A NEW ERA
OF ENGINEERING EXCELLENCE

University of Houston at Katy Opens Its Doors to the Public

Fostering New Generations of Innovation & Entrepreneurship
14 NATIONAL ACADEMY OF ENGINEERING MEMBERS
When I first accepted my tenure as dean of the UH Cullen College of Engineering 11 years ago, I was excited at the prospect of joining an institution with so much promise. UH Engineering had all the components of a great college — energetic students, remarkable faculty and an advantageous location in the heart of one of the most industrious and diverse cities in the nation. While we had great plans for the future, I had no idea just how far we would come and what new heights we would reach together.

Today the Cullen College is barely recognizable compared to a decade ago. Both our student body and faculty population have experienced explosive growth, all while maintaining our high standards and commitment to excellence. We have been granted numerous awards for our devotion to diversity, most recently from the American Society of Engineering Education, and our student success rate has reached a record high.

UH Engineering has entered a new era of engineering excellence. However, our college is not one to settle, and there is still much work to be done. How can we keep growing? How can we keep making the greatest impact possible on Houston and the world beyond?

The answer to these questions lies in two important new initiatives at UH Engineering, both of which are showing great promise.

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UH Engineering has entered a new era of engineering excellence.

First is our expansion into the West Houston area with the grand opening of the new UH at Katy facility. Under the leadership of Associate Dean, J.R. Rao, our presence in Katy serves as a model partnership between academia and industry. The city of Houston needs a homegrown workforce trained to take on the engineering jobs of the future while filling in the skills gaps of today, and we are the only college in the world with the expertise, resources and ingenuity to make it happen.

The second is the launch of our new Innovation & Entrepreneurship initiative. From smart cement to brain machine interface technology, UH Engineering is filled with examples of faculty and students making a difference in the world. Our vision is to support student success and nurture our culture of innovation and entrepreneurship, building on past successes and pushing into new frontiers. Now under the directorship of Haleh Ardebili, even more exciting ideas are being brought from the lab to the market.

We are building a culture of innovation, collaboration and entrepreneurship to help find solutions to the world’s most pressing problems. We dare to pursue ambitious possibilities and engineer them into reality. I invite you to read on and see why we have been engineering excellence since 1941.

Warm regards,

Joseph W. Tedesco, Ph.D., P.E.
Elizabeth D. Rockwell Dean and Professor
Archaeologists and adventure junkies are buzzing about the announcement of previously unknown ruins of a complex Maya settlement hidden for centuries amidst the jungles of Guatemala. Researchers at the National Center for Airborne Laser Mapping, or NCALM, say the discovery of tens of thousands of Maya structures (temples and houses), sophisticated agricultural systems and other human-made features, along with a huge increase in population estimates were not the result of luck or technological voodoo. It was instead the latest research-based reporting using airborne light detection and ranging technology, or LiDAR.

The findings, described in a documentary, which aired on the National Geographic Channel last March, offered a vivid illustration of the way in which LiDAR has expanded the discipline of archaeology, providing a bird’s-eye view of ancient sites that are far more difficult to survey on the ground.

NCALM is based at the University of Houston and jointly operated by UH and the University of California at Berkeley.

In the episode, entitled “How Mind-Controlled Robot Suits Could Enhance Our Limbs,” Elise Hu explores the importance and potential impacts of non-invasive brain-machine interface systems. During a visit to Contreras-Vidal’s laboratory at the University of Houston Cullen College of Engineering, she tried the technology first hand. The ultimate goal is that one day in the future, people who have become paralyzed or have lost mobility may be able to learn to regain those motor skills. “The exoskeletons will improve — it’s inevitable,” said University of Houston researcher Atilla Kilicarslan.

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InnovationMap Houston recently spotlighted Cullen College researcher Cunjiang Yu, Bill D. Cook Associate Professor of mechanical engineering, as one of Houston’s innovators to know for his latest advancements in wearable electronic devices. Yu is leading a project to develop a multifunctional ultra-thin wearable electronic device, so thin it will be imperceptible to the wearer. Most recent findings were published as the cover story in the journal Science Advances. The device also has the potential to work as a prosthetic skin for a robotic hand or other robotic devices, with a robust human-machine interface that allows it to automatically collect information and relay it back to the wearer.

Breaking Barriers

Dr. Bernard Harris, Jr., the first African American astronaut to perform a spacewalk, recently discussed challenges and opportunities in pursuing space dreams with Clare Luckey, a recent graduate of the Sasakawa International Center for Space Architecture (SICSA) at the UH Cullen College of Engineering who now works at NASA’s Johnson Space Center.

The conversation was part of episode four, titled “Breaking Barriers,” of Houston Public Media’s podcast series “Moonwalk.” “Moonwalk” is a series that brings people together for engaging conversations about the Apollo missions and their journeys in space exploration.

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## Engineer Snapshots

### 2019 Average Annual Salaries in Engineering

<table>
<thead>
<tr>
<th>Field</th>
<th>Median Entry-Level Salary</th>
<th>Mean Annual Salary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerospace</td>
<td>$66,892</td>
<td>$117,100</td>
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<tr>
<td>Biomedical</td>
<td>$60,582</td>
<td>$95,090</td>
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<td>$65,469</td>
<td>$114,470</td>
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<td>Civil</td>
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<tr>
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<tr>
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<td>Petroleum</td>
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<td>$156,370</td>
</tr>
<tr>
<td>Subsea</td>
<td>$99,340</td>
<td>$106,347</td>
</tr>
</tbody>
</table>

* Figures from National Occupational Employment and Wage Estimates, U.S. Department of Labor, 2018
* * Figures from National Occupational Employment and Wage Estimates, U.S. Department of Labor, 2017

### 2019 Average Annual Salaries in Engineering Top 10%:

- Aerospace: $164,210
- Biomedical: $144,350
- Chemical & Biomolecular: $114,470
- Civil: $142,560
- Electrical: $153,240
- Environmental: $144,770
- Industrial/Manufacturing: $123,340
- Materials: $114,770
- Mechanical: $114,770
- Petroleum: $116,370
- Subsea: $150,000

### UH Engineering by the Numbers

- **#69** Best Engineering School in the Nation
- **#14** Best Petroleum Engineering Program
- **#36** Best Chemical Engineering Program
- **#48** Best Industrial Engineering Program
- **#65** Best Environmental Engineering Program
- **#72** Best Electrical Engineering Program
- **#72** Best Civil Engineering Program
- **#77** Best Mechanical Engineering Program
- **#82** Best Materials Engineering Program
- **#80** Best Biomedical Engineering Program

- **996** Graduate Students
- **2,869** Undergraduate Students
- **3,865** Total Students
- **1355** Average SAT score of entering freshmen
- **30M+** Annual research expenditures

### UH Engineering By the Numbers

- **139** Total Faculty
- **17** NSF Career Awards
- **14** National Academy of Engineering Members

- **688** B.S.
- **350** M.S.
- **84** Ph.D.
- **1,122** Total

### 80% of UH Engineering undergraduates are employed within six months of graduation.

### 81,410 Jobs


### 80%

### 139

### 17

### 14

**National Academy of Engineering Members**

The American Society of Engineering Education (ASEE) recently honored the UH Cullen College of Engineering with an award recognizing its commitment to diversity and inclusiveness.

The college is one of 74 engineering programs around the country that received a bronze-level designation as part of ASEE’s national Diversity Recognition Program, which launched this year. Bronze was the only level designated during this inaugural award cycle.

Founded in 1893, ASEE is a nonprofit organization committed to furthering education in engineering and engineering technology. Its new program is the first national effort to publicly recognize engineering schools for their contributions to building a diverse workforce.

“This award from the ASEE is a great honor and it signifies that the Cullen College of Engineering is among the nation’s leaders in inclusive excellence.” said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the college. “We have a well-established tradition of encouraging diversity and inclusion at the college and our goal is to keep building our successes.”

UH Cullen College of Engineering Recognized for Achievements in Diversity by ASEE

Previously, the Program for Mastery in Engineering Studies (PROMES) at the Cullen College won two consecutive awards from INSIGHT Into Diversity, the largest and oldest U.S.-based diversity and inclusion magazine and website in higher education. PROMES, established in 1974, received a 2018 Inspiring Programs in STEM Award and Jerrod Henderson, director of PROMES, was honored with a 2017 Inspiring Leader in STEM Award.

In addition to PROMES, the Cullen College offers an array of outreach programs aimed at inspiring underrepresented groups to enter STEM fields. Two such programs – G.R.A.D.E. (Girls Reaching and Demonstrating Excellence) Camp and Girls Engineering the Future (sponsored by Chevron) – focus on encouraging young girls to pursue careers in engineering. The St. Elmo Brady STEM Academy, an innovative after-school program, focuses on young, underrepresented male students.

Researchers at the Cullen College track the impact of these programs annually, reporting that a much higher percentage of the participants go on to study STEM fields in college when compared to their peers.

As of fall 2018, around 25 percent of the Cullen College’s undergraduates are women; 27 percent of enrolled undergraduates identify as Hispanic; and 4 percent as black.

While the college is proactively supporting diversity and inclusion, national numbers show that despite progress being made certain groups – African Americans, Hispanics and Native Americans – continue to be underrepresented among this country’s new college graduates earning sciences and engineering degrees. White students earned about 59.3 percent of U.S. bachelor’s degrees in engineering in 2016, while black or African American students earned 3.9 percent, Hispanics earned 10.4 percent and Native Americans only 0.3 percent, according to the 2019 Women, Minorities and Persons with Disabilities in Science and Engineering Report by the National Science Foundation.

As of fall 2018, around 18 percent of the Cullen College’s graduates are women; 21 percent of enrolled undergraduates identify as Hispanic; and 4 percent as black.

The University of Houston is a Carnegie-designated Tier One public research university. UH serves the globally competitive Houston and Gulf Coast Region by providing world-class faculty, experiential learning, groundbreaking research and strategic industry partnerships.

Located in the nation’s fourth-largest city and one of the most ethnically and culturally diverse regions in the country, UH is a federally designated Hispanic- and Asian-American-serving institution with an enrollment of more than 46,000 students.
Omron Lab Helps UH Engineering Students Get REAL-WORLD TECHNOLOGY EXPERIENCE

BY RASHDA KHAN

The UH Cullen College of Engineering and Omron Corp recently celebrated the official unveiling of the Omron Senior Design and Robotics Lab with cookies, punch and a wide variety of robots. Company representatives and faculty mingled with students and checked out different senior capstone projects – from a sorting robot to a mobile robotic billboard.

The lab, which directly benefits students in the electrical and computer engineering department (ECE), is divided into the senior design area and a robotics area.

Omron, the only company in the world today that offers a full suite of industrial automation products – from sensors and vision to motion control and robotics, not only paid for the lab with dedicated workbenches for student teams, but also donated the cutting-edge equipment and technology inside.

Robert M. Black, president, chief executive officer and chief operating officer of Omron Automation Americas, said partnering with UH was key to building up future generations.

"We believe the generation graduating today is going to be entering the workforce tomorrow, so we want to bring the skills they have learned in school into the manufacturing sector," he said. "I’m ecstatic that we’re able to work with the University of Houston on the Omron Senior Design and Robotics Lab. I think it’s a great way for students to learn real-world technology and apply it once they leave. We couldn’t be more proud to pair up with the University on the future generation.”

"This [lab] makes our graduates very marketable because these are skills companies want. We’re grateful to Omron for making this possible," Black shared with the students. "Today you have robotics, artificial intelligence, big data … things that are changing manufacturing faster than ever before. So the opportunities you have as graduate engineers is outstanding.”

A game-changing gift

Omron has a long history of supporting the Cullen College and its electrical and computer engineering students.

In 2010, the Omron Foundation established the endowed Omron Scholarship in electrical engineering. The company also sponsored a team of students in the Capstone Design course, which requires senior students to apply their engineering knowledge by solving real-world problems faced by those working in industry. Omron’s engineers have worked closely with UH electrical and computer engineering students since then, sponsoring several more capstone design projects and providing one-on-one mentoring to UH engineering students for almost a decade.

Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College, referred to Omron’s most recent gift as a milestone.

"The Omron Senior Design and Robotics Lab is truly a game changer for the Electrical and Computer Engineering Department because it gives our students the opportunity to work with the latest technology, the latest equipment and the latest software – all provided by Omron," Tedesco said. "We’re proud to have the Omron name displayed in our college and I look forward to continuing this relationship into the future.”

Black offered some parting advice to the Cullen College students:

"Make a difference. Everyone today has the ability to make a difference in anything you do. Leave this place with the knowledge you gained, bring it to your next job, make a difference, show what you can do with your skills," he said. "Engineering is about problem solving, and that is what business is today.”

Omron Automation is an industrial automation partner that creates, sells and services fully integrated automation solutions. The company Omron works with include those in the automotive, food and beverage, infrastructure, semiconductor and digital sectors among others. Established in 1933 and currently headed by President Yoshitaka Yamada, Omron’s 36,000 employees help businesses solve problems with creativity in more than 100 countries.
UH Civil Engineering Program Ranks on Two Lists

BY RASHDA KHAN

Reputational awareness helps further not only our Tier One academic mission, but also the resources available to our students, especially in the form of notable faculty and top-notch research.

- PAULA MYRICK SHORT, UH SENIOR VICE PRESIDENT FOR ACADEMIC AFFAIRS AND PROVOST
To Boost Minorities In Academia

In this day and age, the percentage of underrepresented minorities in engineering faculty is nowhere near what it can be,” said Hanadi Rifai, professor of civil and environmental engineering and associate dean of research and facilities at UH’s Cullen College of Engineering.

“I think you will see the picture changing,” Rifai said. “You have to excite people and show them the opportunities available, but then also prepare them to take advantage of those opportunities.”

The universities expect AGEP will enhance tech companies’ bottom lines as newly minted academics develop the diverse workforce of the future.

“We can’t overstate how important and timely this project is,” said the grant’s principal investigator, Reginald DesRoches, the William and Stephanie Dick Rice School of Engineering and a professor of civil and environmental engineering and mechanical engineering. “We are at a unique time when the economy is dominated by companies in the computational and data science domain. At the same time, we know these industries remain among the least diverse.”

DesRoches noted that Rice’s development of The Ion innovation and technology district gives Houston, one of the nation’s most diverse cities, a unique conduit toward diversification in burgeoning high-tech fields. “Although the grant is focused on getting more underrepresented minority Ph.D. and postdoctoral fellows into academia, this will have a direct impact on diverse undergraduates pursuing degrees in the data engineering and data science fields,” he said.

“This project award arrives at the right time, with the nation addressing a STEM achievement gap between underrepresented minority (URM) and non-URM undergraduate and graduate students, and with our universities and colleges struggling to recruit, retain and promote URM STEM faculty,” said Wei Wayne Li, a professor of computer science and director of the TSU-based NSF Center for Research on Complex Networks.

“Research conducted by the Kapor Center shows tech companies’ hiring practices are biased towards candidates from ‘top-rank ing universities’ and against ‘candidates with ethnic-sounding names,’” Pearson said. "We believe this holds true for many STEM faculty hires as well. We will investigate this along with other systemic barriers and inequities. Ultimately, we want to see the results of our research put into practice to help remove those barriers.”

The project will work in tandem with another AGEP grant to grant to Rice, Georgia Institute of Technology, Florida Agricultural and Mechanical University and the University of Colorado focused on advancing underrepresented minority postdoctoral researchers into faculty positions.

“We have a sizeable team of committed people at our institutions and at others nationwide who are working to make this project a success,” Pearson said. “Some get the sense that diversity, equity and inclusion are the responsibility of certain subsets of people. And that is not true,” she said. “It’s all of our responsibility. I want this to become business as usual, and this AGEP award will enable us to make great strides in that direction.”

From left: Wei Wayne Li of Texas Southern University, Pradeep Sharma and Hanadi Rifai of the University of Houston; Yvette Pearson, Reginald DesRoches and Canek Phillips of Rice.
Solid-state sodium-ion batteries are far safer than conventional lithium-ion batteries, which pose a risk of fire and explosions, but their performance has been too weak to offset the safety advantages. Researchers recently reported developing an organic cathode that dramatically improves both stability and energy density.

The improved performance, reported in the journal *Joule*, as well as *Science* magazine, is related to two key findings:

- The resistive interface between the electrolyte and cathode that commonly forms during cycling can be reversed, extending cycle life.
- The flexibility of the organic cathode allowed it to maintain intimate contact at the interface with the solid electrolyte, even as the cathode expanded and contracted during cycling.

Yan Yao, associate professor of electrical and computer engineering at the UH Cullen College of Engineering and corresponding author of the paper, said the organic cathode – known as PTO, for pyrene-4,5,9,10-tetraone – offers unique advantages over previous inorganic cathodes. But he said the underlying principles are equally significant.

“We found for the first time that the resistive interface that forms between the cathode and the electrolyte can be reversed,” Yao said. “That can contribute to stability and longer cycle life.”

Yao also is a principal investigator at the Texas Center for Superconductivity at UH. His research group focuses on green and sustainable organic materials for energy generation and storage.

