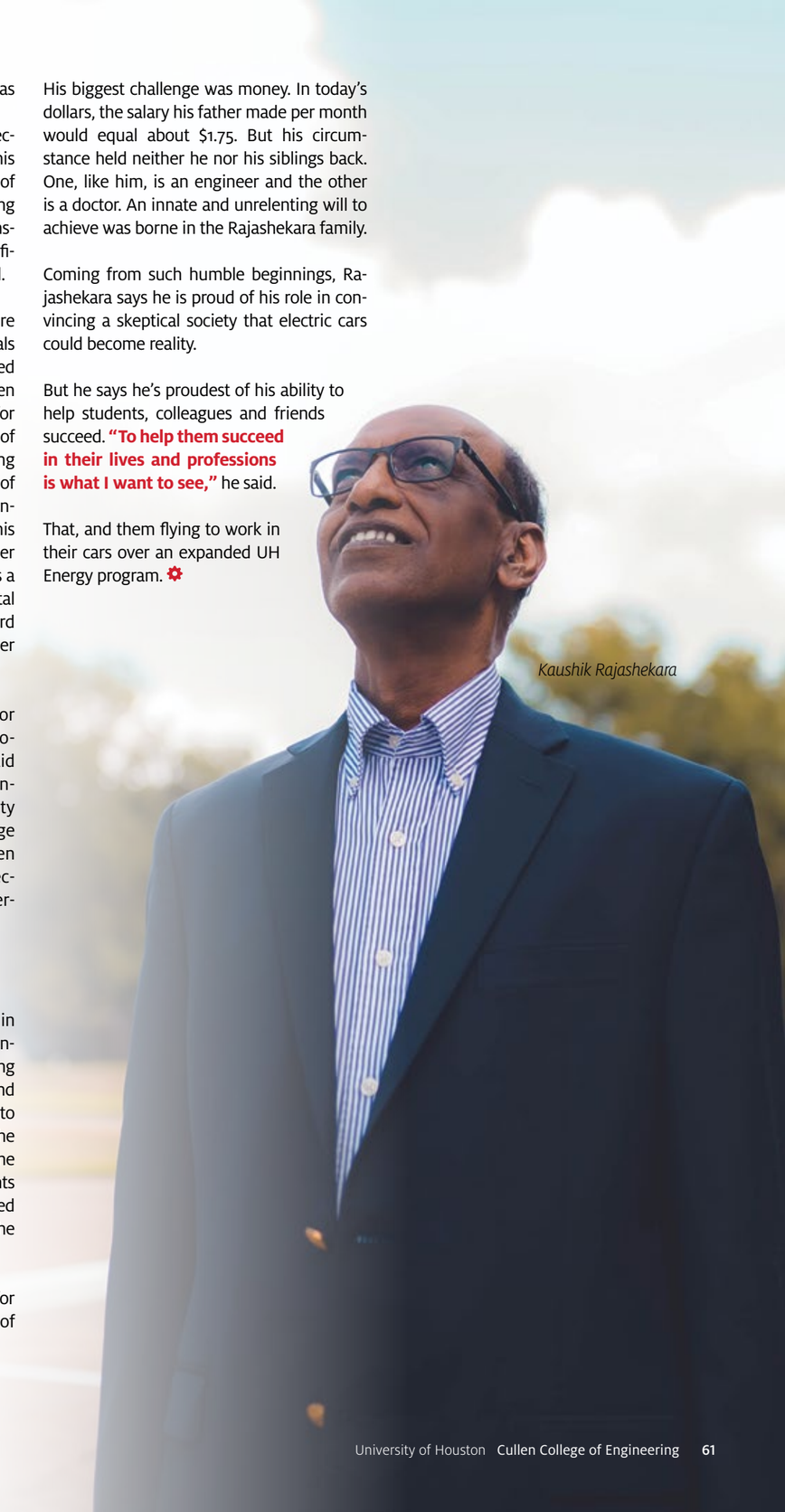
High school came to his village in time for him to attend. He cobbled together scraps of paper, gluing them to do his homework.

His biggest challenge was money. In today's dollars, the salary his father made per month would equal about $1.75. But his circumstance held neither he nor his siblings back. One, like him, is an engineer and the other is a doctor. An innate and unrelenting will to achieve was borne in the Rajashekara family.

Coming from such humble beginnings, Rajashekara says he is proud of his role in convincing a skeptical society that electric cars could become reality.

But he says he's proudest of his ability to help students, colleagues and friends succeed. **"To help them succeed in their lives and professions is what I want to see,"** he said.

That, and them flying to work in their cars over an expanded UH Energy program.


Kaushik Rajashekara

PRADEEP SHARMA TABBED FOR THE NEW EDITOR-IN-CHIEF OF ASME JOURNAL OF APPLIED MECHANICS

PRESS RELEASE COURTESY OF THE AMERICAN SOCIETY OF MECHANICS ENGINEERS

Pradeep Sharma- Hugh Roy and Lillie Cranz Cullen Distinguished University Professor and Chair of the Department of Mechanical Engineering

The American Society of Mechanics Engineers (ASME) announced that Professor **Pradeep Sharma** has taken over as the eighth editor-in-chief of one of its flagship journals, *Journal of Applied Mechanics*. The journal, as part of its raison d'être, "serves as a vehicle for the communication of original research results of permanent interest in all branches of mechanics." The journal was established in 1933 and is not only one of the oldest ASME journals but also one of the first journals dedicated to the broad field of mechanics thus playing a pivotal role in shaping this research field. Subject matter ranges from biomechanics, mechanical and fracture behavior of solids, thermodynamics and waves to nanomechanics, among others.

"I am honored to have this opportunity to serve my community. Some of the most pioneering work in the field of mechanics has appeared in Journal of Applied Mechanics", said Sharma. "I am excited about implementing several new ideas to enable this journal to become the first choice for the next-generation scientists working in the area of mechanics."

Pradeep Sharma is the Hugh Roy and Lillie Cranz Cullen Distinguished University Professor and Chair of the Department of Mechanical Engineering at the Cullen College of Engineering. Sharma's research focuses in the areas of solid mechanics, theoretical and computational materials science and biophysics. Sharma is the recipient of numerous awards such as the Guggenheim Fellowship, Charles Russ Richards medal from the ASME, and the James R. Rice medal from the Society of Engineering Science. He is also a member of the National Academy of Engineering.

CEE'S RODRIGUES CHOSEN AS NSF PROGRAM DIRECTOR

BY STEPHEN GREENWELL

After a competitive selection process, the U.S. National Science Foundation has chosen **Debora Frigi Rodrigues**, Ezekiel Cullen Professor in the Civil and Environmental Engineering Department at the Cullen College of Engineering, as a Program Director under the Intergovernmental Personnel Act.

Rodrigues will be the Program Director for the NSF Partnerships for Innovation Program. According to the NSF, the program has a history of providing opportunities for innovative researchers to turn academic research into tangible solutions to societal challenges. The program supports use-inspired translational research, prototype development and the enhancement of partnerships across U.S. academia, nonprofits and industry.

Rodrigues has experience as a CAREER award winner and has earned NSF I-Corps grants.

"I thought that the PFI program was very interesting because it's a program that will help professors develop their technology and commercialize after they participate in NSF I-Corps," she said. "Also, it helps you develop strong collaborations with industries. This program is a natural step between the NSF I-Corps and an Small Business Innovation Research or Small Business Technology Transfer (SBIR/STTR) award."

Through just 2018, Rodrigues has earned more than $4.7 million in grant funding from major organizations like the NSF, EPA and the Department of Energy, among others. She also holds three patents related to water filtration or purification. Water quality and sustainability is her primary research interest.

Debora Frigi Rodrigues

Rodrigues pointed to her experience with the patent process, and her familiarity with research while at UH, as reasons for her appointment in her letter of interest to the NSF.

"As an interdisciplinary faculty member at the University of Houston, I have worked with fundamental research as well as applied research, which has led me to apply for patents to commercialize the technologies developed in my research laboratory," she said. "One of these patents allowed me and my student to participate in NSF I-Corps and better understand the commercialization potential of the technology."

Rodrigues' appointment is for one year, but can be extended up to four additional years.

TWO ENGINEERING PROFESSORS HONORED AS ASME FELLOWS

BY STEPHEN GREENWELL


Yashashree Kulkami


Roberto Ballarini

Two professors from the Cullen College of Engineering have been honored with election to the Fellow grade of membership for the American Society of Mechanical Engineers (ASME).

The professors chosen for the 2022 class are **Yashashree Kulkarn**i, Bill D. Cook Professor of Mechanical Engineering, and **Roberto Ballarini**, Thomas and Laura Hsu Professor and Department Chairman of Civil and Environmental Engineering.

ASME confers the Fellow grade of membership on worthy candidates to "recognize outstanding engineering achievements and contributions to the engineering profession and to ASME". An ASME Member has to have 10 or more years of active practice, at least 10 years of active corporate membership in ASME, and be nominated by at least two ASME members or fellows.

Only about 3,000 members of ASME are Fellows, out of a total membership of about 75,000.

"Being recognized by the scientific community is indeed an incredible honor and I am humbled by it", said Kulkarni. "Of course, this would not have been possible without the support of my amazing students, colleagues, and collaborators."

Kulkarni is currently the Bill D. Cook Professor of Mechanical Engineering. She joined the Cullen College of Engineering in 2009. In 2019, she was appointed as the Director of Research Computing for the Cullen College of Engineering. Prior to joining the University of Houston, she was a post-doctoral scholar at University of California at San Diego. She earned her Bachelors' degree from Indian Institute of Technology in Bombay, India and her PhD in Applied Mechanics from California Institute of Technology.

Kulkarni currently serves as an Associate Editor for the ASME Journal of Applied Mechanics. She was the recipient of the ASME's Sia Nemat-Nasser Early Career Award in 2017.

Ballarini expressed gratitude for the Fellow designation, and similar to when he earned ASCE Distinguished Member Status, he was quick to thank his colleagues.

"I am honored to receive this recognition from the ASME," he said. "It reflects, more than anything, the contributions of my students to the fields of mechanics, mechanical engineering, and materials science."

Ballarini joined the Cullen College of Engineering as Department Chairman in the Fall of 2014. He previously served as James L. Record Professor and Head of the Department of Civil Engineering at University of Minnesota, Leonard Case Professor of Engineering at Case Western Reserve University, and F.W. Olin Professor of Mechanical Engineering at the Franklin W. Olin College of Engineering.

Ballarini is a Past-President of the ASCE Engineering Mechanics Institute (EMI) and currently serves as Editor of the ASCE Journal of Engineering Mechanics.

In 2019, EMI awarded him the Raymond D. Mindlin Medal, "For the application of elasticity and fracture mechanics to problems in numerous disciplines and at multiple length scales, and for seminal contributions to experiments for measuring the mechanical properties of materials and structures at the micro- and nano-scales." The medal is named after the Columbia University professor, who is considered a giant of 20th Century mechanics (and coincidentally was Ballarini's "academic great-grandfather").

CHBE'S ROBERTSON EARNS ACS FELLOW STATUS

BY STEPHEN GREENWELL

Megan Robertson, Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, has been named one of the 45 Fellows of the 2022 class of the American Chemical Society.

The fellows program began in 2009 as a way to recognize ACS members for outstanding achievements in and contributions to science, the profession, and the ACS itself.

Robertson has received this distinction due to her innovations in polymer sustainability, including developing polymers from renewable resources, exploring structure-property relationships of biobased polymers, probing polymer degradation behaviors, enhancing polymer recycling, and increasing material lifetimes. Additionally, she is recognized for her leadership in the Polymeric Materials: Science and Engineering (PMSE) Division of ACS, of which she is currently the Vice Chair and Program Chair.

"It is an incredible honor to be recognized as an ACS Fellow, and I greatly appreciate the support from and interactions with scientists in the ACS community that have continued throughout my career," Robertson said.

Robertson joined the faculty in 2010, following two years as a postdoctoral research associate at the University of Minnesota. Prior to that, she worked as a senior scientist for Rohm and Haas, now Dow Chemical, and earned her Ph.D. degree from the University of California, Berkeley and her B.S. degree from Washington University in St. Louis.

Robertson has received other distinctions from ACS, including the Rubber Division Sparks-Thomas Award in 2018, and was a PMSE Young Investigator in 2017.

Robertson is the fifth professor from the University of Houston to receive ACS Fellow status, and only the second from the Cullen College of Engineering. **Richard C. Willson**, Huffington-Woestemeyer Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, was named a Fellow in 2014.

SEE THE FULL LIST OF FELLOWS HERE:
https://cen.acs.org/acs-news/programs/Announcing-2022-ACS-fellows/100/i27


Megan Robertson

Now What?

By Aria Shankar
Biomedical Engineering Senior

Aria Shankar

"So, what are your plans post-grad?"

I've been asked this question a million times, or at least that's what it feels like. Graduating from college is one of the most important life milestones. It marks finally completing years of classes, transitioning into the so called "real world", and the new beginnings of a job, graduate school or any post-grad ventures. I, for one, am impatiently awaiting the day I can unpin AccessUH from my laptop's bookmarks bar, as well as never having to verify my login again on Duo Push.

But as excited as I am, or however prepared I may be, I am also victim to the existential "quarter life crisis" that many graduates experience, where this time we're the ones asking ourselves, "Now what?"

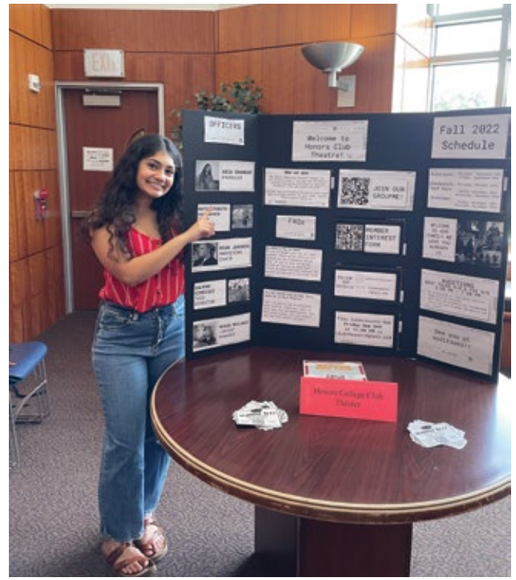
Graduation anxiety is very real. Past the cap and gown photoshoots and grad party celebrations is a realm of unfamiliarity. It's almost as though you're a freshman student again, but this time navigating a much more mature set of circumstances, instead of the four years of college ahead of you. For some, graduation could mark the start of financial independence. It could mark moving away from home, a new city, state or even country. It could mark meeting new people and making a whole set of new friends. Perhaps it could even just mark being on your own unguided time instead of a set schedule of classes you were expected to attend every day. It is normal for changes like these to be overwhelming.

Lucky enough, adaptability is already a skill that the Class of 2023 has mastered. Having classes shift to virtual halfway through freshman spring semester, and for the entirety of our sophomore year, we've experienced our fair share of isolation and adjustment. It was difficult to engage in the so called "college experience" when classmates or anyone you could interact with turned into a black box on a zoom call, on a laptop screen you had to stare at for many hours a day. For me, returning back on campus for junior year felt like I was starting college all over again; re-establishing friendships that grew distant, re-learning how to take notes during in-person lectures to study successfully, and re-sparking my enthusiasm that was dampened by being at home for almost two years. However, despite all challenges, we've built ourselves back up stronger and are only a few months away from our finish line.

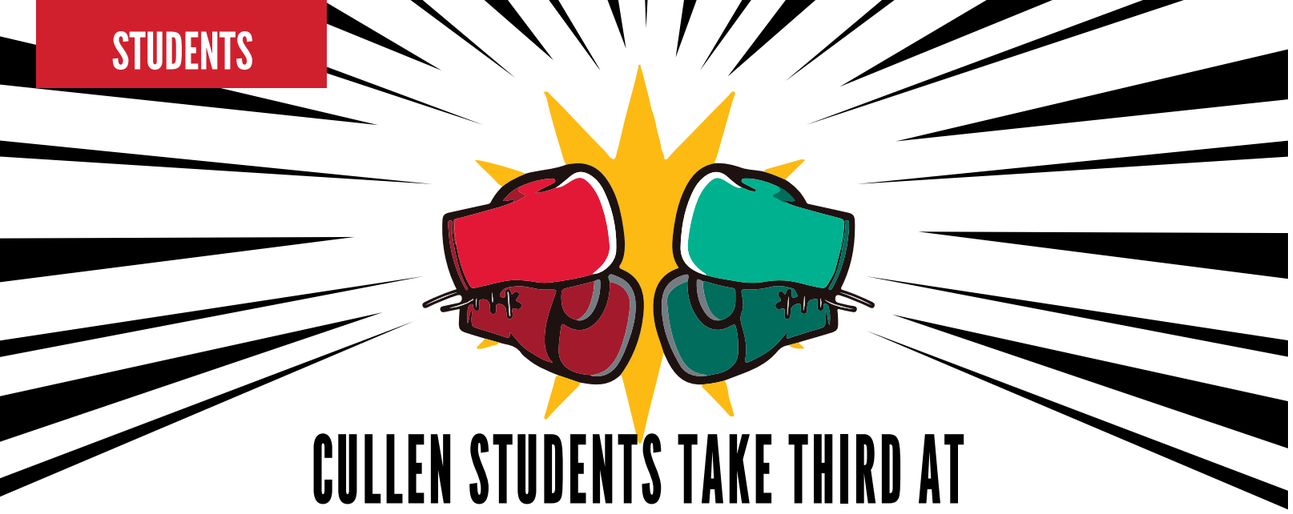
I like to think that the next 10 years will most likely be the most defining decade of our lives. From here, we begin building our careers, chasing aspirations we've dreamed about, and having daily applications of all the calculus equations we've been forced to learn. Just kidding.

Our entire academic journey has consisted of learning. Not just educational material but learning how to grow and improve from our past experiences. Just as we have progressed from semester to semester, and year to year, we will continue to advance into our post-graduation lives. Our undergraduate adventure at the University of Houston has given us a strong foundation for our future successes, and I am confident that the technical and experiential knowledge we've gained will carry us very far in our careers.

So maybe there's not a straightforward, cookie-cutter answer to "Now What?" And maybe there may not be an answer altogether. But I will propose an answer to this looming rhetorical question. We will be just fine. Class of 2023, we are going to be okay! And if it that isn't believable at the moment, be assured that we will make ourselves be okay. After all, we've done it throughout our entire undergraduate career, regardless of any setbacks or doubts that we may have faced. Who's to say we can't do it again?



NOW ANYTHING!



CULLEN STUDENTS TAKE THIRD AT BATTLE OF THE CLASSES

BY STEPHEN GREENWELL

A group of Cullen College of Engineering students has taken home a third place finish in the Third Annual Battle of the Classes, an entrepreneurship contest held by the Cyvia and Melvyn Wolff Center for Entrepreneurship at the Bauer College of Business.

Quang Vo, Danny Guevara, Miguel Arias, Abdur Rahman Abdul Kalam and **Denis Nyarwaya** competed as a team for the event, as an extension of a class they were taking with **Daniel Burleson**, Ph.D., Instructional Associate Professor. That course was MECE 5397, "Advance Engineering Innovation & Entrepreneurship."

Vo described how the group's effort began.

"It started for a class project that Dr. Burleson assigned us, and he wanted us to think about innovation, and to come up with something new," Vo said. "That assignment was similar to something already started the school by the Wolff Center for Entrepreneurship, so we entered in the Battle of the Classes."

As part of that competition, the group first had to complete an application with their idea, as well as record a pitch to be reviewed by the selection committee. Ten groups were picked to compete, with the engineering group finishing in third place.