Yanliang “Leonard” Liang, a research assistant professor in the UH Department of Electrical and Computer Engineering, said that reversibility of the interface is the key, allowing the solid-state battery to reach a higher energy density without sacrificing cycle life. Normally, a solid-state battery’s ability to store energy is halted when the resistive cathode-electrolyte interface forms; reversing that resistance allows energy density to remain high during cycling, he said.

Lithium-ion batteries with their liquid electrolytes are able to store relatively high amounts of energy and are commonly used to power the tools of modern life, from cell phones to hearing aids. But the risk of fire and explosion has heightened interest in other types of batteries, and a solid-state sodium-ion battery offers the promise of increased safety at a lower cost.

Xiaowei Chi, a post-doctoral researcher in Yao’s group, said a key challenge had been to find a solid electrolyte that is as conductive as the liquid electrolytes used in lithium-ion batteries. Now that sufficiently conductive solid electrolytes are available, a remaining challenge has been the solid interfaces.

One issue raised by a solid electrolyte: the electrolyte struggles to maintain intimate contact with a traditional rigid cathode as the latter expands and contracts during battery cycling. Fang Hao, a Ph.D. student working in Yao’s group, said the organic cathode is more pliable and thus able to remain in contact with the interface, improving cycling life. The researchers said the contact remained steady through at least 200 cycles.

“If you have reliable contact between the electrode and electrolyte, you will have a great chance of creating a high-performance solid-state battery,” Hao said.

In addition to Yao, authors include co-first authors Hao and Chi, Liang, Ye Zhang and Hui Dong, all of UH; Rong Xu and Kejie Zhao of Purdue University; and Hua Guo, Tanguy Terlier and Jun Lou of Rice University. The majority of this work was funded by the U.S. Department of Energy’s Advanced Research Projects Agency-Energy (ARPA-E).

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A quest for better batteries has led the U.S. Department of Energy to invest an additional $800,000 in Yan Yao’s research project titled “High-Energy Solid-State Lithium Batteries with Organic Cathode Materials.”


BY RASHDA KHAN
A new battery for the future

Yao and his students have embraced the challenge of creating better, safer and cheaper batteries. The research team specializes in the creation of next-generation batteries that use abundant, low-cost materials.

During the first phase, the team introduced a class of high-energy quinone materials – which can be synthesized from plants and food like maize or soybean – to pursue the 500-Wh/kg specific energy target set by the Battery500 Consortium. They achieved a highly reversible specific capacity of 200 mAh/g and recorded a 1000 charging cycles, while most solid-state batteries diminish rapidly after 100 charging cycles.

“Shipping these high-quality quinones by reusing them in a new battery is an inevitable future for solid-state batteries,” he said. “It will allow us to better understand the properties and create a better interconnected network in the electrode.”

These solid-state batteries could benefit a range of industries including renewable energy, aerospace, transportation and personal electronics. Since the DOE’s Battery500 Consortium is focused on advancing battery technology for electric cars, Yao expects the new batteries will initially be used in high-end products like luxury electric vehicles.

“We’re still at a pretty early stage and advanced manufacturing tools will be needed to scale up these solid-state batteries,” Yao said.

The findings, described in a paper published in the Proceedings of the National Academy of Sciences, address the paradox of why the mineral barite – often laced with the chemical element strontium – is widely present in seawater.

In solving a scientific mystery, researchers from the University of Houston and national laboratories also discovered a new avenue for clearing toxins from water, including wastewater produced by hydraulic fracturing.

The findings, described in a paper published in the Proceedings of the National Academy of Sciences, address the paradox of why the mineral barite – often laced with the chemical element strontium – is widely present in seawater.

Seawater is undersaturated with respect to barite; that is, the concentrations of barium and sulfate ions are too low to form barite precipitates, said Yandi Hu, associate professor of civil and environmental engineering at the Cullen College and corresponding author on the paper. Strontium sulfate is much more water-soluble than barium sulfate, so thermodynamic levels of strontium in barium sulfate precipitates should be low, as well, she said.

But barite is often found in seawater, as is strontium-laced barite. Based on field-site findings that the presence of barite and high strontium levels in barite are associated with the presence of organic matter, she and colleagues began their study.

In addition to Hu, co-authors for the paper include Ning Deng and Bo Cao of UH, Andrew Stack and Julian Weber of the Oak Ridge National Laboratory, and James De Vore of the Pacific Northwest National Laboratory.

“An understanding of barite precipitation in the ocean, which is globally undersaturated with respect to barite, is missing,” they wrote. “Moreover, the reason for the occurrence of higher [strontium] content in marine barites than expected ... remains unknown.”

Field data suggested barite precipitates were more likely to be found in seawater if organic material was nearby, although the researchers said the specific mechanism for mineral-organic interactions are not clear.

To better understand why, they used organic films in both undersaturated and supersaturated solutions and recorded barite nucleation. Tests found barite grew quickly in the solution, with continuous nucleation of barite at the interface between the solution and the organic film.

That interface creates conditions – a microenvironment – that is different from that of the main body of the solution, Hu said.

“The organics can enrich ions from the bulk solution, making the local solution at the interface supersaturated with respect to barite, even when the bulk solution was undersaturated,” Hu said.

The supersaturation along the organic film promoted continuous nucleation of barite there, while the fact that the strontium sulfate exhibited a lower nucleation energy prompted the incorporation of strontium into the precipitates, she said. “That explains the mysteries.”

In addition to offering an explanation for strontium-rich barite formation in marine environments, the researchers said the work offers new insights for understanding and manipulating solid solution nucleation and growth, which could lead to new methods for removing toxins from water and other liquids.

That includes the possibility of a more efficient way to remove strontium from the produced water resulting from hydraulic fracturing, Hu said.

She said both barite and strontium are often found in the produced water, while it is relatively easy to remove barite with the addition of a sulfate, removing strontium is more complicated. “We propose that with an organic presence, you can remove strontium more effectively.”

This work was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, Chemical Sciences, Geosciences, and Biosciences Division.
Researchers Report New LIGHT-ACTIVATED MICRO PUMP

BY JEANNIE KEVER

Very small mechanical pumps can help usher in new possibilities into an engineer’s lab, but they bring challenges, too. For one thing, there are limits on how small mechanical pumps can be. For another, their manufacture demands microfabrication techniques that present problems of their own.

A solution may be on the horizon. Researchers recently announced development of a laser-driven photoacoustic microfluidic pump, capable of moving fluids in any direction without moving parts or electrical contacts.

The work is described in the Proceedings of the National Academy of Sciences.

Using a plasmonic quartz plate implanted with gold atoms, the researchers demonstrated the ability to move liquids by using a laser to generate an ultrasonic wave.

“We can use the laser to make liquids move in any direction,” said Jiming Bao, professor of electrical and computer engineering at the University of Houston Cullen College of Engineering and lead author on the paper.

The work is based on a new optofluidics principle discovered by Bao’s lab and reported in 2017. That work explained how a laser could be used to trigger a stream of liquid, coupling photoacoustics with acoustic streaming.

The latest work involved fabricating a quartz substrate implanted with 1065 gold atoms, or ten thousand trillion atoms, per square centimeter and testing whether a laser pulse could generate an ultrasonic wave capable of creating a liquid stream. The quartz plate — about the size of a fingernail — was implanted with gold nanoparticles; when a pulsed laser hits the plate, the gold nanoparticles generate an ultrasonic wave, which then drives the fluid via acoustic streaming.

“This new micropump is based on a newly discovered principle of photoacoustic laser streaming and is simply made of an Au [gold] implanted plasmonic quartz plate,” the researchers wrote. “Under a pulsed laser excitation, any point on the plate can generate a directional long-lasting ultrasound wave which drives the fluid via acoustic streaming.”

The work could have practical implications, from biomedical devices and drug delivery to microfluidic and optofluidic research. Wei-Kan Chu, a physicist and project leader at the Texas Center for Superconductivity at UH, said the true value isn’t yet known. “We would like to better understand the mechanisms of this, and that could open up something beyond our imagination.”

The device was fabricated in Chu’s lab. He is co-author along with UH colleagues Xiaonan Shan, assistant professor of electrical and computer engineering; Dong Liu, associate professor of mechanical engineering; and Nzumbe Epie, of the UH Physics Department. They are joined by Shuai Yue, Feng Lin and Zhirong Wang of the University of Electronic Science and Technology of China; Qihui Zhang of Henan University of Engineering; and Suchuan Dong of Purdue University.

The nanoparticles offer an almost limitless number of targets for the laser, which can be aimed far more precisely than a mechanical micropump, Bao said.

“The mechanisms of how and why this works are not yet very clear,” Chu said. “We need to understand the science better in order to develop the potential of its unforeseeable applications.”

CULLEN COLLEGE PROFESSORS WIN WELCH AWARDS to Explore Fundamental Chemical Ideas

BY RASHDA KHAN

Two UH Cullen College of Engineering professors received funding from the Welch Foundation for their contributions to basic chemical research that benefits humankind. These three-year grants extend from 2019 to 2022.

Jiming Bao, professor of electrical and computer engineering, earned a $420,000 award — his fourth Welch award — to continue studying cobalt oxides as viable catalysts for energy generation.

Debora Rodrigues, associate professor of civil and environmental engineering, won a $195,000 grant so she can investigate the effects of drug delivery in the emergence of antibiotic resistance.

The awards bring in $1,435,000 in research funding.

“New advances can only come from a better understanding of how the world works,” said Carin Marcy Barth, chairwoman of the Welch Foundation. “Our mission as a Foundation is to support that critical basic research. It has been so rewarding to work with UH faculty — as well as scientists across the state — who are expanding knowledge at the fundamental level. Ultimately, these insights lead to solving real-world problems and improving lives.”

The Houston-based Welch Foundation is one of the largest private funding sources for chemistry research in America. Since its inception in 1954, the Foundation has given more than $66.5 million to the University of Houston.

Jiming Bao

Professor

Project Title: Correlating Photocatalytic and Photoelectrochemical Activity of Cobalt Oxides with Dynamics of Photo-excited Electrons and Holes.

Amount: $420,000

The right bandgap, which represents the minimum energy required to excite an

Under a pulsed laser excitation, any point on the plate can generate a directional long-lasting ultrasound wave which drives the fluid via acoustic streaming.
electron and free it up to participate in conduction, is essential in determining whether a material will be useful in making solar cells or light-emitting diodes (LEDs), or for generating useable fuel.

Transition metal oxides exhibit multiple absorption bands, however their many properties—such as the dynamics of photocreated carriers and subsequent photocatalytic activity—are still not completely understood by the scientific community. Jiming Bao plans to use his most recent Welch award to study the physical and chemical properties of transition metal oxides, specifically cobalt oxides.

Cobalt oxides are really active catalysts and used for many chemical reactions, Bao said. Because cobalt has magnetic properties, it is very hard to predict and measure the band structure of cobalt oxides and has led to polarized debates about its bandgap efficacy and conflicting reports.

“Bandgap is the fundamental property of any semiconductor,” Bao said, “It’s important to understand the physical properties of cobalt oxides because they are related to the chemical properties.”

For example, he said, “If the bandgap is higher, we can use it to split water using light. If too low, then it can’t be used to split water and generate hydrogen.”

His research team plans to use transient optical absorption technique and steady-state photoconductivity to probe the relaxation of electrons and holes from conduction band to d states in cobalt oxide nanoparticles and thin films at different temperatures. The photocatalytic activities will be investigated using photoelectrochemical technology and a new type of solar water splitting using water vapor at elevated temperatures.

Bao appreciates the Welch Foundation for supporting his research. “Initially I thought this would be a short project, but it has turned out to be a long-term one,” he said.

“Continued support is important because along the way we have discovered new properties and fundamental truths and clarified many questions.”

As a material scientist, Bao is eager to advance scientific knowledge by better understanding the basic fundamental properties of cobalt oxides and their range of applications.

“This is very active energy material. It’s being used in lithium ion batteries,” he said. “We want to use cobalt oxides to convert solar energy into chemical fuel to produce hydrogen, hydrocarbon and even ammonia.”

Debora Rodrigues

Associate Professor

Project Title: Plant-based Antibiotic Nano-carriers Investigation in the Simultaneous Reduction of Pathogen Mutations Rates and Intestinal Infections in Humans.

Amount: $195,000

Debora Rodrigues is using her Welch Award to study the impact of nanoparticles used as antibiotic drug delivery systems in the human body and find a way to fight off antibiotic-resistant bacteria.

According to the World Health Organization (WHO), “antibiotic resistance is one of the biggest threats to global health, food security and development today.” A growing number of infections—such as pneumonia, tuberculosis, gonorrhea and salmonellosis—are becoming harder to treat as antibiotics become less effective.

The solution may lie in nanotechnology, which has the potential to revolutionize drug delivery. While it isn’t a new concept, a lot of questions and challenges still need to be addressed.

Rodrigues plans to use novel plant-based carbohydrates (lignin) and (poly)lactic-(co-glycolic) acid nanoparticles loaded with ciprofloxacin antibiotics in a simulated human digestive system bioreactor.

The research project will focus on a) correlating drug release rates in different parts of the gastrointestinal (GI) tract with their physical and chemical properties; b) comparing nanoparticles’ effects on the emergence of antibiotic resistance in two gut pathogenic microorganisms; and c) investigating their efficiency in preventing infection by the two gut pathogenic microorganisms in human intestinal cells.

“We want to determine whether slow released drugs can induce or reduce the emergence of antibiotic-resistant bacteria,” Rodrigues said.

“The idea is to reduce the use of antibiotics over time and reduce the emergence of antibiotic-resistant bacteria.”

WHO links antibiotic resistance to longer hospital stays, higher medical costs and increased mortality.
Researchers Explain VISIBLE LIGHT From 2D Lead Halide Perovskites

BY JEANNIE KEVER

Researchers drew attention three years ago when they reported that a two-dimensional perovskite – a material with a specific crystal structure – composed of cesium, lead and bromine emitted a strong green light. Crystals that produce light on the green spectrum are desirable because green light, while valuable in itself, can also be relatively easily converted to other forms that emit blue or red light, making it especially important for optical applications ranging from light-emitting devices to sensitive diagnostic tools.

But there was no agreement about how the crystal, CsPbBr3, produced the green photoluminescence. Several theories emerged, without a definitive answer.

Now, however, researchers from the United States, Mexico and China, led by an electrical engineer from the University of Houston, have reported in the journal Advanced Materials they have used sophisticated optical and high-pressure diamond anvil cell techniques to determine not only the mechanism for the light emission but also how to replicate it.

They initially synthesized CsPbBr3 from a related material known as CsPbI3 and found that the root cause of the light emission is a small overgrowth of nanocrystals composed of that original material, growing along the edges of the CsPbBr3 crystals. While CsPbI3, the base crystal, is three-dimensional and appears green under ultraviolet light, the new material, CsPbBr3, has a layered structure and is optically inactive.

"Now that the mechanism for emitting this light is understood, it can be replicated," said Jiming Bao, professor of electrical and computer engineering at the UH-Cullen College of Engineering and corresponding author on the paper. "Both crystals have the same chemical composition, much like diamond versus graphite, but they have very different optical and electronic properties. People will be able to integrate the two materials to make better devices."

Potential applications range from solar cells to LED lighting and other electronic devices.

Bao began working on the problem in 2016, a project that ultimately involved 19 researchers from UH and institutions in China and Mexico. At the time, there were two schools of scientific thought on the light emission from the cesium crystal: that it emitted green light due to a defect, mainly a lack of bromine, rather than the material itself, or that a variation had unintentionally been introduced, resulting in the emission.

His group started with the synthesis of a clean sample by dropping CsPbBr3 powder in water, resulting in sharper-edged crystals. The sharper edges emitted a stronger green light, Bao said.

The researchers then used an optical microscope to study the individual crystals of the compound, which Bao said allowed them to determine that although the compound is transparent, "something was going on at the edge, resulting in the photoluminescence."

They relied on Raman spectroscopy – an optical technique that uses information about how light interacts with a material to determine the material’s lattice properties – to identify nanocrystals of the original source material, CsPbI3, along the edges of the crystal as the source of the light.

Bao said CsPbBr3 is too unstable to use on its own, but the stability of the converted form isn’t hampered by the small amount of the original crystal.

The researchers said the new understanding of the light emission will yield new opportunities to design and fabricate novel optoelectronic devices. The techniques used to understand the cesium-lead-halide compound can also be applied to other optical materials to learn more about how they emit light, Bao said.

In addition to Bao, researchers involved with the project include: Chong Wang, Yanan Wang, Xinghua Su, Shengyu Dai, Zhaojun Qin, Francesco C. Rubies-Hernandez and associate professor Yan Yao, all from the Department of Electrical and Computer Engineering at UH; Viktor G. Hadjiev, of the Department of Mechanical Engineering at UH; Yizhou Ni and assistant professor Shuo Chen of the UH Department of Physics; Md. Kamrul Alam of the materials science and engineering program at UH; Zhiming Wang of the University of Electronic Science and Technology of China; Guoying Feng of Sichuan University; Hector A. Calderon Benevides of the Instituto Politécnico Nacional; Haiyan Wang, Jie Jian and Qiang Li of Purdue University, and Quinkai Yu of Texas State University.
Researchers Developing Early Detection, Home Monitoring Tests For LUPUS NEPHRITIS

BY LAURIE FICKMAN

With $5 million in grants from the National Institutes of Health (NIH), two University of Houston Cullen College of Engineering biomedical researchers are moving the needle on early detection and monitoring of kidney nephritis, or inflammation, in patients who have Systemic Lupus Erythematosus, known simply as lupus.

Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering, Chandra Mohan, one of the nation’s leading lupus researchers, is working on disease diagnostics with his $3 million portion. Tianfu Wu, associate professor of biomedical engineering, is leading a $2 million project, developing a system that tests multiple samples for multiple biomarkers at once and a smartphone-based analysis and reporting system for disease monitoring and home care.

“It’s a great day for lupus research at UH,” said Mohan. “Together these grants could be transformative in the way lupus is managed. When we find the best biomarkers present in lupus, we can put that information in patients’ hands and empower them to monitor their own disease.”

Indeed, it all starts with biological indicator molecules called biomarkers. These are proteins that help predict who is likely to develop lupus or kidney disease and how severe the disease might become. Identifying lupus patients at particular risk for severe disease before serious complications arise has implications for early diagnosis and treatment.

Mohan has found such identifiers through proteomic screening, identifying about 30 proteins – out of thousands – elevated in either the blood or urine of lupus nephritis patients.

“These proteins were high in patients with renal disease and predicted worse disease outcome like kidney failure several years and up to 10 years later,” said Mohan. With this new grant, Mohan will conduct further screenings to look for additional biomarkers, which he believes are lurking. Then he would like to identify the most predictive biomarkers among these candidates, so that they can be used clinically.

“This is the wellspring of all the home monitoring projects,” said Mohan. “Before the patient can monitor anything at home, we must know what to monitor.” Aside from diagnostics and monitoring, Mohan’s team will use the new biomarkers to look ahead at prognosis to identify how patients might be expected to do over time and at treatment response to determine which patients will respond best to certain medications.

At home monitoring

Wu is also an investigator on Mohan’s grant. He is joined by Michelle Petri, director of the Hopkins Lupus Center at Johns Hopkins, assistant professor Claudia Pedroza of UT McGovern Medical School, UH research assistant professor Yong Du and laboratory manager Kamala Vanarsa.

“With his grant Wu is hoping that treatment of lupus nephritis flares will be timely when they can be diagnosed at home. Presently the gold standard for diagnosis is renal biopsy. This often painful and invasive procedure could potentially be replaced by Wu’s urine home test kit which will assess an array of biomarkers.

“We are developing a technology allowing us to measure multiple biomarkers at one time, and this is a first,” said Wu. The app-based program would allow patients to read their own diagnosis, which could be particularly helpful for elderly patients who often cannot be transported to an office for a test. The home tests may not only be able to predict flares but to guide individualized treatment.

Wu is an investigator on Mohan’s grant. He is joined by Michelle Petri, director of the Hopkins Lupus Center at Johns Hopkins, assistant professor Claudia Pedroza of UT McGovern Medical School, UH research assistant professor Yong Du and laboratory manager Kamala Vanarsa.
Soon after conception, an embryo’s circulatory system connects to that of its mother. Complications that occur at this critical time can result in miscarriage or birth defects with long-term chronic conditions. Unfortunately, limitations in imaging technologies prevent researchers from fully understanding the cellular-level events leading up to this crucial point.

Researchers from the University of Houston’s Cullen College of Engineering and Baylor College of Medicine are developing a new technology to allow simultaneous imaging of both embryonic structural development and the molecular underpinnings that occur in the developing circulatory system.

David Mayerich, assistant professor of electrical and computer engineering at UH, and Kirill Larin, professor of biomedical engineering at UH, Mary Dickinson, professor of molecular physiology and biophysics at Baylor, and Joshua Wythe, assistant professor of molecular physiology at Baylor.

“When you look at an embryo, things happen at two scales, structural and molecular,” Mayerich said. “Just hasn’t been possible to see both changes at the same time because the imaging systems used to capture them aren’t compatible.”

Current studies require multiple imaging methods: optical coherence tomography (OCT), a non-invasive imaging method typically used to study the eye, to collect high-resolution images of structural growth and changes, and three-dimensional fluorescence imaging such as light sheet microscopy to observe cellular changes. Even a short time lag between images taken with OCT and microscopy can make it impossible to synchronize the structural and chemical changes, said Mayerich, whose work involves the application of data science to microscopy, allowing for high resolution imaging at massive scales. This new system will merge both imaging methods and align them in 3D, he said, using specially designed software to synchronize the data collection.

Larin, an expert in using OCT to study developmental biology, said the technical challenges include the fact that the two imaging systems typically use different wavelengths of light. Using one microscopic lens for both OCT and microscopy will require overlapping optical paths.

Mayerich and his lab will also determine how to interpret the resulting aligned images, identifying and measuring components including blood vessels, blood flow and individual cells as they change over time. Ultimately, they hope to identify biomarkers correlated with certain birth defects, improving early detection.

“It’s technically very difficult,” Larin said. “But it will help us to grasp a fundamental understanding of the process,” potentially leading to treatments that could help avoid miscarriage, fetal death and birth defects.

Imaging Technology Will Offer New Clues to Embryonic Development

BY JEANNIE KEVER

For every new pathogen encountered, a small subset of B cells activates to make an antibody that specifically recognizes that particular pathogenic protein. For every new pathogen encountered, a small subset of B cells activates to make an antibody that specifically recognizes that particular pathogenic protein. For every new pathogen encountered, a small subset of B cells activates to make an antibody that specifically recognizes that particular pathogenic protein.

BY LAURIE FICKMAN

Biomolecular researcher Navin Varadarajan recently published in Arthritis & Rheumatology journal a first-of-its-kind study — a comprehensive profile of B cells in rheumatoid arthritis (RA). B cells are lymphocytes, or white blood cells, that make protein antibodies that attack a patient’s healthy proteins in patients with RA.

“To the best of our knowledge, this is the first study to conduct whole transcriptome profiling of antigen-specific B cells in any human autoimmune disorder,” said Varadarajan, whose results portray B cells not merely as autoantibody producers, but also as a source of diverse molecules that can influence proliferation, differentiation and activation of other pathogenic cell types.

“We anticipate that these data will serve as a foundational data set for investigating multiple hypotheses on the roles of B cells in RA and other autoimmune disorders, and will enable drug discovery,” said Varadarajan, an associate professor at the UH Cullen College of Engineering.

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B Cells, good and bad

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“A number of pathways associated with inflammation and protein modification, known to be amplified in rheumatoid arthritis, were found. At the molecular level, the team found two specific differences in the B cells of RA patients — the inclusion of the protein interleukin 15 receptor subunit alpha (IL-15Ra) and a high amount of the amphiregulin molecule, which can signal adjacent cells. Each was validated at the protein level in independent cohorts of RA patients and prioritized for further studies.

Autoimmune B cells, and they alone, have the protein IL-15Ra.

“We think that protein allows them to become bad actors,” said Varadarajan. “People have been targeting this pathway for quite some time. This now sheds new light on these bad guys in the progression of this disease and how to target it.”

The team is the first to show that B cells make amphiregulin. Amphiregulin sits in a well-studied pathway, the epidermal growth factor receptor pathway (EGFR), and so the next step will be to determine if inhibiting the pathway impacts the B cells.

Varadarajan’s team also published a list of FDA-approved drugs, such as Xeljanz (tofacitinib), that target various pathways of the B cells, though they aren’t specifically approved for that purpose.

The team includes Chandra Mohan, Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering at UH, S. Louis Bridges, Anna Los Waters Endowed Chair of clinical immunology and rheumatology at the University of Alabama School of Medicine, Sandeep Agarwal, associate professor and section chief of Medicine - Immunology, Allergy & Rheumatology at Baylor College of Medicine, Amita Aggarwal, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India.
Industrial engineers work to improve system performance, whether that system is in an oil refinery or an automobile production line or, as in this case, in hospitals.

A collaboration between the University of Houston and the Harris Health System Center for Innovation offered undergraduate and graduate students with the UH Department of Industrial Engineering an opportunity to help solve a real-world problem in a hospital emergency center.

Suresh Khator, professor of industrial engineering and associate dean for graduate programs and computing facilities in the UH Cullen College of Engineering, and Dr. Stephen Spann, founding dean of the UH College of Medicine, were recognized earlier this month at the Harris Health System Innovation Summit for a project to improve the flow of psychiatric patients through the emergency center at Ben Taub Hospital.

Khator said the project grew from conversations between Spann and Harris Health executives and began last fall with undergraduate students in his simulation science class studying patient flow and talking with hospital staff to understand how things worked.

“We don’t have domain knowledge,” Khator said. “We are not doctors. We look at the situation and study, where are the bottlenecks? Where are people waiting in line? What can we do to increase efficiency and productivity?”

Shanna Doucet, director of Care Management and Innovation at Harris Health, said the public health system is interested in innovative thinking to improve patients’ experiences.

Health care engineering isn’t new, she said, but the benefits are still emerging.

“More hospitals are collaborating with engineers to look at how to streamline operations, how to be more efficient,” she said. “There are more opportunities for engineers as we look at the human factors that are impacting how we operate.”

Khator’s spring class, made up of graduate students, has continued the project.

Poria Dorali, a doctoral student in industrial engineering, said he and other graduate students have gathered patient information and other data, as well as spent time in the waiting room and outside the hospital, observing and talking with patients. The information will be added to a computer model, allowing them to incorporate proposed changes — adding a staff member, for example, or combining some functions — to determine the impact.

It is a challenging problem, he said. “No two patients have the same problem. The steps that need to be taken are different for each patient.”

Khator said the Harris Health collaboration allows students to work with a cross-disciplinary team on a real problem, rather than a theoretical issue.

“We’re not Google or Microsoft programmers, that perform more naturally. We assume intention is in there, and we have to extract this information and brain activity out of people who cannot actually move, so this is our way of showing we can still get the information even if there is no movement,” said Francis. This process utilizes mirror neurons, which fire when action is taken and action is observed.

“This examination of reward motivation in the primary motor cortex could be useful in developing an autonomously updating brain machine interface,” said Francis.

Research Moves Closer to BRAIN-MACHINE INTERFACE AUTONOMY

BY LAURIE FICKMAN

A University of Houston engineer is reporting in eNeuro that a brain-computer interface, a form of artificial intelligence, can sense when its user is expecting a reward by examining the interactions between single-neuron activities and the information flowing to these neurons, called the local field potential.

Joe Francis, professor of biomedical engineering at the UH Cullen College of Engineering, reports his team’s findings allow for the development of an autonomously updating brain-computer interface (BCI) that improves on its own, learning about its subject without having to be programmed.

The findings potentially have applications for robotic prosthetics, which would sense what a user wants to do (pick up a glass, for example) and do it. The work represents a significant step forward for prosthetics that perform more naturally.

“This will help prosthetics work the way the user wants them to,” said Francis. “The BCI quickly interprets what you’re going to do and what you expect as far as whether the outcome will be good or bad.”

Francis said that information drives scientists’ abilities to predict reward outcome to 97%, up from the mid-70s.

To understand the effects of reward on the brain’s primary motor cortex activity, Francis used implanted electrodes to investigate brainwaves and spikes in brain activity while tasks were performed to see how interactions are modulated by conditioned reward expectations.

“We assume intention is in there, and we decode that information by an algorithm and have it control either a computer cursor, for example, or a robotic arm,” said Francis. Interestingly even when the task called for no movement, just passively observing an activity, the BCI was able to determine intention because the pattern of neural activity resembled that during movement.

“That is important because we are going to have to extract this information and brain activity out of people who cannot actually

To understand the effects of reward on the brain’s primary motor cortex activity, Francis used implanted electrodes to investigate brainwaves and spikes in brain activity while tasks were performed to see how interactions are modulated by conditioned reward expectations.
HOUSTON, WE HAVE AN EXPERIMENT:
UH Engineer Sends Cancer Research to the International Space Station

BY LAURIE FICKMAN

Precious Cargo

On a crisp November day, University of Houston chemical engineering doctoral student Yuechuan Xu set out for a drive to Houston’s Intercontinental Airport. Beside him on the car seat was precious cargo - a plastic foam box that held 30 tubes of ice in which two miniscule proteins were suspended in various forms. One of the proteins, p53, protects cells from cancer. The other protein, hnRNPA, causes amyotrophic lateral sclerosis (ALS), known as Lou Gehrig’s disease.

Soon the box, with its frozen cargo, would pass through the Transportation Security Administration on the first leg of a 220-mile journey. That short of a trip seems easy, essentially the same as a road trip from Houston to Dallas. Except on this outing, the 220 miles was straight up into the air, beyond the stars, and onto the International Space Station by way of a SpaceX rocket on a resupply mission that launched on Dec. 5.

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“I was worried, carrying these things,” admits Xu, who accompanied the cassettes of tubes to Florida where they would be transferred to the Space X launch pad at Cape Canaveral. “It was very cool though, especially that we were flying them on Elon Musk’s Space X 16, it was just amazing.”

Into Space, But Why?

Two days after launch, the Space X rocket docked with the space station and unloaded its University of Houston cargo.

“Normal p53 protects you from cancer. Mutated p53 causes cancer by destroying all cancer protection mechanisms,” said Peter Vekilov, John and Rebecca Moores Professor of chemical and biomolecular engineering and chemistry. With no gravity in space, conditions are ideal to test Vekilov’s theory about how mutated groups of p53 form into droplets, a deceivingly small-sounding word when you learn that a single droplet might contain thousands of mutated p53 proteins.

“We want to study how these droplets form and how solution flow affects aggregation of p53, and to do this you have to have no solution flow,” said Vekilov. “In space because there is no gravity, there is no solution flow.”

If they find out how the droplets form, they can potentially find a way to prevent them from congregating.

With no gravity in space, conditions are ideal to test Vekilov’s theory about how mutated groups of p53 form into droplets, a deceivingly small-sounding word when you learn that a single droplet might contain thousands of mutated p53 proteins.

The Astronaut And Her Work

On board the ISS, astronaut Anne McClain, a lieutenant colonel in the U.S. army who earned a bachelor’s degree in mechanical engineering at the U.S. Academy at West Point, takes charge of Vekilov’s experiments. Her first task is thawing the tubes, then placing them beneath the Light Microscopy Module, a high-powered light imaging microscope. Back on Earth, in Cleveland at the NASA Glenn Research Center, scientists remotely acquire and download terabytes of digital images and videos of Vekilov’s proteins across many levels of magnification.

Under Vekilov’s watchful eye, his team is scouring the images for change, a process that may take up to two years given the amount of data. “We are subtracting images from one another to see if we find a white pixel. If something has changed in the image you suddenly have a white pixel, and once we process that pixel we can see how things are moving in the solution. We study these motions, which is how we study aggregation in space,” said Vekilov.

Though conditions in space are stagnant, all particles in fluids are subject to random movements due to the phenomena called Brownian motion, the erratic movement of particles as they hit surrounding molecules.

“We use Brownian motion of the particles to see if droplets form and measure their size. If they do develop, it is very slow,” said Vekilov.

A Meaningful Dedication

Vekilov has dedicated this series of experiments to Stephen Hawking, the renowned scientist who died from ALS in 2018. The protein that causes ALS acts the same way as the cancer protein, aggregating into droplets.

After the experiment’s pictures are taken and the data is reviewed, Vekilov expects to find a potential treatment strategy for the two deadly diseases.

“We will find a rationale of how to suppress the aggregation of these two proteins, and that is a potential treatment strategy,” said Vekilov.

And that, like the atmosphere in which the proteins are being photographed, is stellar.

34 PARAMETERS Fall 2019 University of Houston Cullen College of Engineering
We will present a carefully validated and broadly applicable toolkit with unprecedented potential to accelerate investigation and develop next-generation treatments for brain pathologies. 

- BADRI ROYSAM

We can now see are very informative. For each cell, they tell us what kind of brain cell it is, and what is going on with that cell.”

The impact is immediate

Injury to the brain causes immediate changes among all brain cells, severing some connections and potentially causing blood to leak into the brain — where blood is never supposed to be — by breaching the blood/brain barrier. After a concussion, the brain tissue becomes a complex battleground,” said Roysam, with a mix of changes caused by the injury, secondary changes due to drug treatments, side effects and the body's natural processes. Untangling these processes will allow the team to develop new medication “cocktails” of two or more drugs.

“We will present a carefully validated and broadly applicable toolkit with unprecedented potential to accelerate investigation and develop next-generation treatments for brain pathologies,” said Roysam, co-principal investigator with John Redell, assistant professor at UHealth McGovern Medical School. Funded by the National Institute of Neurological Disorders and Stroke (NINDS), the project also includes Associate Professor Saurabh Prasad and Assistant Professor Hien Van Nguyen, both of the Cullen College of Electrical Engineering, and NINDS scientist Dragon Maric.