Danny Guevara, Quang Vo, Denis Nyarwaya and Abdur Rahman Abdul Kalam

The group's idea centered around ocean pollution, and examining how companies currently pick up trash.

"The method they currently use is predicting the ocean currents," Vo said. "It's kind of like predicting a storm, and where the ocean current is shifting and moving. That data is used to predict trash in a particular area. But you know, the ocean is huge, your prediction can only be right to a certain point. There could be trips that the company would go out to a certain spot, but nothing is there because the current shifted somewhere else."

Vo's group proposed using unmanned aerial vehicles (UAV), or drones, with machine learning as well as light detection and ranging (LIDAR) technology, to allow for more efficient route planning and identifying trash locations in the ocean.

"Our idea is to be able to provide a service to those ocean-cleaning companies, and utilizing UAV drones with the LIDAR technology and machine learning," he said. "We could send the drones out in the oceans, and taking pictures and collecting all the data from a particular area, we could identify floating tracks, accurately predict the trash populations and send the results to the trash cleanup company. They could see, 'Oh, this area is highly infected with trash and per trip, we could clean how many tons of trash?' And that would make the effort worth it."

Vo is currently studying for his Master's degree in Mechanical Engineering, after earning his undergraduate degree in December 2021. He said the team featured a mix of graduate and undergraduate students.

"We structured our team based on personal preference," he said. "Whenever we looked at our project together, we would try to find which team member wanted to do which part. I liked doing the business side, so I focused on that, but other team members like focusing on the technology, or looking at the market and what was valuable there."

Ideally, Vo said he would like to one day start a company, so he found Burleson's class and the entrepreneurship competition especially valuable.

"I think its a great class," he said, adding that it provided a look at all of the aspects of a company, as opposed to a more focused, singular view that you get by doing an internship.

"A lot of the times, I saw myself in my internship working on different pieces, like not knowing what the legal process is and why things work in certain ways. Taking this class, it really gives you that perspective. In the future, I'd like to make something on my own, and I think this class really helped me in that regard."

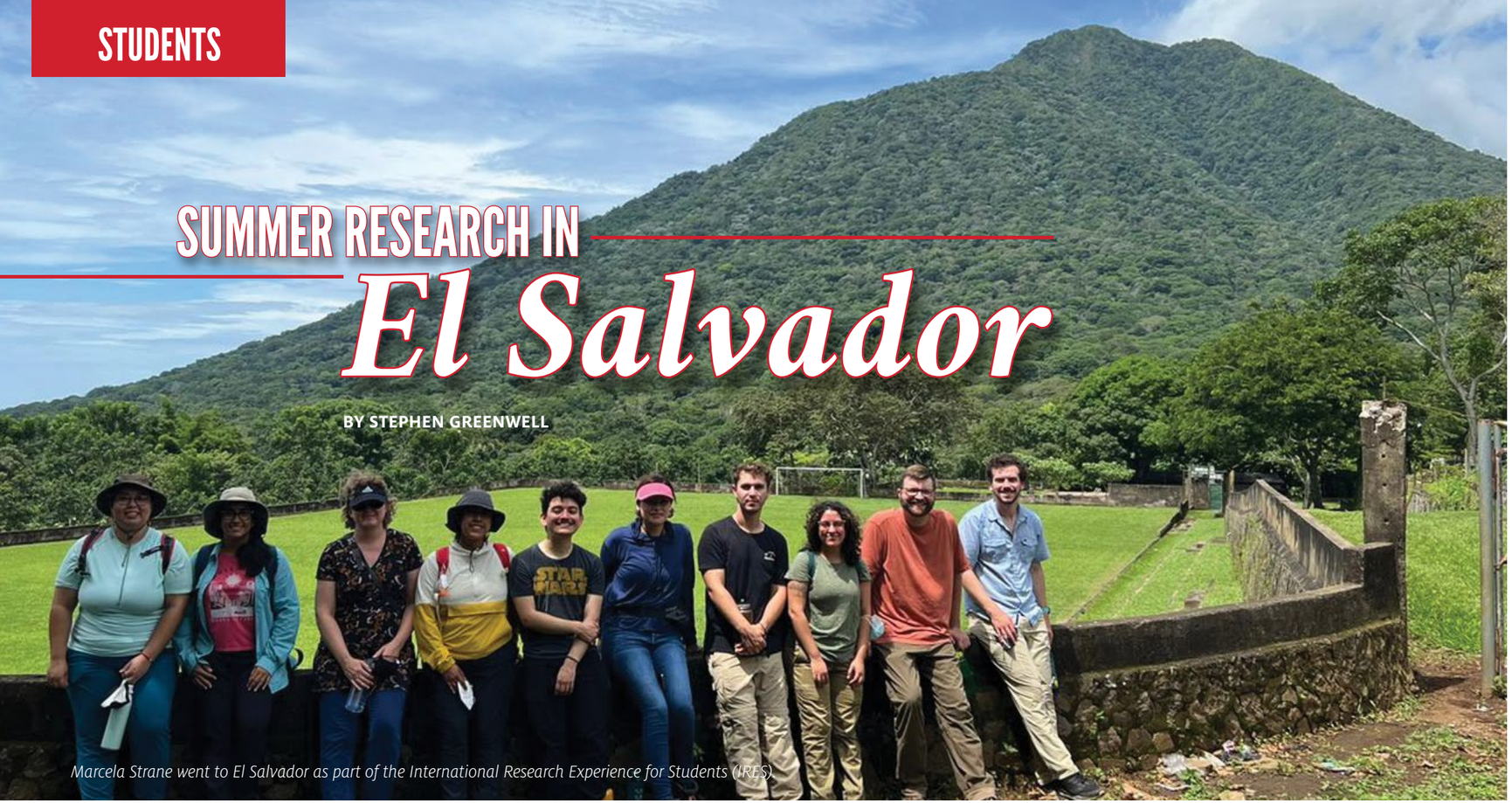
When it came to the results of this group project at the Battle of the Classes, Vo said the team was surprised and pleased with the results.

"We were really excited, and a little shocked and surprised," he said. "Our intention from the beginning was to submit for the first round, and we didn't think we would win that either."

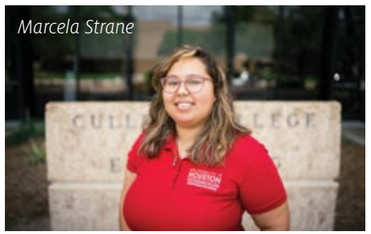
When asked what grade they got for the project, Vo laughed and said, "We did get a 100 percent. I think we tried our best to work hard on it."

SUMMER RESEARCH IN *El Salvador*

BY STEPHEN GREENWELL



Marcela Strane went to El Salvador as part of the International Research Experience for Students (IRES).



Marcela Strane

For **Marcela Strane**, a Ph.D. student in the Civil and Environmental Engineering Department at the Cullen College of Engineering, the opportunity to work on a hydrology project in El Salvador during the summer of 2022 was the culmination of several different educational goals.

"It was something important to me because I am Salvadorean, and I wanted to be able to contribute to research where my family is from," she said. "This was my first extensive experience of fieldwork and I prepared for this by volunteering at the UH Coastal Center working on constructed wetlands, and I spent a week on Sapelo Island doing field work under Dr. Steven Pennings. I've loved conducting fieldwork, and I hope to incorporate it into my own research and career goals."

Strane went to El Salvador as part of the International Research Experience for Students (IRES) offered by the Michigan Technology University and the Consortium of Universities for the Advancement of Hydrologic Sciences (CUAHSI). She first heard of the program from her undergraduate Hydrology professor at Arizona State University, Enrique Vivoni, Fulton Professor of Hydrosystems Engineering and the Director of the Center for Hydrologic Innovations.

"He talked me through many options and about his experiences because he has taught and done research with an international focus," she said. "He ended up sharing the IRES: El Salvador program announcement with me and I joined CUAHSI and applied."

Strane initially applied for an earlier cohort, but decided to delay because of concerns about the global pandemic and needing time to adjust to graduate school. However, she was still intent on doing the program in the future, and completed courses at UH – Disaster Management, and GIS for Engineers – that would enhance her experience.

Strane described her work in El Salvador as impactful for her own development.

"I want to work in the public sector or for a government agency, and in El Salvador, we interacted with many stakeholders, including resident communities, Lutheran World Relief, Civil Protection, the University of El Salvador, the Ministry of the Environment & Natural Resources, the Ministry of Agriculture, and the mayor's office of the municipality we lived in," she said. "I learned a lot from the people I worked and interacted with, and I am adding this to my toolbox to use in the future working with local, state and federal agencies. It felt important to get this experience to get a glimpse of what this would be as an industry practice."

Strane said she was able to draw a direct line from classroom teachings to work in the field.

"Some of the specific tasks we did in the field took the concepts I learned in the classroom, specifically Hydrology at the graduate level under **Dr. Hanadi Rifai**, and brought them to life," she said. "We ran a pump test at a farm, sampled and studied wells and aquifers, collected rainwater, installed weather stations, and interviewed communities on water use to obtain ethnographic and qualitative data, most of it in Spanish. I was so grateful to have the opportunity to communicate Engineering and Earth Sciences in Spanish, as I want to one day develop education materials with the EPA or NOAA in Spanish."

A Houston native, Strane said she has always loved nature and knew she wanted to be a scientist from the second grade. She is a graduate of the Challenge Early College High School, which includes concurrent enrollment at Houston Community College for an associates degree in Science, Technology and Education.

"My parents really wanted me to go to Challenge and so I did, and it was the best decision for me," she said. "I had some of the best professors at HCC, and it was manageable with my high school classes. I started figuring out I wanted to pursue either environmental law or environmental engineering and began applying to college programs. I also wanted to move away from home and live somewhere different. ASU's program is phenomenal – it gave me a scholarship, accepted my credits, and allowed me to live away from home and experience a real 'college experience.'"

Strane chose UH for her doctoral studies in Environmental Engineering because of its proximity to home, after four years at ASU earning her Bachelor of Engineering in Environmental Engineering, and because of the professors she could work with.

"I wanted to come back to be closer to my brothers, my nieces and nephews, my parents, and my best friends who lived here or moved back," she said. "There are many great reasons to be living in a major city like Houston, and I missed the lush greenery, coastal life and amazing food. The desert wasn't my favorite scenery, but Arizona did introduce me to being an outdoorsy 'granola' girl."

She added, "The second major reason was that the professors I wanted to work with wanted to take a chance on pursuing my project idea. When I was applying to programs I interviewed and toured places that had established projects that were great, but I wasn't passionate about them. My undergraduate research was focused on a different type of environmental problem, and I wanted to pursue something completely different, even if I didn't have the complete skillset for it. UH was the place for me to do that. I'm passionate about microplastic transport into wetlands, and at UH I can make that study interdisciplinary to help me achieve my career path goals."

Top to Bottom: Marcela working on hydrology project in El Salvador.

SAYED NAMED FIRST UH RECIPIENT
OF NOTED POWER ELECTRONICS FELLOWSHIP

BY MIKE EMERY


Hussain Sayed

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

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

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

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

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

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

Sayed arrived at UH in 2020, enrolling in the Cullen College's Electrical and Computer Engineering Department. He previously earned a master's degree from the University of Arkansas at Little Rock and a bachelor's degree from the University of Technology, Iraq.

A native of Iraq, Sayed always had a penchant for technology and conducted various experiments as a child. Those experiences inspired him to pursue a degree in engineering.

"When I was a kid, I used to be interested in exploring electrical and electronics circuits and solving issues logically," he said. "I remember trying to energize my radio from the sun's heat that reflected on our home garage. Not only that, but I used to open and explore most of the defected appliances at our house."

His curiosity in STEM subjects fueled an academic journey that continues at UH. Since arriving on campus, he developed an appreciation for its diversity and the opportunities presented in the Cullen College of Engineering. At the college, he has focused his research on developing efficient, reliable power infrastructures supporting the operation of data centers.

"The energy consumption required to run data centers has been rapidly increased, resulting in high operational costs. Because of the increasing energy demand, data centers require efficient and reliable power distribution infrastructure," he said.

Sayed's work in this area has not only garnered awards but has made him a model scholar and student within UH's Cullen College of Engineering.

Both peers and professors have taken note of his commitment to quality research and his passion for engineering.

According to his mentor **Harish Krishnamoorthy**, assistant director and associate professor in the Cullen College's Electrical and Computer Engineering department, Sayed's persistence will yield more rewards for both him and the field of engineering,

"Hussain is one of the most motivated, hard-working, and sincere Ph.D. students that I ever had," Krishnamoorthy said. "He has a true passion for research in the field of power conversion and reliability, which I am sure will lead him to greater heights in the future. He truly deserves this prestigious IEEE PELS award."

pels
IEEE POWER ELECTRONICS SOCIETY
Powering a Sustainable Future

UH IISE student group 2021-2022.

UH IISE EARNS GOLD CHAPTER AWARD

BY STEPHEN GREENWELL

The University of Houston's IISE student group has earned the Gold Chapter Award for its performance during the 2021-22 academic year.

The president of the student chapter for that time period was **Emilia Diaz**, a Spring 2022 Cullen College of Engineering graduate with a B.S. in Industrial engineering. **Yaping Wang**, now an Instructional Associate Professor, served as the faculty advisor for the group.

According to the IISE, Gold chapter status is achieved by holding at least four meetings per year, being in contact with members once per month, setup an officer succession plan for the group for the next year, and graduating two college-level members to IISE Young Professional status.

UH was only one of three universities in Texas to achieve this status, and among about 90 chapters globally with Gold chapter status. The chapter also achieved Gold status in 2019-20.

Diaz wrote about her achievements for the group in a March 2022 essay for the College's website.

"Walking into my senior year and having had the opportunity to be a leader taught me a lot about teamwork, professionalism and mentorship," she said. "It opened many opportunities for me to explore different industries and network with many remarkable mentors I can still count on today. I decided to give all of that back to the IISE-UH chapter for my senior year."

She continued, "I ran for President of IISE-UH to maximize the opportunities for Industrial Engineer students. I struggled to find my place in the prominent engineering organizations, since most of their members were Mechanical Engineering or Computer Science majors. In IISE, I found a community of people that have gone through similar successes and struggles. I have been able to apply everything I have learned from my other leadership experiences to grow the IISE chapter."

Wang joined the University of Houston in 2016, after completing her doctorate at Texas A&M. This year, she was promoted from Instructional Assistant Professor to Instructional Associate Professor.

The IISE maintains active Instagram and Facebook accounts, as well as a Discord server. This year's president is **Diane Nguyen**. For a full list of ways to contact the group, visit its Linktree.


Pictured from left to right: Emilia Diaz, Yaping Wang, and Diane Nguyen.

CHBE'S AGRAWAL ELECTED TO CHAIR GORDON RESEARCH SEMINAR

BY STEPHEN GREENWELL

Aman Agrawal, a Ph.D. student in the William A. Brookshire Department of Chemical and Biomolecular Engineering at the Cullen College of Engineering, was among those presenting at this year's prestigious Gordon Research Conference and Seminar on Bio-inspired Materials in Switzerland, where he was elected to chair the next one, scheduled for 2024.

Agrawal is a Houston Endowment Fellow, pursuing his doctorate in Chemical Engineering as part of the research group of **Alamgir Karim**, Dow Chair and Welch Foundation Professor and the Director of the Materials Engineering Program.

The Gordon Research Conferences (GRCs) are traditionally held in scenic, rural or isolated locations on broadly defined topics with a smaller group of academics speaking off-record about their research. Contrary to traditional conferences, GRCs provide extensive time after each presentation for engaging and fruitful discussions, and the speakers are encouraged to present and discuss their unpublished research. Participants at this year's conference included faculty and students from universities across the globe.

"There are two parts to this conference," Agrawal explained. "The meeting starts with a student-led seminar called Gordon Research Seminar (GRS), which is held for two days, followed by the week-long Gordon Research Conference. While speakers in GRC are established scientists, GRS provides opportunities to early career researchers to present and discuss their work with peers from around the world."

It is a tradition of GRCs and GRSs to hold elections after each meeting to select organizers for the next iteration. Agrawal was elected, alongside Adele Gabba, a postdoctoral researcher at MIT, to chair the next GRS, which is scheduled for June 2024 in Les Diablerets, Switzerland.

"Les Diablerets is one of the best locations for the Gordon Conference, and I was lucky to get a chance to visit there," he said.

Agrawal was among the few selected to present their work orally out of all the submissions. He talked about his then unpublished work on protocells, Manipulation of Polyelectrolyte Protocells with an External Electric Field, on the first day of the conference.

"Life, as we see it today, is quite complex at the cellular level. Cells have various components that work together in complex ways," he said. "However, the cells must have evolved from very simple precursors. Protocell is a theoretical model of primitive cells that is proposed as a stepping-stone toward the origin of life on this planet. I talked about how I made protocells that can be moved with an electric field."

Agrawal said his presentation was well-received, and the nature of the conference allowed him to discuss it with many of the participants. When asked about his experience, Agrawal said "the best part about the conference was the ample time and opportunities provided to us to discuss and learn from others, including leading experts, in the area of bioinspired materials. I was thrilled to have discussions over lunches and dinners with eminent scientists like Anna Balazs (University of Pittsburgh), Zvonimir Dogic (University of California, Santa Barbara), Ehud Gazit (Tel Aviv University), and many others. It was a great experience to talk about the research I am doing here at UH as a grad student."

Much of Agrawal's research with Karim has been on polymers – materials made of long, repeating chains of molecules. In August 2022, Agrawal published his research in the journal Proceedings of the National Academy of Sciences.

For his current projects, Agrawal is collaborating with the world's leading expert on charged polymers, Prof. Matthew Tirrell, and 2009 Nobel Laureate and an expert on RNA, Prof. Jack Szostak, both at the University of Chicago.

"I am working with them to understand how life would have originated in these protocells billions of years ago," Agrawal said.

He is working on completing his doctorate soon, but he plans to stay in academia.

"I love doing research, and the atmosphere and freedom in academia allow me to be creative and innovative," he said. "I am interested in broad topics of soft and living matter research, working with materials such as DNA, RNA, and proteins. I am hoping to move to a suitable post-doctoral position after graduating."

"I am thankful to the Cullen College of Engineering's Future Faculty Program, the Welch Foundation, and my advisor, Prof. Alamgir Karim, for financial support to attend this year's GRC and GRS," Agrawal said. "I am excited and can't wait to get started on organizing the next GRS. The experience will not only benefit my organizational skills but will also foster my academic networks."

- Aman Agrawal

SHPE-UH HONORED WITH *NATIONAL CHAPTER OF THE YEAR AWARD*

BY STEPHEN GREENWELL

SHPE-UH Executive Board 2022-23

The University of Houston's wing of the Society of Hispanic Professional Engineers has earned a National Chapter of the Year for 2021-22 from the national leadership of the group.

According to award criteria, National Chapter awards are given for excellent performance overall. Awards are based on the Chapter Management Template (CMT) submission, chapter report evaluation, chapter's self-nomination, and the strength of the chapter's functions, activities and events in all the relevant categories. A minimum of 90 percent (27 of 30 total points) are required for award eligibility.

Only 14 chapters qualified for this designation in 2021-22. SHPE-UH has student and professional wings, and both received the designation.

Members of the 2021-22 executive board for SHPE-UH included **Tahimy Landestoy**, president; **Natalia Rodriguez**, vice president internal; **Quang Vo**, vice president external; **Rolando Vera**, treasurer; **Roberto Martin**, secretary; **Jimena De Los Reyes**, communications director; and **Amaury Robles**, new member representative.

For the 2022-23 executive board, Robles is now serving as president, and Vera is vice president external. Other members include **Bridgette Salazar**, vice presidental; **Silvestre Solis**, treasurer; **Linda Fulcher**, secretary; **Jessica Avellaneda**, communications director; and **Josea Garza**, new member representative.