The team is tackling the seemingly familiar concussion, suffered globally by an estimated 42 million people. This mild traumatic brain injury, usually caused by a bump, blow or jolt to the head, disrupts normal brain function, setting off a cascading series of molecular and cellular alterations that can result in neurological, cognitive and behavioral changes. Concussions have long confounded scientists who face technological limitations that hinder a more comprehensive understanding of the pathological changes triggered by concussion, causing an inability to design effective treatment regimens. Until now.

“We can now go in with eyes wide open whereas before we had only a very incomplete view with insufficient detail,” said Roysam. “The combinations of proteins we can now see are very informative. For each cell, they tell us what kind of brain cell it is, and what is going on with that cell.”

The team to develop new medication “cocktails” of two or more drugs.

Researchers at the University of Houston have found neuro biomarkers for Parkinson’s disease that can help create the next generation of “smart” deep brain stimulators, able to respond to specific needs of Parkinson's disease patients. Those with the disease often undergo the high-frequency brain stimulation, a well-established therapy for the progressive nervous system disorder that affects movement, but the therapy has been imprecise.

Currently, stimulators can only be programmed clinically and are not adaptable to the fluctuating symptoms of the disease, which can include tremors, slowness or inability to walk. The biomarkers are key to improving the technology to make it responsive, or smart.

“We can now make the closed-loop stimulator adaptive to sense a patient’s symptoms, so it can make the adjustments to the fluctuations in real time, and the patient no longer has to wait for weeks or months until the doctor can adjust the device,” said Nuri Ince, associate professor of biomedical engineering at the UH Cullen College of Engineering. He and doctoral student Musa Ozturk, lead author of the paper, published their findings in Movement Disorders journal.

Nearly 10 million people worldwide are living with Parkinson’s disease and approximately 60,000 Americans are diagnosed with the disease each year.

Redefining coupling

The team also reports a new understanding of the electrophysiology of Parkinson’s disease after examining cross frequency coupling in the subthalamic nucleus of patients with Parkinson’s disease both in the OFF state (before medication) and the ON state (after medication). Coupling, the interaction between the brain waves, has been reported in the past, but its significance and functional role have not been well understood.

The team reports that in the OFF state, the amplitude of high-frequency brain wave oscillations in the 200–300Hz range was coupled with the phase of low-beta (13-22Hz) in all patients. After transition to the ON state, three distinct coupling patterns were observed among subjects. Among these, patients showing ON coupling between high-beta (22-30Hz) and high-frequency oscillations in the 300–400Hz range had significantly greater improvement in bradykinesia, or slowness of movement, one of the cardinal manifestations of Parkinson’s disease.

“Previous research showed coupling only existed in the basal ganglia of untreated patients and assumed to block the brain from functioning properly,” said Ozturk. “We found that strong coupling also exists in treated patients, though at different frequencies, so in effect we have ‘cleared coupling’s name’ and showed the frequencies involved in coupling impacts whether its effects are negative or positive.”

Other investigators include David Frans, University of Houston Department of Psychology; Arvind Abosch, University of Colorado Denver School of Medicine, Neurosurgery; Jian-Ping Wu, Medtronic Inc. Restorative Therapies Group Implantables Research and Core Technology; and, Joshu Jimenez-Shahed, Baylor College of Medicine Department of Neurology.
In these devices, heat dissipation by materials plays a critical role and is a bottleneck for boosting computation and performance capacity of these systems,” said Hadi Ghasemi, Bill D. Cook associate professor of mechanical engineering at the UH Cullen College of Engineering. “Low thermal conductivity of polymers impede their use in these applications.”

Most polymers conduct heat at around 0.1 to 0.5 watts per meter per kelvin.

New game-changing polymers

Ghasemi and his research collaborators have developed a new generation of polymers — aligned thin polyethylene films that have thermal conductivity of 62 watts per meter per kelvin. In comparison, iron has a thermal conductivity of 50 and stainless steel has thermal conductivity of 15. This development means that at some point devices could be viable alternatives to traditional metal heat conductors.

“These new materials provide a great opportunity to develop flexible and high performance electronic and photonics devices. For example, all the new flexible cellphones are in great need of these materials,” Ghasemi said. “Heat exchangers in petrochemical facilities and desalination systems could also benefit from these next-generation materials.”

The collaborators recently published their research in an article, titled “Nanostructured polymer films with metal-like thermal conductivity,” in the journal Nature Communications.

In addition to Ghasemi, contributing authors on the paper are: Yanfei Xu (lead author), Daniel Kraemer, Bai Song, Jiawei Zhang Jiang with the Argonne National Laboratory.

The researchers will continue working to improve polymer heat conduction and the fabrication process.

“In these devices, heat dissipation by materials play a critical role and is a bottleneck for boosting computation and performance capacity of these systems. Low thermal conductivity of polymers impede their use in these applications.”

- HADI GHASEMI

SurfEllent, a startup which brings innovative durable anti-icing coating technologies to the market, competed in the Texas A&M New Ventures Competition (TNVC) for the first time this year and performed extremely well. It won the second place award and its accompanying $15,000 check and walked away with the Texas A&M Engineering Extension (TEEX) Product Development Center Prize of $10,000.

The startup, which is about a year old, is based on the cutting-edge research conducted by Hadi Ghasemi, Bill D. Cook associate professor of mechanical engineering at the UH Cullen College of Engineering, and students in his NanoTherm lab.

“Icing is a major problem that impacts a wide range of things, including aircraft wings and engines, automobiles, buildings and bridges, ships and vessels, and power transmission systems,” Ghasemi said. “This recognition is another proof of the critical need for advanced anti-icing coating technologies and opens opportunities for collaboration with various industries and business partners.”

The company’s initial anti-icing coating was inspired by the tiny North American Wood Frog, a creature that can freeze up to 65 percent of its total body water without dying. Similarly, Ghasemi’s biologically-inspired anti-icing material can withstand critically low temperatures.

The new material — which can be applied to various types of surfaces as a coating — was one of three winners of the NASA iTech competition in 2017. NASA recognized the project for its potential to broadly impact human life on earth and the future of space travel.

Ghasemi and Peyman Irajizad (MSME ’16, Ph.D. ’18) are co-founders of SurfEllent, which is located at the UH Technology Bridge – a research park that offers 30,000 square feet of incubator space and 700,000 square feet for laboratories and light manufacturing. Plans are to use the $45,000 of prize money to expand SurfEllent’s manufacturing facility and market share, Ghasemi said.

“While R&D is ongoing at the start-up, we are also increasing number of our commercial products,” he added.

SurfEllent’s products, available as aerosol sprays and paints, are available through the company’s online shopping platform at surfellent.com.
While many people dream of seeing the world one day, a group of UH Cullen College of Engineering students recently returned from Brazil as part of the first engineering faculty-led study abroad experience through the Program for Mastery in Engineering Studies (PROMES).

The students’ learning adventure included leaping off a cliff to go hang-gliding, visiting the famous Museu Afrot Brasile as well as a favela (a Brazilian shanty town), learning to speak Portuguese and presenting their projects at the famous Museu Afro Brasil as well as a churrascaria. This was after a dinner at a churrascaria. This was after a dinner at a churrascaria.

The NAE’s 14 “Grand Challenges” put together by a committee of global experts, are those that impact the world and need to be addressed. These include: making healthy, longer lives for all; ensuring sustainable energy; improving urban infrastructure; advancing health informatics; engineering better medicines; reverse-engineering the brain; preventing nuclear terror; securing cyberspace; enhancing virtual reality; advancing personalized learning; and engineering the tools of scientific discovery.

The aim of the PROMES study abroad trip was for students to “understand the Grand Challenges that Brazil faces in the context of Brazilian culture, technological advances, economy, workforce and its K-12 population,” said Jerrod Henderson, director of PROMES, who led the group of 24 students on the trip.

He wanted the students to see real-world situations and come up with solutions, as well as take advantage of the cultural opportunities offered by the trip.

“It was unique being immersed in another country and seeing how our work can impact the world,” said Emilio Ames, a mechanical engineering junior at the Cullen College, who has always dreamed of traveling abroad and jumped on the opportunity. He challenged himself to speak a little more Portuguese each day he spent exploring Brazil.

“We visited some amazing laboratories that opened my mind to all the possibilities to take my skills international,” Ames said. “I hope I can do some work outside of the U.S. one day.”

Stephanie Fose, a junior majoring in chemical engineering, shared her favorite experience from the Brazil trip. “Spending the afternoon on the Copacabana beach in Rio as a group, surrounded by the ocean with a view of the mountains and the Copacabana strip, and then going to dinner at a churrascaria. This was after visiting a laboratory focused on ocean engineering.”

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Fose said the trip was a chance to grow both her academic and cultural knowledge and be a global citizen.

“Given the opportunity, I would one-hundred percent participate in it all over again,” she added.

Henderson is already working on the next PROMES study abroad trip. He recently received a $20,000 Access Grant from the Council on International Educational Exchange (CIEE) for a faculty-led program to Ghana and plans to go next year with a group of 20 students.

The PROMES program was selected by CIEE for “its innovative focus on the role engineering will play in solving global challenges like access to clean water and healthcare, renewable energy, and more” in the context of a developing nation.

Study abroad opportunities are not only fun and educational, but also invaluable “life-changing experiences,” Henderson said.

“There is significant research linking increased student success and retention to experiences such as learning abroad and undergraduate research,” he said. “I want to help provide as many opportunities to our students as possible. In addition, engineering is a global industry. I think experiences like these will give our students a competitive edge.”

PROMES was established at the University of Houston in 1974 for the recruitment, retention and academic development of Hispanic, African American and Native American students in the Cullen College of Engineering. Today PROMES is open to all students in the college, and its mission is to provide a positive learning environment that supports the needs of undergraduate students.

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An article citing improvements in research involving a new generation of flexible photovoltaic devices reported by the Selva Research Group at the UH Cullen College of Engineering was recently published in the journal *Energy & Environmental Science*. The article is titled “Flexible GaAs Solar cells on roll-to-roll processed epitaxial Ge films on metal foils: a route towards low-cost and high-performance III-V photovoltaics.”

The research improvements are based on the collaborative effort undertaken with UH’s Ryou Research Group and funded by the U.S. Department of Energy’s SunShot Initiative, which seeks to make solar energy and electricity affordable for American consumers. The Selva group fabricated all materials used in the solar cell and made the devices, known as the “single junction gallium arsenide solar cells,” while the Ryou group helped in modeling of the devices and supported their fabrication.

The article reports a 50 percent higher efficiency in gallium arsenide solar cells – also known as GaAs – on inexpensive metal foils. The metal costs related to GaAs photovoltaics and all associated applications, Khatiwada said. “Manufacturing these cheaper and flexible GaAs solar cells will diversify their use – from space photovoltaics to terrestrial.”

While the highest efficiency solar cells are made with gallium arsenide, they are very expensive and are primarily used in space and military applications. The biggest component of the cost is the wafer on which these solar cells are made. Khatiwada shared that an eight-inch diameter wafer of GaAs could cost around $5,000 compared to $5, for a similarly-sized silicon base.

“We are replacing the wafer with an inexpensive metal foil. The metal foil allows roll-to-roll continuous manufacturing which can further lower cost,” Selvamanickam said. “We have developed methods to grow single-crystal-like templates of germanium (a commonly used substrate for gallium arsenide) on flexible, inexpensive metal foils. The templates were then used to fabricate the gallium arsenide solar cells.”

In this new publication, the team made high-quality germanium films by roll-to-roll PECVD and then used them to fabricate gallium arsenide solar cells of improved quality and 50 percent higher efficiency.

“We believe our technology will address costs related to GaAs photovoltaics and all associated applications,” Khatiwada said. “Manufacturing these cheaper and flexible GaAs solar cells will diversify their use – from space photovoltaics to terrestrial.”

While celebrating project gains, the UH researchers are not ready to rest on their laurels.

“We are working to further improve the materials quality, device fabrication and the efficiency of the gallium arsenide solar cells,” Selvamanickam said.

**COULD ROBOTS MAKE A DOCUMENTARY About A 5K Race?**

BY JEANIE KEVER

A 5K race can offer both victory and heartbreak, but capturing those moments on video requires both planning ahead and making on-the-spot decisions about where the camera operators should be.

A project led by Aaron T. Becker, assistant professor of electrical and computer engineering at the University of Houston’s Cullen College of Engineering, will study how to direct a team of mobile robots to document a race, predicting likely events and changing plans based on real-time action.

Getting robots to capture video footage is easy. The difficulty lies in directing them to act on their own to capture the most pertinent moments of the race, required for weaving an engaging and complete narrative from the footage.

The camera-equipped robots will be programmed to gather information as they go, without knowing in advance what will happen, including who will win the race. “Unlike the highlight reel in MarioKart™, real robots won’t know ahead of time where the interesting parts will be,” Becker explained, “but they will know a lot of probability theory and will be able to calculate the odds of good video footage as a function of race status and robot position.”

He will collaborate with Dylan Shell, associate professor of computer science and engineering at Texas A&M University, and Jason O’Kane, professor of engineering and computing at the University of South Carolina, on the project, which is funded by a $600,000 grant from the National Science Foundation.

The project will play out over three years, with the robots tasked with filming a 5K race on the UH campus each year. Becker, whose lab works on a number of projects involving swarm robotics, said the quality of the resulting documentary should improve each year.

“Unlike the highlight reel in MarioKart™, real robots won’t know ahead of time where the interesting parts will be, but they will know a lot of probability theory and will be able to calculate the odds of good video footage as a function of race status and robot position.”

The first task, like said, is training the car to autonomously track a runner for the entire 5K race. She will graduate in May and continue working on the project as a graduate student.

“I love making autonomous robots,” she said. “The overall goal is to make a system where a robot can actually predict what will happen, and that’s pretty cool.”

A date for the first race has not been set, but the team is searching for partners. The project will start with five robots, including a robotic car capable of moving up to 10 mph, currently being built by a senior design team made up of electrical engineering students Rhema Ike, Farah Luba, Henry Nguyen and Ramsey Daou.

In an upcoming paper, the researchers propose several potential applications for what they expect to learn, from explaining the outcome of an athletic competition to identifying the cause of an explosion. Directing robots to produce documentary-style coverage of a race encapsulates many of the elements those other projects would require, they said.

"A robot position.”

- AARON T. BECKER

**LEAD NEWS**

**UH Researchers Forge Ahead With LOW-COST, HIGH-EFFICIENCY SOLAR CELL DEVICE DEVELOPMENT**

**PARAMETERS** Fall 2019 University of Houston Cullen College of Engineering
The UH Cullen College of Engineering has changed tremendously over the past decade. Under Dean Joseph Tedesco’s leadership, UH Engineering has entered a new era of engineering excellence. From student success to faculty excellence and game-changing research, the college has achieved more milestones than can be named.

Now as it sets its sights forward, UH Engineering hopes to continue setting the bar even higher. From the new facility in Katy, to advancements in innovation and entrepreneurship under the guidance of its new director, Haleh Ardebili, there are many promising developments on the horizon. Read on to see why we have been engineering excellence since 1941.
UH Engineering Looks to the Future As It Expands to UH at Katy
Built at the confluence of I-10 and the Grand Parkway, the new 80,000-square-foot UH at Katy building stands tall against a backdrop of big Texas sky and a constant flow of traffic.

This fall, the UH Cullen College of Engineering began offering high-in-demand engineering courses at the brand-new facility with state-of-the-art design studios and equipment. The move is part of larger plan to continue strengthening the Cullen College's position as the leading source of engineering education in the Greater Houston area.

"My vision is for the University of Houston Cullen College of Engineering to be a global leader of engineering education and research, and our expansion into Katy is a key step in this mission," said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering. "This is an incredibly exciting time for the college and its students."

According to the Greater Houston Partnership, the Houston area, known as the Energy Capital of the World, is home to nearly 5,000 energy-industry businesses, which employ a total of 250,000 area workers — almost 10 percent of the region's workforce. The Cullen College has made a tradition of taking the lead and offering industry-relevant engineering programs in the city it calls home.

The Cullen College launched its bachelor's degree in petroleum engineering in the fall of 2009 to counteract the critical shortage of talent needed to replace the industry's aging workforce. Then, with support and input from Houston's booming energy industry, the Cullen College established a petroleum engineering doctoral program in 2015. Since then, the petroleum engineering program is thriving and has been highlighted as a model partnership between industry and academia. Four of the 14 the prestigious National Academy of Engineering members at college are petroleum engineering faculty.

In 2011, the college established the first academic program in subsea engineering in the country and in 2012 offered the first master's degree in the discipline. In 2013, the Cullen College spearheaded the establishment of the Global Subsea University Alliance.

The UH Cullen College perceived yet another opportunity to bridge a gap when it came to Katy, neighbor to the many companies located along the robust Energy Corridor.

"Given the demand for engineering talent across the Greater Houston area, the expansion of UH engineering programs in Katy is both imperative and inevitable," Tedesco said. "The city of Houston needs a homegrown workforce trained to take on the engineering jobs of the future while filling in the skills gaps of today."

The Katy Area Economic Development Council (KAEDC) estimated that the new UH at Katy facility will have an approximate $56 million economic impact over the next five years. Local leaders expect UH's presence to provide a highly skilled workforce and attract more businesses and jobs to the area.