In the United States, Hispanic Heritage Month runs from Thursday, Sept. 15 through Saturday, Oct. 15 for 2022. To recognize this, in addition to spotlighting the SHPE-UH's awards, we are also running the following five profiles of group members. These write-ups were provided by Robles, the organization's current president.

Linda Fulcher

is a first-generation college student majoring in Civil Engineering, graduating Spring 2023. Outside of her classes, she's working part time as a Civil Engineering Intern at Black & Veatch and is the current Secretary for the Society of Hispanic Professional Engineers (SHPE). Her favorite place to study (and get coffee!) on campus is Cougar Grounds, and post graduation she plans to join Black & Veatch full time as a Structural Engineer!

Rolando Vera

is a Mechanical Engineering senior graduating in May 2023, and after being a part of SHPE for 2.5 years, he has grown fond of the organization. That's why he is serving as the VP-External for SHPE-UH. If you know Rolando, you know he loves sports and never declines the opportunity to play soccer, basketball, football or volleyball. He tries to organize his time to see his sister and parents but also leaves time for his classes. His passion for engineering will take him to the oil and gas industry next year as a Wells Engineer with BP.

Christian Reyes

is a junior majoring in Civil Engineering graduating in the Spring of 2024. Being a first-generation student, Christian finds navigating through college challenging yet thrilling. He comes from a Guatemalan and Mexican background, which led him to enjoy working with students from various backgrounds. Outside of class, Christian holds a position as one of the MentorSHPE coordinators for the Society of Hispanic Professional Engineers (SHPE) and works as an undergraduate teaching assistant for ENGI 1100. Although Christian enjoys all of his civil courses, he is very intrigued with structural engineering and is excited for what the future holds.

Samantha Tovias Leija

is a first-generation college student majoring in Biomedical Engineering and double minoring in Biology and Mathematics. She plans to graduate in Spring 2024. Samantha is an active member in UH Chapters of SHPE, SWE and AIAA. She serves as the social chair for SHPE and values the chapter development of her committee. Samantha loves to work out, crochet, knit, hike, travel and read. She loves to empower her community to participate in STEM through advocacy, access, support and development.

Amaury Robles

is a Mechanical Engineering senior graduating in May 2023. He currently serves as the President of SHPE-UH. In fall 2020, Amaury served as SHPE-UH's Engineering Events Coordinator and New Member Representative. While his college career started at Texas A&M and then Lone Star College, it was through his involvement at the University of Houston and the SHPE-UH chapter where he found his 2nd Familia. He felt empowered to be the best version of himself, and now wants to inspire and empower the next generation of Hispanics in STEM. Amaury has interned at Hewlett Packard Enterprise as a Hardware Engineering intern and The Boeing Company as a Quality Engineering Intern. His interests are medical devices and the aerospace industry. In his free time, Amaury loves playing guitar and watching mixed martial arts.

CHBE'S SINGH PICKED FOR MIT RISING STARS WORKSHOP

BY STEPHEN GREENWELL

Garima Singh

A doctoral student in the William A. Brookshire Chemical and Biomolecular Engineering Department at the Cullen College of Engineering has been selected for a prestigious workshop at the Massachusetts Institute of Technology.

Garima Singh said she first learned of the Rising Stars in Chemical Engineering workshop after receiving emails from Department Chairman **Triantafillos J. (Lakis) Mountziaris** and her advisor, Professor **Michael Nikolaou**. The two-day workshop, which takes place on Sept. 29 and 30 this year, brings together top female doctoral students and postdoctoral researchers that are about one year away from submitting applications for faculty openings.

The program includes research presentations, panel discussions with MIT faculty, communications workshops and networking events with faculty, graduate students and postdoctoral researchers currently at MIT.

"I applied this year again and was selected. It's an honor as well as privilege to be selected to this competitive program," Singh said. "I am excited to meet the fellow recipients and esteemed faculty at MIT. This workshop is definitely going be helpful in preparation for pursuing a career in academia and expand my network."

Singh earned her Bachelor of Technology in Chemical Engineering from the Indian Institute of Technology, Banaras Hindu University, in Varanasi. After two years as a shift engineer and a year as a process engineer at Reliance Industries in Gujarat, she joined UH as a doctoral student with Nikolaou in August 2018.

Singh noted that she had always planned to pursue her doctorate, but she wanted real-world experience in industry first. A competitive Ph.D. stipend helped to lure her to the Cullen College of Engineering.

"I always wanted to have a brief exposure to industry before pursuing a doctorate. I felt it gave me a true sense of the application of theory in practice before going back to books again," she said. "Looking back, this has surely changed the way I perceive things now, and I have a more rounded outlook to solving problems. I was inspired by the professors in my undergrad who had similar experience and brought up industrial illustrations and applications to teach concepts. I wanted to do the same when I became a faculty member."

When it came to positive academic influences, Singh highlighted her undergraduate and Ph.D. advisors.

"Dr. A. S. K. Sinha was instrumental in instilling an interest in research and academia," she said. "My current advisor, Dr. Michael Nikolaou, has helped me improve my technical presentation and writing skills significantly, which has got me appreciation at various occasions."

PETROLEUM GRADUATE VILLARROEL TAKES 1ST IN REGIONAL STUDENT PAPER CONTEST

BY STEPHEN GREENWELL

A Petroleum Engineering graduate from the Cullen College of Engineering has earned a first-place finish for his presentation at the Society of Petroleum Engineers GCNA/SWNA (Gulf Coast and Southwest North America) Regional Student Paper Contest.

Andres Villarroel, a May 2022 graduate with a Master's degree in Petroleum Engineering, won the contest, which was held virtually this year.

Describing his presentation, Villarroel said, "We proposed a new method to estimate oil volumes in complex reservoirs where conventional methods do not work. The novel method allows for more accurate results and at less expense."

A competitive financial aid package initially drew Villarroel, a native of Bolivia, to UH. He earned his B.S. in Petroleum Engineering from Universidad Privada Boliviana in La Paz. However, it was his academic work that encouraged him to stay.

"After a couple of months of studying here, I came to realize the culturally diverse and intellectually stimulating environment the University of Houston has to offer," he said. "I enjoyed engaging with people from all walks of life and cultures. I felt at home from the very beginning."

While at UH, Villarroel was advised by **Michael T. Myers**, Ph.D., Ali Daneshy Endowed Associate Professor, and **Lori Hathon**, Ph.D., Assistant Professor, both in the Petroleum Engineering Department.

"I will always be grateful to my advisors for the many hours they spent helping me make sense of things," he said. "Without their invaluable assistance, vast knowledge, and graceful senses of humor, I could not have completed my degree. Last but not least, I'm indebted to my parents, Carmen and Enrique, for their unfailing love and encouragement."

In addition to this honor, Andres also earned first place in the Society of Petrophysicists and Well Log Analysts Student Paper Contest in March 2022. He is a member of the Tau Beta Pi Engineering Honor Society, and the 2021 recipient of the Chester F. Barnes Scholarship. Andres said he would like to pursue a doctorate, and then seek opportunities in the industry.

Andres Villarroel

Jakob Lee:

OUTSTANDING JUNIOR

BY STEPHEN GREENWELL

Juggling assignments and managing responsibilities isn't anything new for Jakob Lee, the Outstanding Junior at the Cullen College of Engineering for 2022-23. After all, you learn a thing or two about scheduling and personality management when you're running your own business. »

Jakob Lee

After his freshman year in 2019-20, the Mechanical Engineering student became the owner and operator of Surfside Beach Lawn Service in July 2020. The business services more than 200 commercial and residential properties, and Lee manages three employees.

"Freshman year, I didn't have any source of income as a student, and I was struggling to pay for gas to get to and from campus, so I decided to get a summer job," Lee said. "I was cutting grass full time for a guy in his 60s who was basically ready to retire. Within three months of working for him, I was running everything. He came to me saying he wanted out."

Becoming a business owner in their late teens or early 20s would be intimidating to some. But Lee knew he had the work ethic and skills to not just take over the business, but to help it thrive.

"We wrote up a contract, and I purchased the company with a loan. Since then, I was able to expand the company to about 250 percent of what it was when I purchased it and paid back the loan while maintaining full-time enrollment. I think there's an obvious comparison between my dedication for school and work. I have never been one to half-ass anything, so when I took over the company I did it head on, while never sacrificing my grades in school."

He attributes the development of his work ethic to his experiences growing up.

"I think back to my weekends as a child. My stepdad would wake up early and we'd spend the entire day outside doing yard work," Lee said. "Taking the day off was never an option. Starting at about 15, my mother and stepdad both worked in offshore oil and would be gone for months at a time. I think because of this I've always had a very 'sink or swim' mentality."

With a parent offshore, it meant that Lee was asked to take care of more of the household chores than some of his peers, which he said made him mature fast. However, this in turn made him confident he could handle the workload of a business, and he's gotten more comfortable with three years under his belt.

"Learning to operate a business was extremely stressful, let alone while still in college. I finally feel as if the fruits of my hard work are finally in harvest as I get to relax and focus on school while my company supports all of my financial endeavors."

Lee hasn't just survived a challenging course load, he's thrived while completing it. He has been a member of the Dean's List for his entire time at UH, and attributed his success to his support network.

"I would like to shout out my wonderful girlfriend Grace for always supporting my decisions and growth, and my brother Jr. for convincing me to never give up on my company no matter how hard it got," he said. "My mother and step-dad helped me financially at the beginning of the company, and so did my grandmother when it came to the equipment."

Perhaps not so surprisingly, Lee has plans for his short and long-term futures, regardless of his age.

"I plan to graduate in 2024, and get an engineering job in Houston. As for the field, or job in mind, I am very open," he said. "My girlfriend is also a junior and Mechanical Engineering student at UH. Within the first five years after graduation, she and I plan to heavily invest our three incomes – from the landscaping business and our two engineering jobs – into commercial real estate. Ideally we'd like to be 100 percent financially free within 15 years of graduation through investments, so we can fulfill our dream to travel around the world full-time."