"Currently, our labor shed area is home to over 50,000 employees in architecture and engineering occupations at world-class companies such as Wood, BP, Shell, ConocoPhillips, Aecom, LJA, Jones and Carter, and Baker," said Lance LaCour, president and CEO of the KAEDC. "The offerings from UH engineering will allow Katy area companies to find high-quality candidates close to home."

This is what the city of Houston, the Katy area and the Energy Corridor needed, and we are the only college in the world with the expertise, resources and ingenuity to make it happen.

- DEAN JOSEPH W. TEDESCO
UH’s expansion into Katy and other areas makes strategic sense. “The way Houston is expanding in all different directions, we have to provide local centers where we can achieve not only financial growth, but also the educational growth that is required by the local community out there as well,” said Ali Raza, chief digital officer of Apergy and a member of the UH Katy Engineering Advisory Board.

Back around 2008, then state Senator Glenn Hegar and then state Representative Bill Callegari started a task force to consider expanding UH to the Katy area. Since that time, it’s been years of planning and anticipation.

In 2016, the Cullen College put its plans into motion by purchasing the land for a future building and by offering two energy-focused engineering courses at the Houston Community College (HCC) Northwest-Katy Campus.

By 2018, the engineering offerings had expanded to more than 15 graduate-level courses in Katy. That same year, UH celebrated the ground breaking on the UH at Katy project on May 23.

In 2019, there were 26 graduate courses being offered in Katy in the key areas of subsea, petroleum, environmental, mechanical and electrical engineering.

However, the demand for top-notch engineering courses kept growing and so did the plans for engineering classes at UH at Katy.

Then finally on August 19, 2019, the new UH at Katy opened its doors and welcomed students for the first time. This fall, four engineering undergraduate courses and four graduate-level subsea engineering courses are being offered there. The Mechanical Engineering Senior Capstone Design class is the first to use the brand-new, spacious engineering design studios at the facility.

More courses are being planned for spring 2020.

In addition, the college plans to launch three new undergraduate engineering programs specifically designed for Katy: systems engineering, construction engineering, as well as computer systems and analytics.

“I obtained my master’s degree in civil engineering from UH in 1969, and remember the long drive from west Houston to the main campus,” said Bill Callegari, now retired from politics. “With the expansive growth of Houston and accompanying traffic, it would be extremely daunting for prospective students to make that drive several times each week without sacrificing valuable time from their work and families.”

Callegari considered the new UH at Katy to be a win-win for everyone involved – UH, the Cullen College, as well as Katy residents and businesses. “It is very important to our community,” he said.

Dean Tedesco agreed. “This is what the city of Houston, the Katy area and the Energy Corridor needed, and we are the only college in the world with the expertise, resources and ingenuity to make it happen,” he said.
Future plans and promise

Now that UH at Katy is a reality and the first classes are progressing, the Cullen College administration isn’t resting on its laurels. Instead, the team is forging ahead with another exciting and ambitious plan.

A partnership between the University of Houston and Houston Community College (HCC) is currently in the works to enable Katy-area students to earn engineering degrees right in their neighborhood at an affordable price at UH at Katy.

The program, officially called the UH/HCC Engineering Academy, is set to launch in the fall of 2020.

“Students will have access to a world-class engineering education. The quality of education and research at the UH Cullen College of Engineering contributes to UH’s ranking as a Carnegie-designated Tier One public research university,” said Rao.

The strategy behind the program is to utilize both UH Cullen College and HCC resources for maximum benefit to the students.

“The curriculum in the Engineering Academy is structured so that students get to take all their engineering classes with the Cullen College faculty at UH in Katy, whereas other core non-engineering courses will be taught by HCC,” Rao said. “Under this model, the students will have significantly lower costs in the first two years, thus increasing access to UH Engineering degrees, and they will also enjoy shorter commutes by attending classes at the conveniently located UH at Katy facility.”

Unlike traditional transfer programs, students admitted into the Engineering Academy are UH Cullen College of Engineering students from day one and are co-enrolled at both partner institutions.

After successfully completing the academy in one or two years, students will then transition to the UH main campus to complete their bachelor’s degrees in several different engineering areas. There are five existing engineering programs that will be offered to Katy students: civil, electrical, computer, industrial or mechanical engineering.

Similar programs and partnerships have emerged all across Texas in recent years involving four-year university engineering programs and community colleges.

The goal is to make engineering education accessible to a broader swath of students who may be deterred by the price tag of the more traditional route and address future workforce needs. The Texas Workforce Commission projects a 25 percent growth in engineering jobs across the state over the next decade.

“Relevance in the global marketplace is key to the training we offer our students and we at the UH Cullen College take our mission very seriously,” Tedesco said. “Engineers fix problems, and our new Engineering Academy will address student needs, community needs and state needs.”
As breath is an integral part of life, innovation is an integral part of engineering.

Fueled by human ingenuity, the spirit of innovation drives transformative advances across all areas of life. It has led to things like electricity, heart transplants and rockets, and it will continue to birth new generations of discoveries and creations.

Being innovative means being creative.

“Serendipitous discoveries in science comes out of this idea of being creative,” says Jeffrey Rimer, Abraham E. Dukler Professor of chemical and biomolecular engineering at the UH Cullen College of Engineering, who is known for his groundbreaking research in crystallization. His work has led to the development of novel drugs for kidney stones – marking the first advance in kidney stone therapy in a span of 30 years – and malaria.

“With anything we do there is serendipity because the outcomes are never predetermined and things happen that simply cannot be foreseen,” he says. “That’s what makes it fun.”

In the last few years, the Cullen College has put several initiatives in place to support student success and nurture the culture of innovation and entrepreneurship, building on past successes and pushing into new frontiers.

“We’re building a culture of innovation, collaboration and entrepreneurship at the Cullen College to help find solutions to the world’s most pressing problems,” says Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College. “We dare to pursue ambitious possibilities and engineer them into reality.”

The college is filled with examples of faculty and students making a difference in the world.
Innovation is the alarm that wakes me up. It is the daily motivation that keeps me going. It is the process of thinking, brainstorming, trying, failing and creating. Once in a while, I see what may be a game changer in real life. That is where entrepreneurship comes into play.

-HADI GHASEMI

Cumaraswamy "Vipu" Vipulanandan, professor of civil and environmental engineering and director of the Center for Innovative Grouting Materials and Technology (CIGMAT), believes innovation should be disruptive, “a major shift from the current operations, and it should make an impact all around the world.”

As the inventor of “smart” cement, Vipulanandan knows what he’s talking about. Cement is the most commonly manufactured material globally, and his research is revolutionizing construction to make it safer.

“It’s a warning material that gives feedback,” Vipulanandan says. Smart cement is an innovative 3D highly sensing chemo-thermo-piezoresistive material used as an additive to cement or concrete to make construction safer by enabling monitoring and real-time data collection. Less than eight ounces of the additive is needed to produce 1,000 pounds of smart cement, which can detect earthquakes, gas leaks, cracks and curing among other things.

Vipulanandan also developed the real-time monitoring system for smart cement users. Smart cement has broad applicability and can be used in oil, gas and water wells; pipelines; highways; bridges; buildings; and more. The sensing ability lasts the lifetime of the structures.

His work was inspired by the 2010 Deepwater Horizon explosion, which killed 11 people and spilled almost 5 million barrels of oil into the Gulf of Mexico. Vipulanandan began working on the smart cement in 2012 with a $2.6 million grant from the U.S. Department of Energy and additional funding from Baker Hughes, an oilfield services company.

“I have been researching how to make materials with sensing properties for a long time, and it’s evolved over more than 15 years,” he says. “It’s not a simple process. I tried things, learned, developed new things, published and kept on improving it until now; when it’s a paradigm shift.”

He also developed a new Vipulanandan rheological model to characterize the behavior of all types of fluids, including smart cement slurries and drilling fluids. This model, which is a mathematical framework, is used around the world by different industries.

Twenty-first century engineering involves innovative thinking, perseverance, new technologies and strategic partnerships across disciplines for global impact.

Building a better future together

Located in Houston – the energy capital of the world, Space City and home to the world’s largest medical center – the UH Cullen College is in a unique position to recognize opportunities and address needs involving the Greater Houston area and beyond. Faculty, researchers and students collaborate with partners from the Texas Medical Center, the Energy Corridor, NASA and more to engineer solutions to real world problems.
Another big advantage is the ability to work with national and state-level research centers. Such partnerships make greater funding and resources available, as well as allow collaborations on a much larger scale.

One such institution is the Building Reliable Advancements in Neurotechnology (BRAIN) Center, an Industry-University Cooperative Research Center (IUCRC) dedicated to bringing new neurotechnologies and treatments to market. The BRAIN Center – a collaboration among the University of Houston, Arizona State University and industry members – was launched in 2017 with a $1.5 million grant from the National Science Foundation.

“It’s a catalyst for faculty, students and industry to come together and develop the next neurotechnologies to improve the human condition. We’re thinking about the next 10, 20, 40 years from now,” says Jose Luis Contreras-Vidal, Cullen distinguished professor of electrical and computer engineering and the director of the BRAIN Center at UH. “We have an environment that has been optimized for discovery. We work on innovation that we know is industry-relevant because industry partners are involved and have a say in what’s funded.”

The BRAIN Center’s members come from all over and since all the stakeholders are in place, “we can cut red tape,” Contreras-Vidal says. “There’s less time wasted in writing proposals, on logistics, making connections because we have optimized the networking of the center through our own experience and through the experience of this type of program funded by the NSF.”

In addition, the center has a process for protecting intellectual property through patents, engages in outreach and publicity, and trains students to work on emerging technologies, thus building a highly skilled workforce. The BRAIN Center is partnering with IEEE Brain and the University of Pittsburgh to organize the Neurotech Entrepreneurs Workshop in December to inspire, empower and connect aspiring entrepreneurs in neural engineering.

In his roles at the college and at the BRAIN Center, Contreras-Vidal – one of the world’s leading researchers in the field of noninvasive brain-machine interfaces – warns that technology is the byproduct. “We’re in the business of training people. We train them to do STEAM research, develop new ideas and technologies and create opportunities to invent the future,” he says. “I’m not an expert in everything. I’m happy to help with what I know. When I don’t know, I look for somebody else, a collaborator I can bring in to fill in the gap.”

We’re in the business of training people. We train them to do STEAM research, develop new ideas and technologies and create opportunities to invent the future.

- JOSE LUIS CONTRERAS-VIDAL
If innovation drives all of humanity’s advances, then it’s the entrepreneurial spirit that brings these advances to the people who can use it the most.

Several Cullen College faculty members and students work with other entities at the University of Houston, such as the Office of Intellectual Property Management, the Wolff Center for Entrepreneurship and UH RED Labs – a shared workspace, startup accelerator and technology entrepreneurship program – for training and assistance in getting their research into the market.

Contreras-Vidal has been featured in national and international media for his thought-controlled robotic exoskeleton, which can help paralyzed patients regain their mobility. At present he’s working to develop a pediatric version for young patients who are still growing.

He also developed a groundbreaking robotic rehabilitation system. Funded by a $750,000 grant from the NSF’s Partnerships for Innovation program (PFI), the goal is to build a system that can be approved by the U.S. Food and Drug Administration and is sturdy, simple and inexpensive enough for stroke patients to use at home.

Both his products are on the verge of leaving the research lab, but it’s been a long journey requiring the research team to learn the intricacies of the business world.

“We have been supported by the Office of Intellectual Property Management and the Office of Technology Transfer and Innovation at UH and also the workshops at UH RED Labs,” Contreras-Vidal says. “I wish everyone would make use of them.”

Today, Vipulanandan is an advisor to Sensytec, a UH startup that is bringing his smart cement and two-probe monitoring system to the commercial market.

The company – established in 2015 – is run by Ody de La Paz, a UH graduate with bachelor’s degrees in accounting and entrepreneurship, and Sai Anudeep Reddy Maddi, who is working on his Ph.D. in civil and environmental engineering at the Cullen College. Maddi also earned his master’s in structural engineering at UH in 2016.

“They took the patent and commercialized it and that benefits everyone, including the university,” Vipulanandan says.

Earlier this year, the company was chosen as one of three local winners of the inaugural Houston MassChallenge program, won a $50,000 investment prize from the Houston Angel Network and was named one of 10 most promising companies by the Rice Alliance for Technology and Entrepreneurship.

Sensytec, which has previously won funds from the NSF, the U.S. Department of Defense and the Techstars Accelerator, is also part of the Smart Cities Ion Accelerator Program in partnership with Microsoft, Intel and the City of Houston. The UH startup tops the list of 10 companies selected for the inaugural cohort of the accelerator.

Sensytec is housed at the UH Technology Bridge, a 74-acre park on the Gulf Freeway, just a few miles from the UH campus, with office and laboratory space for startups. About 25 companies are currently based there.

“We are proud to be a part of a grand vision to push boundaries, impact the community and embrace innovation,” says the Sensytec team.
Instead of innovative and valuable research findings being left on journal pages and in books, why not turn it into a product and get it into the hands of the people who need it?

-HALEH ARDEBILI

Investing in a new era of innovation

Haleh Ardebili, Bill D. Cook Associate Professor of mechanical engineering, was appointed director of the Innovation and Entrepreneurship initiative at the UH Cullen College in 2018.

"Instead of innovative and valuable research findings being left on journal pages and in books, why not turn it into a product and get it into the hands of the people who need it?" she says, adding that commercialization is the essential next step to consider in taking research from the abstract to real-world application and benefits.

Her goal over the next few years includes establishing an engineering technology incubator at the college to support increased student and faculty IP generation and start-ups, she says. An accomplished researcher and inventor, Ardebili is no stranger to taking innovative ideas out of the laboratory and into the marketplace. Her research focuses on energy storage, with a variety of projects aimed at developing flexible, stretchable batteries capable of powering everything from spacesuits to submarines. Two patents are pending for her stretchable batteries, while her research has received funding from the National Science Foundation, Army Research Lab, the Office of Naval Research, the Air Force Office of Scientific Research, the Subsea Systems Institute and others.

"The more people who have access to the end results, the greater the longevity of the research and the more advances are made in all sectors, whether it be in medicine, space exploration, renewable energy or another area," she adds.

Other new additions include the Research Computing Division at the college, created to encourage student engagement in design activities with data, computing and e-media; the recently hired industrial relations and intellectual property manager at the college, created to encourage student engagement in design activities with data, computing and e-media; the recently hired industry partners and professional organizations. He envisions leveraging existing resources and working with Ardebili, the HPE Data Science Institute and others for maximum benefit to Cullen College undergraduates.

"I think it’s a great time to be trying out these different things, and it’s only going to end up providing many more opportunities for our students," Burleson says. "There’s clearly a strategic plan that connects all of these different things together. The best thing we can do is leverage each of these components and create partnerships that are mutually beneficial.”

The Inaugural INNOVATOR AWARDS

The winners of the 2019 UH Cullen College of Engineering Innovator Awards showcase the amazing things happening at different levels of the college. Haleh Ardebili, director of the Innovation and Entrepreneurship initiative at the college, created the awards to recognize and encourage the spirit of innovation and entrepreneurship among faculty and students.

"Even if engineering faculty and students choose not to pursue entrepreneurship, if they’re entrepreneurial in thinking – aware of how businesses work, understand all the factors going into commercialization – they have an edge in the market," Ardebili said. "Their individual success reflects and adds to the University’s success and it benefits society as a whole.”

Meet the recipients of the inaugural 2019 Innovator Awards:

VENKAT SELVAMANICKAM Career Innovator Award

This award recognizes full professors with a track record in innovation, entrepreneurship and mentorship during their career at UH.

WEI-CHUAN SHIH Rising Innovator Award

This award recognizes efforts by a tenure-track assistant professor in innovation and entrepreneurship at UH. The award comes with an honorarium of $3,000.

HADI GHASEMI Early Innovator Award

This award, with an honorarium of $2,000, recognizes efforts by the tenure-track assistant professor in innovation and entrepreneurship at UH.

JAY ADOLACION Young Innovator Award

This award, with a prize of $1,000, recognizes efforts by Cullen College students or postdocs in innovation and entrepreneurship at UH.
A robust culture of innovation, creativity and opportunity has a domino effect and leads to more ideas, projects and new frontiers. Juan Carlos Mier, a senior majoring in chemical engineering and computer science, and his half-brother Mauricio Andrade started Aeolika, an urban wind turbine business in 2018. The technology – a magnet driven motor – was developed by John Harms, a HPE retiree, but the brothers saw an opportunity to take it further.

“We realized the motor could be used in an environmentally friendly, highly efficient wind turbine that would be perfect for cities,” Mier says. “Our idea is to recycle energy wasted in HVAC systems and reduce electricity costs to our customers by about 20 percent, which is a significant saving. We do it by installing these wind turbines on roofs of buildings that have centralized air and generating electricity.”

Both engineers, the brothers worked with UH RED Labs to develop the idea into a startup and network with others to gain business insights.

Mier is also president and co-founder of the Houston Innovation Ventures and Enterprise. HIVE is a UH student organization that brings together students from different fields who are interested in working together to solve real-world problems with new ideas and venture into entrepreneurship. The focus tends to be on tech startups.