Elizabeth Richardson:

OUTSTANDING SENIOR

BY STEPHEN GREENWELL

For Elizabeth Richardson – the Outstanding Senior at the Cullen College of Engineering for 2022-23 – its been such a productive four years at the University of Houston that it's hard to know where to start when it comes to summing them all up.

Elizabeth Richardson

Her success in the classroom while studying Industrial Engineering has led her to being on the Dean's List since she enrolled in the Fall of 2019. She's also been an active member in the student chapter of the Institute of Industrial and Systems Engineers (IISE), serving as the group's vice president. She has parlayed her learning into internships at Northrop Grumman in Utah and TechnipFMC in Houston.

But unlike some of her peers, Richardson has done this while having a grueling, physical schedule outside of the classroom as well. Richardson has been a member of the Division I Swimming & Diving team for all four years, which has meant a 20-hour weekly practice schedule, often starting at 6 a.m. in the water. She is now a captain for the team, which has won six straight American Athletic Conference titles through 2022.

Richardson acknowledged her effort and hard work when she reflected on being named this year's Outstanding Student.

"Being the recipient of the Outstanding Senior award is a huge honor, one that I couldn't begin to express my gratitude for," she said. "This award makes all the early morning practices and late night grinds worth it."

Richardson was an athletic recruit after a successful high school swimming career for Vero Beach High School. At the time of her signing, she told TC Palm her reasons for UH.

"When visiting the university, I instantly fell in love with the campus," she said. "Once I met with the coaches, support staff and swimmers, I felt very welcomed and knew it was the right place for me."

It's a sentiment she still holds after four years, thanks to the support of her teammates, the organizations she joined and the people she met.

"I'd like to thank my teammates for helping me through the hard times, and my sister Jessica for being my biggest mentor, as well as all of my IISE officers throughout the years, and Dr. Yaping Wang for nominating me for the award. I directly contribute my success these past four years to those around me."

Richardson was also interviewed by Civil Engineering junior **Trinity Doan** about the balance between academic and athletic life for the College's "Steminist" podcast. Listen on Anchor via Spotify, or with your podcast application of choice.

Although she's been focused on a medley of academic and athletic activities in her four years at UH, Richardson admits that she's still open to possibilities for her future.

"I have been offered some job positions, but none of them felt like the right fit," she said. "So at the moment I do not have any set-in stone plans, but I am exploring job opportunities in the data analytics field."

To read more about Richardson's journey to UH, and her experiences as an athlete and a student, turn to p. 90 for an excerpt from her podcast episode

LOCATION, OPPORTUNITY ALLOW IE GRAD LUO TO THRIVE

BY STEPHEN GREENWELL

For **David Luo**, it was the combination of location, finances and a faster-paced curriculum that challenged him, which drew him to the University of Houston's Cullen College of Engineering.

Since graduating with his master's degree in December 2019, Luo has worked as a Healthcare Systems Engineer focusing on Human Factors for the University of Texas M.D. Anderson Cancer Center. Earning both his B.S. and master's degree from the Industrial Engineering program at Cullen, Luo knew of UH after growing up in the area and attending Bellaire Senior High School.

Luo had several options coming out of high school, but chose UH because of the location and the financial incentives offered.

"Having grown up in the Houston-Galveston area, I wanted to attend a local school. Family is important to me, and I did not want to attend out-of-state schools or schools outside the Greater Houston area," he said. "The University of Houston also offered me an $18,000, four-year scholarship, which when combined with my other scholarships, lowered the cost of attendance significantly. I wanted to graduate college without taking on any student loan debt and the fixed tuition of the 'UH in 4' program and my scholarships helped to ensure that I could graduate without any debt."

However, Luo noted that he did feel a bit "burnt out" after high school, especially because of the crunch involved with taking multiple tough advance placement (AP) courses at once. He was interested in earning a B.S. and a master's in a shorter time span.

"Upon speaking with my advisor, I learned of our Accelerated BS/MIE Program, which allowed me to take graduate courses as an undergraduate student," he said. "The Accelerated Program, coupled with my AP credits and taking additional courses every summer, allowed me to graduate with my bachelor's and master's degrees in four years."

When it comes to his educational achievements, Luo said there were several important influences at different stages.

"My parents were my first educational mentors," he said. "From an early age, they instilled in me a strong work ethic that carries through today. From there, my high school AP Macroeconomics teacher, Mr. Michael Clark, encouraged me to pursue engineering at UH, even though math and science were never my best subjects in high school."

Luo said that once he got to UH, "Dr. **Gino Lim** believed that I had what it takes to be a successful engineer. Dr. **Randal Sitton** introduced me to the world of Industrial Engineering in Health Care, and Drs. **Ali Kamrani** and **Yaping Wang**, my two undergraduate advisors, helped facilitate my goal of graduating with my bachelor's and master's degrees in four years."

David and his family at his father's college graduation.

Among other duties at M.D. Anderson, Luo's job involves designing and implementing the institution's Tiered Readiness Briefings to ensure the timely resolution of safety concerns, and automating their Covid-19 screening algorithm to reduce errors. Asked to describe his role, Luo said he specializes in the "human factors" of the hospital environment.

"I evaluate processes for potential sources of human error and then redesign them to either eliminate or mitigate the effects of such errors," he said. "In essence, we want to ensure that the correct process is the easy process to perform."

Luo also continues to further his education.

"In addition to working full-time, I also go to school full-time. I am currently a Ph.D. candidate in Healthcare Management at the UTHealth School of Public Health after recently passing my Ph.D. preliminary exams. The Healthcare Management Ph.D. program has allowed me to connect my Industrial Engineering background with my Health Care work environment to better leverage my skill and understanding of both."

Luo had advice for current students as well, shaped by input from **Dan Burleson**, Instructional Associate Professor for the Cullen College of Engineering's First Year Experience program.

"I would tell current students to have high expectations for the future, since you won't be a student forever and there's much to look forward to once you finish school! Grit and resilience are two traits that helped me be successful in my time at UH," he said. "Dr. Burleson introduced me to the concept of grit during my freshman year. Grit involves putting in consistent effort, even if you encounter difficulties and setbacks. Resilience is the ability to adapt, recover and continue after encountering those difficulties and setbacks. Even if you have a rough semester or two, focus on the progress that you are making towards your degree and let that drive you to continue past the finish line."

David at his father's commencement

> *Both pictures are from my dad's master's degree ceremony at UTMB in Galveston when I was 5 years old. 17 years later, I got my master's in Industrial Engineering from UH. I'd like to think that I got a "head start" by wearing his cap and hood back then.*
>
> - DAVID LUO

IE ALUM ECHEVERRY LATEST MEMBER OF INDUSTRY ADVISORY BOARD

BY STEPHEN GREENWELL

In a way, **María Patricia Echeverry** serving on the Industrial Engineering Department's Industry Advisory Board is a "full circle" moment for the UH graduate – from an undergrad collaborating with the college, to Master's student and industry professional, and now, an expert lending her expertise back to the school in 2014.

Echeverry earned her B.S. in Industrial Engineering from Universidad Javeriana in Colombia. While there, she learned about the links between that college and Cullen, and it made her interested in attending when she found herself in the metro area.

"When my husband was transferred to Houston some years later, I already knew that I would be looking to obtain my Master's from UH due to its location and its size," she said. "The diversity and tenure of my professors, and the diversity of my peers, made it an excellent experience!"

Echeverry earned her Master's in 2004, and soon joined Cadeco Industries – the sister company of Gulf Coast Distillers – as a production manager in October 2004. She was promoted to general manager in 2007, serving in that role for more than seven years.

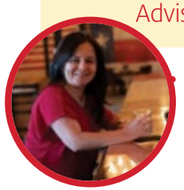
In 2014, Echeverry was deeply involved in the process of creating Gulf Coast Distillers from its inception.

"We continue growing every year, and GCD is now the largest distillery west of the Mississippi," she said. "We just expanded our capacity with the installation of our distillation column, in addition to our potstills. That includes Big Dave, which is a massive 4,000 gallon potstill. We produce a variety of spirits, including bourbon, whiskey, brandy and vodka. We have a unique tasting room, and tours for visitors to see our process and learn about the unique spirits we produce here in the heart of Houston."

After working as GM for Gulf Coast Distillers for a couple of years, Echeverry became the Vice President of Operations for the group of companies in 2016, overseeing the coffee, distillery and sugar operations. Her total tenure with the group is now more than 18 years.

This isn't the first time that Echeverry has provided her time and expertise to the college either. For three semesters in 2013 and 2014, she served as an Adjunct Faculty Instructor at the College of Technology, teaching courses focused on Quality Improvement Methods and Lean Six Sigma.

> "By being in Houston and working in food production environments that are part of a family business, I am exposed to opportunities and experiences that are different from those of other members who work in oil and gas, service industries or other workplaces. That combination of skills and profiles is invaluable for the Advisory Board."
>
> - MARÍA PATRICIA ECHEVERRY



"When Dr. **Gino Lim** [R. Larry and Gerlene R. Snider Endowed Chairman of IE] invited me to be part of the Advisory Board, it was an honor, and I love the opportunity of being able to strengthen my link to the IE Department, and to give back to the university and learn from my colleagues," she said.

"I am passionate about Industrial Engineering and manufacturing," she said, noting that her range of experiences in the work force allow her to bring vital skills to the IAB.

Cullen Alum Named One Of City's MOST ADMIRED CEOS

BY STEPHEN GREENWELL

An alumni of the Cullen College of Engineering has been selected by The Houston Business Journal as one of 45 honorees in the fifth-annual Most Admired CEO Awards.

Daniel Wong, CEO of Tolunay-Wong Engineers, Inc., is a 1988 doctoral graduate of the Cullen College of Engineering. He also earned M.S. and B.S. in Civil Engineering from the university in 1985 and 1983, respectively.