Last year, HIVE partnered with the Cullen College, UH RED Lab and the City of Houston’s Office of Innovation to host its first campus-wide student innovation competition. It had 60 participants divided into 14 teams. Called “The Community Innovation Challenge,” the competition involved student teams developing an idea to address a real-world problem in Houston and pitching it to a panel of judges over the course of a weekend.

“Creating an impact

INNOVATOR SPOTLIGHT

VENKAT SELVAMANICKAM

Venkat Selvamanickam, M.D. Anderson Chair and professor of mechanical engineering at the Cullen College, is one of the world’s leading experts and pioneers of innovative manufacturing technologies related to superconductors. With a master’s degree in mechanical engineering and a Ph.D. in materials engineering from the UH Cullen College of Engineering, Selvamanickam has compiled 30 years of research contributions in applied superconductivity, specifically the development and manufacturing of superconductor wires.

Selvamanickam established a startup company – AMPeers – in 2009 to scale up novel round superconductor wires developed at UH – AMPeers, which stands for Advanced Materials Pioneers, provides innovative solutions to material problems in a broad range of sectors – from defense to medicine and other industrial applications; consultancy, and continued research in partnership with UH.

The Houston company, housed at the UH Technology Bridge, received two Small Business Innovation Research (SBIR) contracts including a Phase 2 in which manufacturing technologies are being developed to scale up these round superconductor wires from a few centimeters in the laboratory to hundreds of meters.

The above-mentioned accomplishments are just a drop in the bucket. Selvamanickam has held a variety of positions at various institutions, and his research at the University spans a wide range of advanced processing techniques for high-performance materials for energy and electronics applications such as high temperature superconducting thin film wires, photovoltaics and flexible electronics. His students receive exceptional mentorship and exposure not only in conducting very intensive, innovative research but also in broad engineering skill sets at his unique facilities and through his highly experienced engineering and scientific support staff.

Venkat Selvamanickam and Jithin Sai Sandra

Creating an impact

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“What I’m really proud of is that the mayor actually reached out to us and expressed interest in implementing the idea of the first-place team,” Mier says. “We helped make that connection.”

Mier, who also works at ConocoPhillips as part of the Cullen College’s co-op program, credits his successes to his educational environment.

“Mostly the opportunities that I have gotten here at UH helped me on my journey,” Mier says. “We’re given a lot of resources and a lot of freedom to make mistakes, try again, get back on track and kind of iterate through… so coming in and being given those opportunities, I wasn’t afraid to fail. I think that’s one of the things that keep people from innovating – a fear of failure.”

Venkat Selvamanickam and Jithin Sai Sandra
Mario Romero-Ortega, an award-winning Engineering Cullen Endowed Professor of Biomedical engineering and research. “They will add to our strength and make the Cullen College a pre-eminent institution to the University of Texas at Arlington Research Institute (UTARI); and as a partner researcher at the University of California Santa Barbara. His research interests include studying hurricane boundary layers, urban canopies and resilience, wind energy, reduced modeling and machine learning.

Mostafa Momen
Assistant Professor of Civil and Environmental Engineering

Mostafa Momen joins the Civil and Environmental Engineering Department at the Cullen College as an assistant professor. Previously, he served as an associate research scientist in the civil engineering and environmental mechanics department at Columbia University. His research interests include studying hurricane boundary layers, urban canopies and resilience, wind energy, reduced modeling and machine learning.

Momen has a master’s degree and a Ph.D. in civil and environmental engineering from Princeton University, and served as a Ph.D. Exchange Scholar in mechanical engineering at the Massachusetts Institute of Technology (MIT). He worked as a postdoctoral researcher at Stanford University and Princeton. His bachelor’s degree in civil and environmental engineering is from the Sharif University of Technology in Iran.

He is the co-inventor on a U.S. patent titled “Dynamic Models for Short-Term Wind Energy Forecasting” and has two registered inventions in the national registry of industrial ownership in Iran.

The UH Cullen College of Engineering is kicking off the 2019-2020 academic year by welcoming seven new faculty members to its teaching and research rosters. They bring expertise in a wide variety of fields ranging from neuroscience to data science and machine learning. Their research covers topics ranging from innovations in bioengineering to sustainability of energy systems.

“We’re delighted to welcome our new colleagues to the Cullen College. They each bring impressive academic credentials, research achievement and life experiences,” said Joseph W. Tedesco, Elizabeth D. Rockwell dean of the UH Cullen College. “They will add to our strengths and make the Cullen College a premier destination for engineering education and research.”

Meet the talented newcomers:

Mario Romero-Ortega
Cullen Endowed Professor of Biomedical Engineering

Mario Romero-Ortega, an award-winning researcher in the field of neuroscience, will join the Cullen College on Jan. 1, 2020, as the Cullen Endowed Professor of biomedical engineering. He is the founder and chief scientific officer of NerveSolutions Inc., a company that commercializes the biosynthetic Nerve implant and NeuroBlock devices developed in his laboratory.

His research centers on the molecular basis of axon guidance and target recognition during development and after injury, and to generate novel nerve repair strategies. Specific interests include: spinal cord injury and neuroprotection, peripheral nerve gap repair, neumna pain prevention and regenerative peripheral nerve interfaces for the control and feel of robotic prosthetic limbs.

Prior to his UH appointment, he worked in several key roles — associate professor of bioengineering at the University of Texas at Dallas (UTD); as adjunct faculty in the surgery department at the University of Texas Southwestern Medical Center (UTSW); and at the University of Texas at Arlington Research Institute (UTARI); and as a partner researcher with the University of Wollongong in Australia. Romero-Ortega has also served as director for the Regenerative Neurobiology Division at the Texas Scottish Rite Hospital and as assistant professor of neurology and plastic surgery at UTSW.

His accolades include the 2014 UTA College of Engineering Excellence in Research Award, the 2013 TechFortWorth Impact Award and the 2013 Tech Titans Award in Technology Innovation.

He earned his doctorate in neuroscience from Tulane University and postdoctoral training from UTSW as associate member of the Christopher Reeve Paralysis Foundation Research Consortium on Spinal Cord Injury. His bachelor’s degree in biology is from Guadalajara University in Mexico.

Mariza Cescon
Assistant Professor of Mechanical Engineering

Mariza Cescon joins the Cullen College as the David Zimmerman Assistant Professor of mechanical engineering. Her interdisciplinary research interests include areas of systems engineering and machine learning with applications in diabetic care, translational medicine and water management.

Cescon comes to UH from the Harvard John A. Paulson School of Engineering and Applied Sciences, where she worked as a post-doctoral fellow. Her project focused on the development and translation of novel control algorithms in human clinical trials to improve glucose control in people with type 1 diabetes.

At the same time, Cescon also worked as adjunct investigator with the William Sansum Diabetes Center in Santa Barbara, California.

Cescon received her bachelor’s degree in information engineering and her master’s in automation engineering from the University of Padova in Italy. She went on to earn a technical license and a doctorate in automatic engineering from the University of Texas at Dallas. Her thesis was titled “Modeling and Prediction in Diabetes Physiology.” In addition, she completed the Harvard Catalyst’s Medical Device Development course in 2018.

She also served as the lead scientist with Di- anovator AB, a Swedish startup focused on diabetes technology, a research fellow at the University of Melbourne in Australia; and as a visiting research specialist at the University of California Santa Barbara on another type 1 diabetes research project.

Cescon has also served as director of the UH Cullen College of Engineering. In 2013, she was awarded the 2013 Tech Titans Award in Technology Innovation.

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Jennifer Luna-Singh
Lecturer with the Division of Undergraduate Programs and Student Success

Jennifer Luna-Singh, who graduated with a bachelor’s degree in mechanical engineering in 2006, returns to the Cullen College as a lecturer with the Division of Undergraduate Programs and Student Success. She went on to earn a Ph.D. in mechanical engineering from Rice University and participated in The Data Incubator’s highly selective fellowship program.

Luna-Singh has served as a volunteer data analyst and technical advisor with Central City Co-op since 2017. As a student, she participated in a Pathways Co-Op program with Wright Patterson Air Force Base in Ohio.

Kristin Schaefer
Lecturer with the Division of Undergraduate Programs and Student Success

Kristin Schaefer is now a lecturer with the Division of Undergraduate Programs and Student Success at the Cullen College. She is the owner and project engineer of Schaefer Engineering, established in 2013. Prior to coming to UH, Schaefer also worked as a teacher with the Katy Independent School District. She taught project-based engineering and manufacturing courses with KSID’s Career and Technology (CTE) Department.

Schaefer earned her bachelor’s and master’s degrees in mechanical engineering from Texas A&M University. She is the co-author on six U.S. patents.
Senior members also are recognized for

"Dr. Clarke and Dr. Shih both have impressive records of producing impactful intellectual property and spurring innovation that is pertinent to the Houston region," El-Nashai said. "Their further efforts, including helping UH faculty commercialize technologies as well as working with graduate and undergraduate students to boost their entrepreneurial efforts, are a critical contribution to building the region’s innovation ecosystem."

The inaugural class of senior members represents 37 research universities and government and nonprofit research institutes. The members are named inventors on more than 1,100 issued U.S. patents and will be recognized at the eighth annual NAI meeting, set for April 10-11 in Houston.

The academy also elects a class of fellows every year, awarded to academic inventors whose work has "made a tangible impact on quality of life, economic development and the welfare of society." UH currently has 12 NAI fellows.

Shih, whose NanoBioPhotonics Group focuses on developing new sensing and imaging techniques, has been granted 11 U.S. patents.

ASCE Recognizes
UH Civil Engineering Retiree
With Service Award

By Rashda Khan

Jerry Rogers, who retired as professor emeritus from the UH Department of Civil and Environmental Engineering in 2013, received a Service to the Institute Award from the American Society of Civil Engineers (ASCE) on May 20 at the ASCE Environmental and Water Resources Congress in Pittsburgh, Pennsylvania.

The award is given in recognition of extensive and outstanding service to the Institute.

Rogers is a founding member of the American Academy of Water Resources Engineers (AAWRE), a subsidiary of the ASCE, and the AAWRE Board of Trustees. He participated on the AAWRE Admissions Committee from 2006-2015. He was also one of the founding members of the ASCE Environmental & Water Resources Institute (EWRI) and served on the former ASCE Water Resources Planning & Management Division. He helped launch the EWRI History & Heritage Committee and served as chair of First National ASCE Education Congress in 1999.

Rogers is a life member of ASCE – elected as a Distinguished Member in 2008 – and served on the ASCE National Board. He also served as president of the ASCE Texas and ASCE Houston Branch section and served as president of the American Water Resources Association. He currently serves as president of the Civil Engineering Certification (CEC) Inc.

Volunteerism has been a rewarding experience for Rogers and he advises UH students to seek out opportunities to give back and get involved.

Volunteering for engineering committees in your interest areas allows you to respond to committee needs. Submitting abstracts of projects to society conferences allows you to share your experience with others. And, along the way, you become better known to others.

- Jerry Rogers
Mike Harold, M.D. Anderson Professor and chairman of the chemical and biomolecular engineering department at UH Cullen College of Engineering, recently won the 2019 Southwest Catalysis Society (SWCS) Award for Excellence in Applied Catalysis.

“We were impressed by your tremendous contributions in emission control catalysis and fuel processing,” wrote Lin Liu, chairman of the SWCS Award Selection Committee, in his notification email to Harold. “We believe you set a role model for the society to demonstrate how to apply scientific methodology to real world problems and achieve high impact on the development of new generation catalysts.”

Harold, who is an expert in catalytic reaction engineering, has spent much of his 34-year career working to improve air quality in Houston and beyond.

As founding director and principal investigator of the Texas Center for Clean Engines, Emissions and Fuels (TxC Ef), Harold has helped develop technologies to reduce harmful vehicle emissions, performed testing and verification on emission-reducing technologies developed by outside groups, and worked to improve fuel economy for medium- and heavy-duty vehicles.

Most recently, he is leading a team of researchers chosen by the U.S. Department of Energy on a $2 million project to develop and optimize a lower-cost, more efficient catalyst for natural gas vehicles to eliminate unreacted methane.

“Specific to research, I think probably the advancement of new types of catalytic convertors for vehicles is the thing I’m most proud of,” said Harold, adding that there is a certain satisfaction in knowing “the advances you’re making will benefit health by reducing pollution. Sounds kind of apple pie and motherhood and that kind of thing, but it is fulfilling to know you are making an impact.”

But Harold said the most rewarding aspect of his career is working with students. “Some of these problems are pretty challenging, but the students that I have had have been very good,” he said. Reflecting on where his former students are now … many are still working in emission control. You know you’re making a difference when you see groups of students doing well in companies that are really needing to put all this knowledge and development into practice.”

He credited the University, Cullen College and specifically his department for contributing to his productivity. “I’m surrounded by outstanding people and collaborators,” Harold said. “It’s a nurturing environment, but also a challenging environment. All of us professors have very high goals as a group, and that kind of lifts everyone up.”

Harold added that being a professor in chemical engineering in Houston and the Gulf Coast where energy is king and the chemical industry is thriving has definite perks. “It really helps the students see how their work is making a difference by interacting with these collaborators from industry,” he said. “Plus the proximity allows us to bring in more real world issues and problems into the classrooms.”

He earned his doctorate in chemical engineering from the Cullen College in 1985, studying under the guidance of his now-colleague Dan Luss. After graduating, Harold took a faculty position at the University of Massachusetts at Amherst, where he became a tenured associate professor. However, he wanted to solve real-world problems and took a R&D position with the DuPont Company.

In the late 1990s, the company began to move away from chemical conversions. Around that time, Harold was approached by the Cullen College about the recently opened chairman position in the department of chemical and biomolecular engineering. He returned to UH in 2000.

Past accolades include being elected a fellow of the American Institute of Chemical Engineers (AIChE) on 2014 as well as the University’s most prestigious faculty honor – the Esther Farb Award in 2015 among numerous other research and teaching awards.

Harold’s most recent award was presented at the 2019 SWCS Spring Symposium at the UH Alumni Center in April.

Each spring, the University of Houston recognizes the best and brightest faculty members, honoring them with teaching and research awards. This year three members of the Cullen College of Engineering community earned distinct honor.

Yi-Lung Mo, professor of civil and environmental engineering at the UH Cullen College of Engineering, was a prestigious 2019 John and Rebecca Moores Professorship. Mo is the Munger Professor of civil and environmental engineering at the UH Cullen College of Engineering, won a prestigious 2019 John and Rebecca Moores Professorship. Mo was awarded in 2019 in honor of the University’s most prestigious faculty honor – the Esther Farb Award in 2015 among numerous other research and teaching awards.

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Mo’s primary research interests are related to the study and design of reinforced and prestressed concrete, steel, periodic metamaterials, and hybrid and composite structures subjected to various types of hazards – both natural (such as earthquakes and flooding) and manmade (such as explosions).

He has developed periodic metamaterials and smart sensors for vibration control and damage detection in engineering structures (from buildings to bridges and more) and created innovative seismic resistant structural designs using new materials – such as pre-stressed concrete box bridges with corrugated steel webs. Mo has also worked on analytical models for seismic hazard mitigation primarily using the Universal Element Tester, designed and built by his mentor and colleague Tom T.C. Hsu, Moores Professor of civil and environmental engineering. It is the only machine of its kind in the country and one of two in the world. It can test the tension, compression, bending, shear and torsion of wall panels.

Mo earned his bachelor’s degree in civil engineering from the National Cheng Kung University and his master’s in civil engineering from the National Taiwan University. He earned a second master’s degree in computer science from DePaul University and his doctoral degree in structural engineering from the University of Hannover in Germany. He served as a post-doctoral research associate at UH from 1982 to 1984. He joined UH in 2000 as a professor.

Mo said the University – a Carnegie-designated Tier One public research university – was conducive to his research and teaching.

“I’m very proud of being a faculty at UH,” he said. “Our facilities are outstanding and our faculty are united and very supportive of each other.”

He also appreciates the diversity on campus. “My students come from all over the world, from many different countries,” Mo said. “I like to talk to my students and brainstorm with them. Everyone thinks in different ways and it helps broaden my mind and ideas.”

Other Cullen College faculty honored by various University awards are:

Daniel Burleson, instructional assistant professor at Cullen College, won an Undergraduate Research Mentoring Award. This award honors outstanding teaching effort.

Aaron Becker, professor of electrical and computer engineering, won an Undergraduate Research Mentorship Award. This award recognizes faculty with at least five years mentorship involvement – making a significant impact in their field by supporting and mentoring undergraduate students in research and scholarship.

Becker, a robotics expert, is known for his work with microbots – millimeter-sized robots – and drones.
for its potential to broadly impact human life on earth and the future of space travel. Once Ghasemi had plenty of concept for his novel material, he partnered with students in his Nano Therm lab to launch the startup SurfEllent and began marketing the product to consumers.

Peter Vekilov, John and Rebecca Moores Professor of chemical and biomolecular engineering and chemistry, discovered the two-step nucleation mechanism – called the Vekilov mechanism – whereby antimalarial drugs suppress the crystal growth of A beta fibrils that is crucial for the understanding of the action of potential drugs that suppress amyloid aggregation.

He leads the Vekilov Research Group at UH with a primary focus on phase transitions that occur in protein solutions. The group investigates the nucleation of the polymer fibers of the sickle cell hemoglobin that underlie the deadly sickle cell anemia and the nucleation of protein crystals.

Both professors were honored at the Faculty Excellence Award Dinner at the Hilton University of Houston last April.
Rose T. Faghih, assistant professor of electrical and computer engineering at the UH Cullen College of Engineering, received an invitation to attend the prestigious 2019 U.S. Frontiers of Engineering Symposium. The event was held Sept. 25-27 in Charleston, South Carolina.

The symposium, organized by the National Academy of Engineering, brings together 100 of the nation’s promising early-career engineers under the age of 45 from industry, academia and government to discuss pioneering technical advances and cutting-edge research in various engineering fields and industry sectors.

Attendance at the symposium is by invitation only following a competitive selection process.

The 25th annual symposium explored four key topics: Advanced Manufacturing in the Age of Digital Transformation, Engineering the Genome, Self-Driving Cars: Technology and Ethics, and Blockchain Technology.

Faghih expressed her excitement about attending the symposium.

“This is a unique opportunity to learn about new real-world technologies related to three topics highly related to my research: advanced manufacturing in the age of digital transformation, self-driving cars and genome engineering,” she said. “My students and I have been developing algorithms for inferring brain activity from peripheral physiological signals. These methods could potentially be used for intuitive human-technology interactions.”

For example, if a human supervisor detects an error in a technology’s performance (a robot or a self-driving car), the autonomic nervous system becomes activated, Faghih said.

“This activation results in changes in the skin conductance response (such as sweating) and heart rate,” she said. “These peripheral signals from the human can alert the technology to the error and lead it to correct the behavior and adapt to human supervision.”

Faghih also wants to learn more about genome engineering to expand her research by “including genomic information to further personalize my algorithms for decoding brain states.”

The USFOE fosters cross-disciplinary and cross-sector networking and collaboration.

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- ROSE FAGHIH
The medal is named for Raymond D. Mindlin, a pioneer in the field of solid mechanics. The ASCE’s Engineering Medal from the American Society of Civil Engineers (ASCE) was established in 2008 to recognize outstanding research contributions to applied solid mechanics. The award recognizes the application of elasticity and fracture mechanics to problems in numerous disciplines, including advanced composites, micromechanical systems, natural and synthetic nanostructures, biological structures, aerostructures, applied mathematics, and prosthetics.

Early on in my career I decided not to work on one specific topic,” Ballarini said. “Instead, I decided to adopt a multidisciplinary approach and to pursue interesting problems in many different fields.” Ballarini, who joined UH in 2014, said he most enjoys teaching and working with students.

“I can make a strong argument that this award reflects, more than my own abilities, the talents of the graduate students and post-doctoral fellows with whom I have collaborated with over the past 34 years,” he said.

Ballarini received the medal at the ASCE’s EMI 2019 Conference in June in Pasadena, California. The Mindlin Medal is particularly special to me because Raymond Mindlin, one of the great mechanicians of the 20th century, was my academic great-grandfather. That is, he was the advisor of the advisor of my advisor,” Ballarini said. He added that he was surprised and humbled by the award because “past winners include leading scholars whose seminal contributions to mechanics have inspired my own research and teaching.”

Ballarini earned his bachelor’s degree in civil engineering from the City College of New York, and his master’s and doctoral degrees — also in civil engineering — from Northwestern University. Although his primary background is in the mechanics of materials and structures, Ballarini’s research spans a wide range of topics, including advanced composites, micromechanical systems, natural and synthetic nanostructures, biological structures, aerostructures, applied mathematics, and prosthetics.

Roberto Ballarini, Thomas and Laura Hsu Professor and chairman of the department of civil and environmental engineering at the UH Cullen College of Engineering, is the recipient of the 2019 Raymond D. Mindlin Medal from the American Society of Civil Engineers (ASCE). Established in 2008, the award recognizes outstanding research contributions to applied solid mechanics. The ASCE’s Engineering Mechanics Institute (EMI) selected Ballarini 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 micro and nano length scales.”

The medal is named for Raymond D. Mindlin, who was a professor at Columbia University and is best known for his pioneering contributions to applied mechanics. “The Mindlin Medal is particularly special to me because Raymond Mindlin, one of the great mechanicians of the 20th century, was my academic great-grandfather. That is, he was the advisor of the advisor of my advisor,” Ballarini said.

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Established in 2008, the award recognizes outstanding research contributions to applied solid mechanics.
The Society of Petroleum Engineers (SPE) recognized two UH Cullen College of Engineering faculty members with major international awards.

Phaneendra Kondapi, interim assistant dean and founding director for engineering programs at UH at Katy and a professor with UH’s subsea engineering program, will receive the SPE’s Projects, Facilities and Construction Award. The award recognizes outstanding achievements and/or contributions that advance the field of petroleum engineering in the technical area of projects, facilities and construction.

“I sincerely thank SPE and many of my colleagues at the University of Houston and at my previous organizations, who gave me plenty of opportunities to be involved with various professional development activities and mentor the younger generation over the years,” Kondapi said. “This is a great journey so far and I feel that this recognition motivates, encourages and increases the responsibility to continue to serve even better.”

This is the most recent in the growing collection of SPE awards garnered by Kondapi. In 2017, he received two awards – The SPE Regional Distinguished Achievement Award for Petroleum Engineering Faculty and the SPE’s Regional Projects, Facilities and Construction Award. In 2013, he won the SPE International Innovative Teaching Excellence Award.

Kondapi is an active member of SPE. He was a founding member and chairman of the SPE Flow Assurance Technical session in 2005. That same year, he also chaired the SPE “Flow Assurance: Future State of the Art” global forum. He continues to serve on various SPE committees and has organized and chaired over 45 technical sessions at various conferences.

In addition to his work in academia at UH and Texas A&M University, Kondapi has more than 20 years of engineering experience gained at FMC Technologies, KBR and other organizations.

The SPE also announced its highest honor – the SPE/AIME Honorary Membership – for Ganesh Thakur, distinguished professor of petroleum engineering at the UH Cullen College of Engineering and a member of the National Academy of Engineering.

The award recognizes individuals who have demonstrated outstanding service to SPE or distinguished scientific or engineering achievements in the fields within the technical scope of SPE.

“The oil and gas industry has been good to me and led to a very lucrative and rewarding career providing exciting work where you can use advanced technologies, constantly learn new things and work all over the world, meeting diverse people and making friends everywhere,” Thakur said. “I’m humbled and honored by this most recent recognition.”

The University of Houston recruited him in 2016 as director of Energy Industry Partnerships with a $3 million grant from the Governor’s University Research Initiative (GURI) in Texas. Thakur is a globally recognized leader in reservoir engineering and management, secondary and enhanced oil recovery (EOR), offshore and onshore oil and gas field management, heavy oil, EOR of unconventional resources, and carbon capture and sequestration (CCS). Under his leadership at UH, researchers have performed an extensive study on reservoir management and CCS pilot project for Oil India during Phases 1 and 2, which amounted to $2.25 million in research grants in 2016-18. His team is pursuing additional funding and extending the research into Phase 3 of this partnership.

“This ambitious partnership has offered clear benefits for both Oil India and for the University of Houston,” said UH President Renu Khator about the CCS project in a previous article. “Finding a way to safely meet the growing demand for energy in India and other parts of the world is a fundamental challenge, and we appreciate the opportunity for our faculty and students to play a vital role in solving such important real-world problems.”

During a career with Chevron that spanned 37 years, Thakur served in various roles including vice president and global advisor and Fellow. Serving as the highest level technical professional across the entire corporation with over 50,000 employees, he led teams in the design of several key deep water offshore, shallow water offshore and onshore major capital projects involving billions of dollars of capital expenditures, which successfully created significant values for the company through hundreds of million barrels of reserves and hundreds of thousand barrels of production.

He has also served as chairman of the Corporate Reservoir Management Forum, focusing on the development of oil and gas projects and surveillance, analysis and optimization of projects, and sharing best practices and lessons learned from projects around the world. He actively participated in corporate reserves reviews of various oil and gas assets around the world for 15 years.

In addition, he served as the SPE president in 2012 and is currently the treasurer of the SPE Foundation and a board member of TAMEST (The Academy of Medicine, Engineering and Science of Texas). Thakur will begin serving as the president of the SPE Foundation in October.

He became a member of the NAE – an elite group that brings together many of the world’s most accomplished engineers – in 2016 for leadership in the implementation of integrated reservoir management techniques in the oil and gas industry. He has written over 70 papers in SPE publications; presented over 250 seminars, workshops, distinguished lectures, and short courses around the world; authored/co-authored three books, and edited two SPE Reprint Series.

Previous accolades include: Orange County, California’s Outstanding Engineer of the Year award in 1994, Petroleum Reservoir Engineer of the Year Award from the SPE in 2005, Pennsylvania State University’s Outstanding Alumni Achievement Award from the College of Earth and Mineral Sciences in 2006, and the Indian Institutes of Technology – Indian School of Mines (IIT ISM) Distinguished Alumni Award in 2016.

He earned his Ph.D. in petroleum and natural gas engineering (PNGE) from Pennsylvania State University in 1973, after receiving his M.A. in mathematics and M.S. in PNGE there in 1971 and 1972. He holds an MBA from Houston Baptist University and received his bachelor’s degree in petroleum engineering in 1970 from IIT (ISM) Dhanbad in India.

He offered some advice for Cullen College students:

• Develop a positive attitude and “can do” approach. Be persistent, stay focused, use your time effectively, respect others and embrace diversity.

• Our industry has seen many ups and downs and it has affected all of us in some ways. But the outlook for the future of the oil and gas industry in general is bright and healthy. I see a robust oil and gas industry in the future. We should focus on describing the value of our profession to society, such as providing energy for light, heating, air conditioning, driving, running machines, airplanes, etc. It’s important to continue exploring, drilling, producing, refining and transporting oil, gas and derivative products for a variety of usage, while taking care of the environment and focusing on safety and social responsibility. If we stop these activities, the whole world will come to its knees. What we do is an integral part of our society, and today’s young engineers and scientists are going to play an even more important role than our generation played.

• I would encourage young professionals and college students to continue to stay active, take leadership roles and continue to develop themselves as this is a very important industry, and it is going to be here for many more years.

SPE is the largest not-for-profit professional association whose members are engaged in energy resources development and production. It serves more than 168,000 members in 144 countries worldwide. SPE is a key source for technical knowledge related to the oil and gas exploration and production industry and provides services through its publications, events, training courses and online resources at www.spe.org.
Kaushik Rajashekara, distinguished professor of electrical and computer engineering at the Cullen College of Engineering and a member of the National Academy of Engineering (NAE), is the winner of the 2019 IEEE PELS Vehicle and Transportation Systems Achievement Award presented by the Institute of Electrical and Electronics Engineers (IEEE)'s Power Electronics Society (PELS).

He is being recognized “for contributions to the advancement of power conversion and propulsion systems for electrification of land and air transportation.”

“I am honored to be the first recipient of this award from the IEEE Power Electronics Society,” Rajashekara said.

Rajashekara, who is the head of the Cullen College power and energy systems program and director of the Power Electronics, Microgrids and Subsea Electrical Systems (PEMSES) laboratory, is a world-renowned authority and advocate for transportation electrification and futuristic vehicles.

Early in his career at General Motors/ Delphi, Rajashekara was a member of the team that helped develop the General Motors EV-1, the first mass-produced electric car from a major automaker. As chief scientist, he continued to develop and advocate for electric, hybrid and fuel cell vehicle propulsion systems. He then served as chief technologist at Rolls-Royce, where he worked on advanced architectures for more electric and hybrid electric aircrafts. During this time, Rajashekara also investigated strategies for electric taxiing of airplanes, flying trucks and powering drones.

“There is an increasing trend in transportation electrification, which will further accelerate the advance of connected cars and autonomous vehicles,” he said. “The electric and hybrid vehicle technologies being developed for automotive systems are being adapted for aircraft systems. It’s an exciting time to be part of the transportation world.”

Rajashekara became a member of the NAE – an elite group that brings together many of the world’s most accomplished engineers – in 2012 for contributions to electric power conversion systems in transportation. He is also a fellow of the IEEE and the U.S. National Academy of Inventors.

After earning his Ph.D. in electrical engineering from the Indian Institute of Science in Bangalore, India, he completed a master’s of business administration from Indiana Wesleyan University in Indianapolis.

Rajashekara received the award at the IEEE Transportation Electrification Conference (ITEC) and Expo in Novi, Michigan.

UH Engineering Community MOURNS PROFESSOR EMERITUS KAMEL SALAMA

BY RASHDA KHAN

Kamel Salama, former professor of mechanical engineering with the UH Cullen College of Engineering, died Friday, July 12, 2019, at M.D. Anderson Hospital following an extended illness. He was 87.

Passionate about science and education, he nurtured many young scientists and made significant contributions in the area of materials science. He held 10 patents.

Born in South, Egypt, Salama received a bachelor’s degree in physics and mathematics, followed by a master’s degree and a doctorate in physics from Cairo University.

He first joined the University of Houston in 1973 as a visiting professor for a year, and then served as an associate professor until 1978. At that point he served as a professor and director of the materials engineering program. Altogether, Salama taught and led an active research program at UH for over 35 years.

During that time, he established the materials science and engineering program at UH and mentored more than 60 master’s and doctoral students. He also directed a research team in the Superconductor Processing and Application Group at the Texas Center for Superconductivity and Advanced Materials.

“He was part of our department right from its inception and made lasting and valuable contributions to our University,” said Pradeep Sharma, M.D. Anderson Professor and chair of the mechanical engineering department. “He was a kind mentor to many of us and was always ready with a chuckle.”

Salama was a visiting scientist in the Materials Characterization Section of the NASA Langley Research Center in Virginia in 1983. He also did research work at Uppsala University in Sweden, the Ford Scientific Laboratory in Michigan and at Rice University.

He collected many accolades in his lifetime, including the Jacob Wallenberg Foundation Award for his research in materials science from the Swedish Academy of Engineering, being elected a Fellow of the Institute of Physics (United Kingdom) and an honorary fellowship from the International Congress on Fracture.

“Our faculty, staff and students are deeply saddened by this news,” said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College. “We were blessed to have him share his extensive knowledge and expertise with our community. Our hearts go out to his family and loved one at this very difficult time.”

- PRADEEP SHARMA

He was part of our department right from its inception and made lasting and valuable contributions to our University. He was a kind mentor to many of us and was always ready with a chuckle.

- PRADEEP SHARMA
Bo Cao, a doctoral candidate in environmental engineering at the UH Cullen College of Engineering, was among the recipients of the 2020 Graduate Student Award in Environmental Chemistry from the American Chemical Society (ACS). ACS makes up to 20 such awards annually.

The awardees receive a cash prize and membership in the Environmental Division for one year. They are also publicized in the ACS newsletter, Environment, and Environmental Division for one year. They are also publicized in the ACS newsletter, Environment, and Environmental Division.

Sponsored by ACS’s Division of Environmental Chemistry, the award recognizes promising graduate students working in areas related to environmental chemistry at U.S. educational institutions. Winners are selected based on transcripts and record of research productivity, a brief discussion of the student’s future goals and a letter of recommendation from the faculty advisor.

“I chose to study environmental engineering to help protect our living environment, which is so important for the future well-being and happiness of mankind,” Cao said.

His faculty advisor is Yand Li, associate professor of civil and environmental engineering. “I’m very grateful for her mentorship and support,” Cao said. “Without her efforts in the past four years, I wouldn’t have earned this award.”

The awardees receive a cash prize and membership in the Environmental Division for one year. They are also publicized in the ACS newsletter, EnvironSci, and the journal Environmental Science and Technology. More importantly, the award recognizes the students’ potential for future contributions as professionals in environmental chemistry. Cao’s research focuses on reducing the mineral scaling during the reverse osmosis filtration process, which is used in seawater desalination. Reduction of the scaling can improve membrane fouling and more water recovery.

After receiving a bachelor of science from UH in biomedical engineering, Ershad is now pursuing a Ph.D. in the same field at UH. His research proposes to develop soft neural interface devices and he focuses on stretchable and flexible electronics for biomedical applications, hoping to create new technologies for use in health care and medicine.

Bo Cao received an ACS Award in Environmental Chemistry.

Ali Ansari, a doctoral student at the UH Cullen College of Engineering, was recently awarded the American Society of Civil Engineers’ John B. Hawley Memorial Fellowship. The fellowship, established in 1961, promotes graduate study and research in hydraulic and environmental engineering.

Growing up in Tehran, Iran, Ansari experienced water rationing and scheduled electricity blackouts. This motivated him to find solutions to environmental issues and led him to pursue his Ph.D. in civil and environmental engineering.

“Considering the environment is vital for sustainable development,” Ansari said. “I have always wanted to work with microorganisms; to understand their role in environmental issues; and to apply their endless potential to solve those issues.”

The one issue close to his heart is the availability of clean water.