Recently, Wong was also selected as the 2022 Houston Engineer of the Year. Tolunay-Wong Engineers, Inc., headquartered in Houston, 10 offices in Texas and Louisiana. He is a licensed engineer in Texas, and an adjunct professor in the Civil and Environmental Engineering Department. Wong has given generously to the college in the past, and in June 2020, he established an Endowed Professorship, known as the **Honorable Daniel Wong** Endowed Professorship that currently supports the research of **Cumaraswamy Vipulanandan**.

Image credit: TWE Inc.

According to the journal, "In selecting our CEO honorees, a panel of judges looked for characteristics such as contribution to company success, civic involvement, career achievement and more. The honorees represent several of Houston's prominent industries, with CEOs from energy companies, nonprofits, homebuilders, real estate firms and more — even an arts organization."

The 45 honorees were recognized in a special section of *The Houston Business Journal's* Sept. 2 edition, and an awards luncheon in September 2022 at the Marriott Marquis Houston.

Daniel Wong pictured outside Tolunay-Wong Engineers, Inc. headquarters.


Don Sparacino


Sparacino at the 2022 Crawfish Boil

MATCH MADE AT UH FOR CRAWFISH BOIL CHAIRMAN

BY STEPHEN GREENWELL

Given the ties that he and his wife have to the University of Houston, it wasn't a tough decision for **Don Sparacino** to decide to volunteer his time for events like the UH Offshore Industry Crawfish Boil. Well, especially now that his 11 children – eight girls and three boys – with his wife **Cynthia** are grown.

"My wife and I have 11 kids, so there's no stress level you can reach with me that they haven't already," he said, laughing. "We're both native Houstonians, and raised our kids in Houston. One wife, no twins, so that's a lot of work, and she's the drill sergeant of the family."

The comparison to the military is apt, because seven of the 11 children have gone on to serve in the Army, the USAF or the USMC. The family was recognized at a Houston Astros game for their devotion to the armed forces. Five of the seven serving are women.

Sparacino sees it as an extension of the work ethic he and his wife have always demonstrated, while giving credit to Cynthia for "keeping him on track" after he initially struggled with college. The two met while taking night classes at Houston Community College, before transferring to UH.

"We had a marketing class together," he said. "We were in that class, and I started talking to her and asked her out. Come to find out, we went to the same grade school together, but she was a year ahead of me. Her best friend was my best friend's wife. She lived on 32nd Street, and I lived on 31st Street."

The two first met in 1973, and they graduated from UH's College of Technology – Bachelor of Science and Technology, with a focus in Marketing – in 1979, followed by Master Degrees a few years after, from the same college. However, the years between were filled with activities. The couple married in May 1975, and had their first child together in January 1977. Both worked and went to school to pay their way through college, as well as raise a family at the same time.

"I wouldn't advise anyone to do that," Sparacino said, laughing. "If you want to get married, that's one thing, but if you want to have kids, finish school."

When people ask how he and his wife raised 11 kids and remained together for 47 years, Sparacino says he has a standard answer for them.

"You're going to track meets, swim meets, basketball games... You're just on the move. You don't really have time to look back. Have you ever tightrope walked? What you do is, you don't look down and you don't look back, you just keep moving forward or you will scare the hell out of yourself! That's how it's like raising 11 kids. And we're up to 15 grandkids now."

Sparacino's first job out of college was for Cameron Iron Works, where he worked in sales for aerospace forgings for a jet engine manufacturer. It was also the first time he significantly spoke to and worked with people outside of Texas.

"That was my first real jousting with the people from the northeast, the yankees. I told my wife, 'These people talk funny,'" he said, laughing.

Sparacino worked for about 21 years for Cameron, before moving on to several other companies, typically in sales of steel products in marketing management and director roles. He still loves sales, and for the past year, he's mostly worked part-time with his own company, Sparacino Associates, LLC, as a manufacturer's sales rep for about five Houston companies.

"I just kind of want something to do, to keep busy," he said. "I sit at the kitchen table and write emails."

After college, Cynthia taught school, earned her real estate license, and also has her own travel agency. The pair love to travel, especially cruises. So far, they've taken an Egyptian cruise down the Nile that Sparacino called a highlight, as well as a river cruises in Europe and another on the Mediterranean Sea, out of Rome. However, the best trip to date was a week in the Galapagos Islands, which everyone he said everyone should travel to once in their lifetime.

"We have plans in 2023 to go to the Middle East and take a cruise on the Red Sea, which has been a goal for a good while now," he said.

Sparacino first got involved in giving back to the University of Houston when he attended the Crawfish Boil about five years ago. He thought his sales background would be a natural fit for the fundraising effort.

He viewed the university as serving a vital role for the students and the industry of the Houston metro area and beyond.

"I think UH is a really important part of the city, and the history of the city," he said, noting how much the school had grown. "When we went there at night, it was mostly a commuter school, and you didn't have people living on campus. It's a wonderful school for people, and when I'm around younger people, I try to get them to look at it as an option."

Sparacino is serving as both the Event Chairman and Sales Chairman for the 32nd annual UH Offshore Industry Crawfish Boil, which is scheduled for Sunday, April 30 from 1-5 p.m. at Lynn Eusan Park on the UH campus.

TO LEARN MORE ABOUT THE 2023 CRAWFISH BOIL VISIT:

https://www.egr.uh.edu/eaa/offshore-industry-crawfish-boil

Elizabeth Richardson at a UH swim meet.

STEMINIST PODCAST

Season 3 - Episode 3

DEEP DIVE INTO WHAT IT'S LIKE TO BE A STEM ATHLETE

In this episode we meet **Elizabeth Richardson**, a senior at the Cullen College of Engineering, who is practically an expert at deep dives at this point – both in the classroom, and at the University of Houston's Natatorium, to discuss how she balances her academic and athletic lives.

This episode was hosted by **Trinity Doan**, a junior Civil Engineering student.

Elizabeth Richardson

More about Elizabeth Richardson:

A native of Vero Beach, Florida, Richardson has balanced an aggressive academic course load in Industrial with her work in the pool. The Cougars' swimming and diving team has won six straight American Athletic Conference titles.

Richardson was part of the title effort, earning seven points for a 10th place finish in the 1650-yard freestyle. The Cougars ended up needing every single point they could get, as they finished only a half-point ahead of Southern Methodist, 866.5-866, for the victory. Richardson was also named the Female Academic Cougar of the Year by UH Athletics.

EPISODE EXCERPT:

My name is Elizabeth and I'm a senior here at the University of Houston. I'm studying industrial engineering, while also being in the Honors College, and I also partake on the University's Swim & Dive team, primarily a freestyler as well as we've been conference champs the past 6 years now in a row, so hoping to keep that streak alive. This coming spring we get to compete against SMU.

Nice! Can you tell me what SMU is?

Southern Methodist University. They are hosting our American Athletic Conference Championship.

When did you first become interested in the field of Industrial Engineering?

When I was searching for colleges, I had committed to the University of Houston for Swim & Dive early on in my senior year, so then I started looking into what kind of majors, I've always been involved in the STEM field, but I didn't know quite what route I wanted to take in the STEM field. I was looking at the engineering route and read up on industrial engineering and the definition of it and it pretty much fully explained my type of the way I work, efficiency and proposing new solutions to make things work better and faster and that's just pretty much my day-to-day life, always thinking of new solutions in that sort of way, so I decided to go that route for engineering.

How did you first get involved with STEM?

I've always been in STEM. I've been a math whiz since I was in third grade. We called it "sunshine math" back in elementary school, where we had an extra math class. I've always enjoyed problem solving with a definitive answer, getting to solve that. I've always been the math whiz, the statistics route, I was considering that, but I wanted to go into an engineering field because I feel like it offers you more opportunities to not only work the problems but also see the change happen as well, especially with industrial engineering where there's a lot of that change and improving things, so I very much like that aspect of it to not only think of the ideas but also put them into action.

What's it like for you to do competitive swimming and diving while majoring in STEM?

Yeah, so I mean it can definitely get overwhelming at times, it's pretty much a full-time job on top of another full-time job of doing school, but I've grown up with my mindset of staying busy and doing as much as possible and making worth your time. I like having that set schedule of consistency, having practice in the morning, running to classes, going to another practice, then get home and you're only given about 3 or 4 hours of time to do your actual schoolwork, so it very much gets you to do your schoolwork. You can't procrastinate because you don't have the time that other students might have, so in that aspect, it is very nice having that support system that I have with the Swim & Dive team to help me be successful in STEM and industrial engineering to help back me up when I need help when times get rough, just having that support system too.

LISTEN TO THE FULL EPISODE AND OTHERS AT:
www.egr.uh.edu/news/podcast

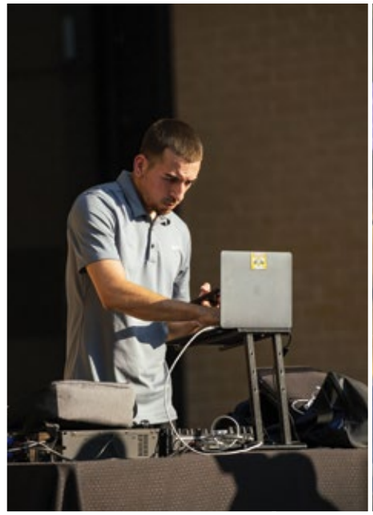
ABOUT THE STEMINIST PODCAST:

The STEMinist podcast aims to support an underrepresented topic: science communication. The podcast project seeks to improve science communication skills and give a voice to women in STEM fields, and features students, scientists, engineers and industry leaders. Nicole Guinn served as the podcast's primary host for seasons 1 and 2. Season 3 features five student hosts: **Michelle Patrick-Krueger, Nusayba Eli-Ali, Sarah Mukhida, Aria Shankar,** and **Trinity Doan**. Topics have ranged from student athletes, space exploration, career advice, and work-life balance.

Listen to new episodes online, or start from the beginning, at ***www.egr.uh.edu/news/podcast*** or on Anchor, Spotify, or anywhere you get your podcasts.

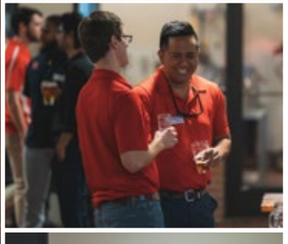
BEGINNING OF SEMESTER PARTY

The Beginning of Semester (BOS) Party was held in late September and was sponsored by Fluor Corporation. The event is a fun opportunity for students to let loose and check out the College's many student organizations. Food, drinks and games are available to attendees free of charge, and students can even try their hands at drenching a professor at the ever-popular dunk tank.



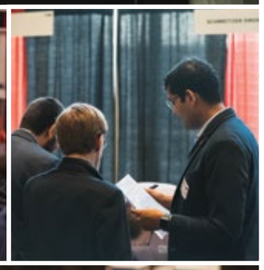
EAA ANNUAL MEETING

The Engineering Alumni Association hosted its annual meeting at Saint Arnold Brewery in August. The meeting is an opportunity for alumni to connect, network and learn more about what's happening at the Culln College of Engineering.



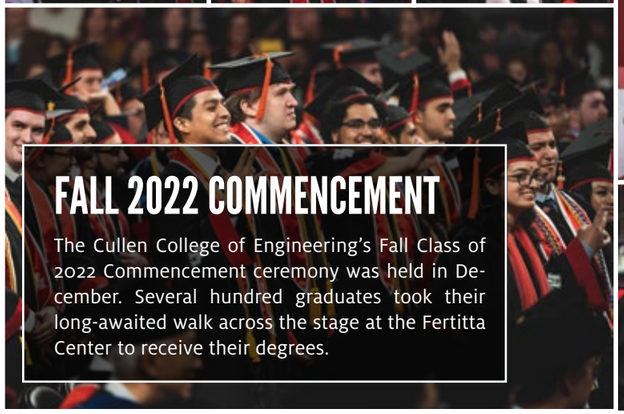
FALL CAREER FAIR

The Cullen College of Engineering held its annual Fall and Spring Career Fairs at the UH Hilton on the main campus last September and February respectively. Hundreds of companies and recruiters and thousands of students were in attendance between the two events, and featured big name sponsors including BP, Burns & McDonnell, Chevron Phillips, Patterson-UTI Energy, Inc., Visa Inc., Enterprise Products Partners L.P., ExxonMobil and Schlumberger.



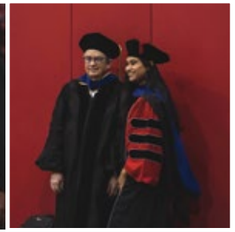
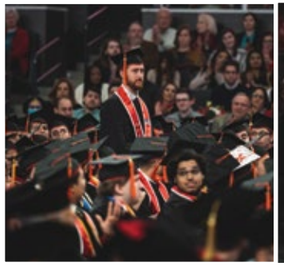




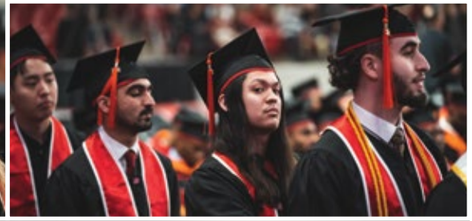


FALL 2022 COMMENCEMENT

The Cullen College of Engineering's Fall Class of 2022 Commencement ceremony was held in December. Several hundred graduates took their long-awaited walk across the stage at the Fertitta Center to receive their degrees.

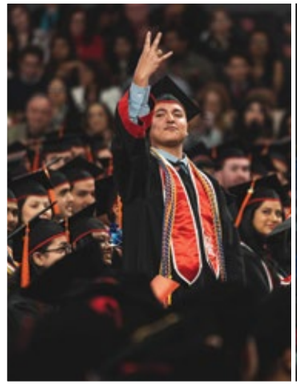











To learn more about events and outreach at the Cullen College,

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

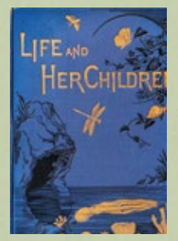
www.flickr.com/photos/cullencollege/albums

ENGINES OF OUR INGENUITY

NO. 3284: SPIDERS AND STEM

BY JOHN H. LIENHARD

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



Here's a fine old book. It's Arabella Buckley's "Life and Her Children." Buckley knew the great biologists of her day – Darwin, Lyell, and more. She worked for Lyell until he died. Then she began writing science books for young people. Today we talk about STEM education – Science, Technology, Engineering, and Math. Well, this was STEM back in the 19th Century. So, let's open her book:

She begins by asking us to look at the family bond that unites all living things. She wants us to see how we're all interconnected. The deeply religious Buckley revels in the miracle of evolution. She describes our wonderfully evolved biosphere.

Let's look at her chapter on "Snare Weavers." Mostly, that means spiders. Of course, spiders make many of us cringe! But Buckley knew that children haven't yet learned to be frightened. They can still see a spider for what it really is – a creature of tenacity and amazing skill. I think there's something here to bear in mind as we weigh our own STEM tactics.

Buckley begins with a garden spider's body – its jaws, torso, eight legs, and more. Its six spinnerets are fascinating. She tells how each puts out a different filament: Strong structural threads anchor the web. Then radial spokes. Elastic threads then circle the spokes. (They're the ones that carry tiny adhesive blobs to snare insects.) We learn how spiders capture, then consume, their prey.

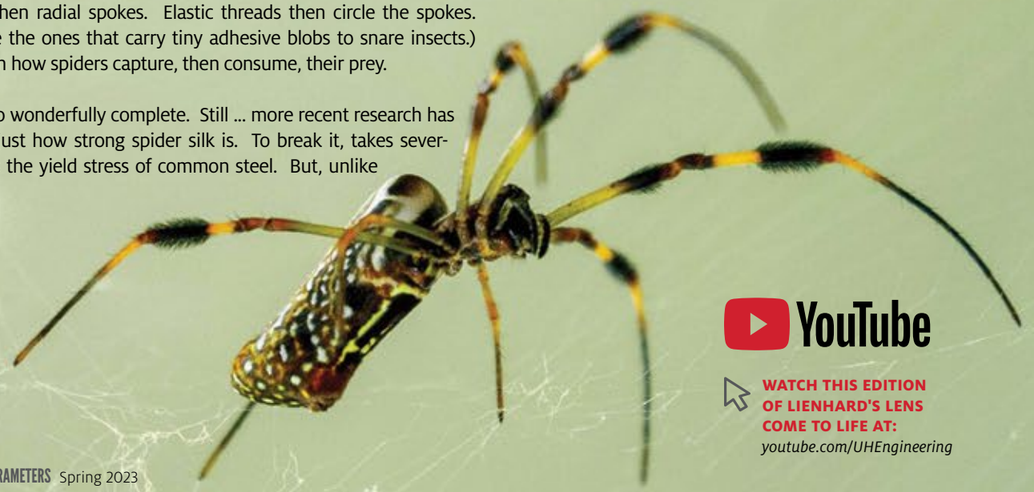
It's all so wonderfully complete. Still ... more recent research has shown just how strong spider silk is. To break it, takes several times the yield stress of common steel. But, unlike steel, it easily deforms. Then it creeps back to its original shape. That way, insects can't trampoline off a thread once they've landed on it.

I'm really surprised she could already tell us that each spider thread is a structure – not a single thread of material. Each spinneret puts out hundreds of incredibly small threads. They give the visible thread its underlying structure.

Buckley finishes by saying, "Thus the 8-legged insects ... make good their right to live ... If we could watch them all in their daily labour, we should find them quite as active and industrious as [we ourselves] ... struggling far more bravely against the thousand dangers and privations which threaten them every moment ... "

And so, Arabella Buckley has used this once maligned creature to capture the young imagination. She teases young people to ask still more questions. Today, we wonder how to make STEM education work. Well, here's an idea. Let's not be afraid to engage children with slightly scary themes. But frame them so they trigger curiosity. I think you'll agree. If we can lay aside our own fears, then nature's complexities have so much to teach us all – young and old alike.

I'm John Lienhard, at the University of Houston, where we're interested in the way inventive minds work.



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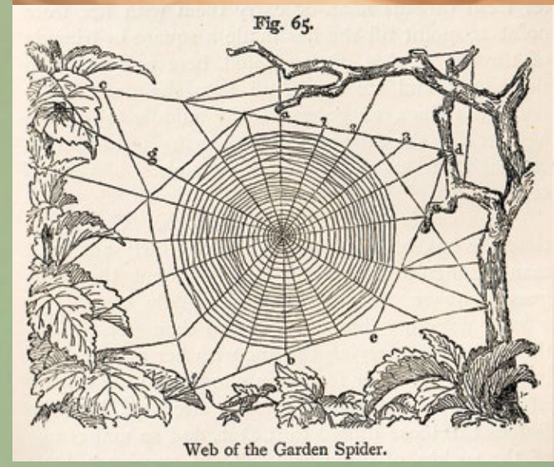

Fig. 65.

Web of the Garden Spider.

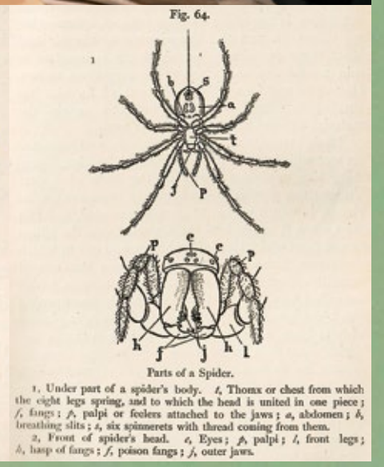

Fig. 64.

Parts of a Spider.

1. Under part of a spider's body. *t*, Thorax or chest from which the eight legs spring, and to which the head is united in one piece; *f*, fangs; *p*, palpi or feelers attached to the jaws; *a*, abdomen; *b*, breathing slits; *s*, six spinnerets with thread coming from them.
2. Front of spider's head. *e*, Eyes; *p*, palpi; *l*, front legs; *h*, hasp of fangs; *f*, poison fangs; *j*, outer jaws.

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.

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