Worldwide population growth has fueled industrialization and pollution, which in turn have caused a water crisis for billions of people and the situation is worsening, Ansari said. The number of affected people is projected to rise to 3 billion in the next decade, according to the World Water Council, he pointed out. “With a small amount of freshwater available, desalination is one of the most promising technologies to provide an infinite, uninterruptible and reliable source of clean water,” Ansari said.

Working under the guidance of Cullen College Associate Professor Debora Rodrigues, known for her expertise in environmental engineering, Ansari’s research focuses on understanding the complex physical-chemical-biological interactions in the reverse osmosis (RO) systems that are a part of large-scale desalination systems around the world. RO membrane can work with different water sources, including seawater, brackish water and wastewater to produce fresh, drinkable water.

But such membranes still suffer from low recovery for seawater desalination, relatively small removal of low-molecular-weight contaminants, reactivity to chlorine and fouling.

Membrane fouling by inorganic materials (scaling) and microorganisms (biofouling) have been the subject of many studies since membrane fouling will decrease clean water production levels, increase energy consumption due to clogging of the membrane pores and potentially damage equipment. It adds unnecessary expenses to the desalination facilities’ bottom line.

Conventionally, researchers address the scaling and biofouling separately. Ansari said. For instance, when proposing methods to prevent scaling, researchers only consider water chemistry. However, the condition favorable for scale formation could be provided by the metabolic activity of the microorganisms via different mechanisms.

His aim is to simultaneously prevent scaling and biofouling on RO membranes to boost clean water production.

“The main goal of my research is to understand how the chemical and biological properties of the feed solution into a desalination system will interact with each other and affect membrane fouling, i.e. scaling and biofouling on reverse osmosis membranes,” Ansari said. “By understanding the fundamentals of the interaction between the biological and chemical components, I hope to pave the way to develop desalination systems with less fouling and more water recovery.”

In addition to his research, Ansari has also led an undergraduate team in the 2017 Campus Rainworks Challenge, which is the U.S. Environmental Protection Agency’s annual national competition to engage college students in the design of on-campus green infrastructures to address stormwater pollution. His team built a biosand filter and was a finalist.

Ansari received his bachelor’s degree from the Isfahan University of Technology (IUT) in Isfahan, Iran, and a master’s degree in chemical engineering, with a focus on energy and environment, from University of Tehran (UT) in Tehran, Iran.

While at the University of Tehran, Ansari worked as a water treatment expert with the United Nations Educational, Scientific and Cultural Organization (UNESCO) Chair on Water Reuse. UNESCO’s water-related chair positions are established teaching or research positions at universities and research institutes around the world.
Cullen College Alumna Scores Prestigious Chinese Government Award

BY RASHDA KHAN

Chong Dai, who earned a Ph.D. in environmental engineering from the UH Cullen College of Engineering, was awarded a 2019 Chinese Government Award for Self-financed Students Abroad. Given by the China Scholarship Council, this competitive award is presented to only 500 graduate students studying abroad. The program prepares scientists and engineers with entrepreneurial training to move towards commercialization of scientific projects that emerge from academic research.

Cullen College Student Wins Big in Scholarships and Opportunities

BY RASHDA KHAN

Almost everyone has heard the advice “Don’t put all your eggs in one basket” at some point in their life. But Esther Akinwande, a chemical engineering junior at the UH Cullen College of Engineering, took its wisdom to heart and is now reaping the benefits.

Akinwande, who is a UH Honors student and a regular on the dean’s list, applied for several scholarships in 2018. As a result, she won eight scholarships totaling $17,200 for the 2018-2019 academic year.

She won scholarships from BP, the Society of Women Engineers (SWE), the National Society of Black Engineers (Houston chapter), AACE International (originally the American Association of Cost Engineers), the UH Cougar Athletic Alliance, the UH Urban Experience Program, the UH Honors College and from the University of Houston Foundation. Akinwande, who is a UH Honors student and a regular on the dean’s list, applied for several scholarships in 2018. As a result, she won eight scholarships totaling $17,200 for the 2018-2019 academic year.

Akinwande attributed her scholarship success to various factors – good grades, campus involvement and “actually making the effort to apply.” The support of her mentors – from writing reference letters to looking over her application – was also tremendous help. Underlying it all is her family, originally from Lagos, Nigeria.

“My family is an amazing support system for me,” Akinwande said. “They constantly inspire and encourage me to push through and never give up, regardless of the challenges I face.”

What’s next for Akinwande?

She is reapplying for most of the scholarships because some of them don’t automatically renew and she is applying for new scholarships.

Meanwhile, she shared some advice for other students.

“My family is an amazing support system for me,” Akinwande said. “They constantly inspire and encourage me to push through and never give up, regardless of the challenges I face.”

“Stay focused on your academics but also get plugged to different organizations,” said Akinwande. “UH has a lot of organizations/groups you can be a part of. Find the one that feels like home to you and build relationships.”

8 scholarships totaling $17,200 for the 2018-2019 academic year.
he was excited to be working on optimizing leaf spring suspensions, which is a key part of the automotive industry’s goal to reduce the weight on every component of vehicles while maintaining strength, performance and reliability.

Hixon shared his thoughts before heading to Germany. “I am most excited to gain experience doing research in a country that is known around the world for outstanding engineering and gaining experience in the automotive industry,” Hixon said. “For fun, I want to visit different race tracks around Germany like the Nürburgring, try German beer and, hopefully, do some mountain biking.”

Vincent Laroche Research Project: Recycling Processes of Fibrous Particles

Vincent Laroche, also a mechanical engineering major, chose his project because of his interest in sustainability and the environment. He worked at the Technical University of Braunschweig, analyzing the bulk flow of fibrous particles in recycling processes. The main goals of the project were to find how different factors affect the efficiency of bulk flow and to use this data to determine the most optimal conditions for recycling.

“This research is important because recycling and recyclable materials are becoming more and more common in the modern world,” he said. “The knowledge this research could provide would advance our understanding of optimal recycling processes.”

Mary Olear Research Project: Blockchain Technology in Supply Chain Management

Mary Olear, an industrial engineering major, worked at the Technical University of Dortmund. Her project focused on the implementation of blockchain technology in supply chain management – whether dealing with the financial aspects or pertaining to warehouse and delivery – with the goal of increasing efficiency, transparency and innovation.

Upon her acceptance, Olear shared her excitement. “Along with the research experience that I hope to gain from this internship, I’m excited to have access to some of the other ongoing projects currently being researched by the Fraunhofer Institute. They research everything – from energy and the environment to production,” Olear said. She also hoped “to take in all that Europe has to offer.”

Joshua Tran Research Project: Cleaning Mechanisms in Food Processing Plants

Joshua Tran, a first-generation college student and chemical engineering major, chose his project because of his interest in innovation and a desire to pursue a career in food processing plants. The project focused on cleaning strategies for food processing plants.

“This research will help battle the economic and ecological disadvantages that food-processing plants encounter,” said Tran, who was intrigued by the project’s combination of engineering and food.

Before the trip, Tran shared that he was looking forward to using his passport for the first time and experiencing the university culture in Braunschweig.

Meet the University’s 2019 DAAD-RISE scholars

Christopher Hixon
Research Project: Modelling and Simulation of Fiber-Reinforced Leaf Springs

Christopher Hixon, a mechanical engineering senior, worked at the Karlsruhe Institute of Technology. He chose his major because he wanted to build fast cars and

Vincent Laroche
Research Project: Recycling Processes of Fibrous Particles

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While two students declined the award in order to pursue other opportunities, six spent their summers in Germany, which included career-building research, learning German and lots and lots of traveling and adventure.

Stuart Long, professor of electrical and computer engineering and associate dean of undergraduate research and the Honors College, is proud of the Cullen College students.

“It’s great to see our hardworking and creative engineering students taking advantage of research opportunities like this,” Long said. “I know the DAAD RISE summer internships will provide great experiences and take them onto even more important accomplishments.”

Maria Laura Rossodivita
Research Project: Particle Engineering for Dry Powder Inhalation - A Pharmaceutical Approach

Maria Laura Rossodivita, a chemical engineering major, worked at the Christian-Albrechts-Universitaet zu Kiel located in the port city of Kiel in northern Germany. Her project focused on inhalable medicine and ways to increase the amount of drug reaching the lungs by the use of interactive blends dispersed by inhalation devices.

“Since my mom was a doctor in Venezuela, I’ve wanted to explore the medical field and see if it’s the right place for me. If I end up really enjoying this project, I hope to pursue pharmacetics to create new and better medicines that can save lives and improve the quality of life for many people with debilitating diseases,” Rossodivita said. “Also, growing up during the American opioid crisis inspires me to use my engineering abilities to create medicine that doctors can give to their patients, to help alleviate their pain, without fearing the risk of addiction.”

Jesus Silva Rodriguez
Research Project: HVDC Transmission

Jesus Silva Rodriguez, an electrical engineering major, worked with high voltages measurement systems and research insulation materials that can withstand this high electric potential at the Technical University of Dortmund.

“These high voltage systems could be used in future energy grids powered by renewable energy systems such as solar and wind power systems,” he said. “One of my greatest passions is renewable energy technologies because I believe that it is now time to stop using fossil fuels and depend solely on renewable energy sources before the negative ecological impact on our planet becomes irreversible.”

Last spring, Silva Rodriguez shared that he was most excited about his first airplane ride.

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Wearable electronics – from smartwatches to fitness trackers – are not just trendy and fashionable accessories, but an integral part of many people’s lives. People use these devices to log the number of steps taken, monitor heart rates and sleep patterns, count calories and more.

The demand for wearable devices has spurred advances, such as more compact designs and more complex activity tracking (broken down into different sports), which require more efficient power storage. Traditional batteries can’t meet customer’s expectations of smaller devices and longer run times between chargings. As a result, researchers are working to identify or create alternate power supplies.

Jie Chen, a doctoral candidate in materials science and engineering at the UH Cullen College of Engineering, recently tackled the issue in an article published in the prestigious Nano Energy journal.

“It would be really amazing if one day we could have electronics that work forever – without the need for charging or replacing the batteries,” Chen said. “Energy harvesting from biomechanical energy is one of the promising approaches to make this a reality.”

Biomechanical energy is power harvested from human motion, such as walking. It is widely available to almost every living person.

Chen is the lead author of the article titled “Biocompatible and sustainable power supply for self-powered wearable and implantable electronics using III-nitride thin-film-based flexible piezoelectric generator.” Co-authors include Jae-Hyun Ryou, associate professor of mechanical engineering and Chen’s faculty advisor; Seungkyu Oh, a UH postdoctoral fellow; Noor Nabulsi, a UH mechanical engineering senior and an undergraduate research assistant; Heidi Johnson, a UH undergraduate research fellow and Weijie Wange, a UH doctoral candidate in mechanical engineering.

The article shares research that demonstrates the capability of harvesting biomechanical energy using a high-durable and biocompatible material, called III-nitride thin film, in flexible piezoelectric generators.

At present, state-of-the-art biomechanical energy harvesters or generators suffer from low stability, low power output or the use of toxic elements, Chen said.

“Group III-nitride thin film-based piezoelectric generator developed in our research overcomes most of these drawbacks and could make the self-powered electronics one step closer to reality,” he added.

However, the research team grew the thin film on silicon by epitaxy, which is expensive and makes it difficult to fabricate the flexible device. The Ryou Group is now working to develop new approaches to deposit the group III-nitride thin film directly onto a flexible material, like metal foils, to reduce cost and simplify fabrication.

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– JIE CHEN
A team of UH Cullen College Engineering students are basking in the sweet smell of success in NASA’s 2019 Special Edition: Moon to Mars Ice & Prospecting Challenge, a college competition to design and build a machine to extract water from Mars’ hidden underground ice.

The UH team, called The Phoenix, and its Planetary Ice Extractor (PIE) robot was one of ten finalists to advance in the challenge.

“The Phoenix Team provides a commendable example of the type of exciting, inventive projects that young mechanical engineers can develop if they keep an open mind and dedicate themselves seriously to it,” said Ralph Metcalfe, professor of mechanical and biomedical engineering and faculty advisor on the project. “The merit of this team’s work has been confirmed by a NASA panel of judges from around the U.S.”

Each finalist won a $10,000 development stipend. All 10 teams visited NASA’s Langley Research Center in Hampton, Virginia June 4-6 for a final competition.

As a result, water is expected to play a key role in the development of any lunar or Martian bases. It will be needed not only for direct use by the astronauts for drinking and washing, and growing fruits and vegetables, but also as a source of rocket fuel for interplanetary travel.

“Water can be used to create liquid oxygen and liquid hydrogen, which are the most efficient rocket propellants known today,” Metcalfe said. “Thus, on trips to Mars or the moon, it wouldn’t be necessary to bring along rocket fuel for the return trip, as the Apollo lunar astronauts in the 1970’s had to do at very great expense.”

In addition to the $10,000 stipend from NASA, the team garnered several corporate in-kind donations of materials and parts for the project.

The Phoenix team used the months leading up to the final competition to build, test and fine-tune the PIE. Final scoring was based heavily on the robot’s ability to drill through layers of simulated subsurface to extract and collect water found in the ice.

Meet the team

The Phoenix team consisted of four Cullen College mechanical engineering students—Andrew Advani, Jacob Frady, Joseph Pauwels and Sharlyn Tijerina. PIE also happens to be the team’s senior capstone design project. All were seniors when they first started this challenge, and three of them graduated this spring. Tijerina will graduate in the fall.

Each member brought their individual skills and expertise to the project, including robotics, rocketry and machinist experience. The project, described by one member as “a mountain of work,” involved a lot of detailed work, thinking out of the box, trial and error and time.

The team chose the PIE project because the members wanted “to stretch our knowledge and abilities to do something great and perhaps put ourselves, and the University, on the map,” Pauwels said.

The prototype shows that extremely complex tasks can be accomplished by using a very simple design, autonomous software and improving fault tolerance, according to Frady, founder of Space City Rocketry, a competitive collegiate rocket engineering team at UH.

“We hope to offer some insight into a robust, autonomous mining robot,” he said, adding the hope that NASA engineers would consider the team’s PIE prototype a platform to design a full-scale Mars mining robot.

The group’s success in the initial round was a surprise and an emotional moment.

“After we heard that we got selected… I shed some tears because I couldn’t believe it. Granted, I think our success is because we have a strong team but, just knowing that I also helped make that happen gave me a huge confidence boost that I needed,” Tijerina said. “I think a big takeaway is to remember we are all budding engineers and it’s OK to feel like you’re not the best engineer ever, but what matters is trying your best and you’ll get to where you want to be eventually.”

One person not surprised by the team’s success is Christina Chang, instructor for the mechanical engineering capstone design class. She prospcts their success to the students’ willingness to seek outside help and expert advice as well as their own experience in industry and academic research.

“The team came with a strong sense of what would be needed to implement and execute their project in terms of resources, skills, and knowledge,” she said. “I hope that our team can prove that you don’t have to go to MIT to be successful,” Tijerina said. “They are a team of only four students (with families and jobs), the other national finalists are much larger teams and some are repeat competitors. My hope is that they will be able to inspire more UH students to take the step to compete on the national level.”

All four members of The Phoenix are over the moon with excitement.

“I hope our team can prove that you don’t have to go to MIT to be successful,” Tijerina said. “I’m excited to represent the University of Houston on a national level and also excited to meet the other engineers competing and see how they tackled the same problem.”

The Phoenix team consisted of four Cullen College mechanical engineering students—Andrew Advani, Jacob Frady, Joseph Pauwels and Sharlyn Tijerina. PIE was a finalist in the NASA’s 2019 Special Edition: Moon to Mars Ice Prospecting Challenge. The team was a finalist in the NASA’s 2019 Special Edition: Moon to Mars Ice Prospecting Challenge.
The UH chapter of Tau Beta Pi – Texas Epsilon (TBP) recently hosted an information session with representatives of INEOS, a global manufacturer of petrochemicals, specialty chemicals and oil products. The INEOS presenters included Bob Sokol, chief financial officer of INEOS Oligomers and Oxide; Fred Rulander, chief operating officer of INEOS Oxide North America; Matt Abraham, university sponsor and business development director; and Joel Roberts, lead recruiter.

INEOS is a major supplier of basic chemical components found in a range of everyday products. It has a production network of 171 sites in 24 countries and employs about 19,000 people.

The highlights of the presentation included the growth of the private company, hiring practices and professional growth opportunities within the company. “We saw their business philosophy as a parallel to what we want to do at TBP (Tau Beta Pi): bring engineers to the forefront of the modern world, not just as the mighty problem solvers that we are, but as the strong and ambitious leaders we are meant to be,” said Pietro Antonio Cicalese, a master’s student in biomedical engineering at and spokesman for TBP.

Company representatives also accepted student resumes for consideration for existing and future job and internship opportunities.

“This is what we want to do at TBP: bring engineers to the forefront of the modern world, not just as the mighty problem solvers that we are, but as the strong and ambitious leaders we are meant to be,” Cicalese said. “The company representatives explicitly expressed their interest in creating a program with TBP at UH.”

TBP, founded in 1885, is the oldest engineering honor society and second oldest collegiate honor society in America. It represents the entire engineering profession.

Chemicals Giant Ineos Visits With UH Engineering Students

We saw their business philosophy as a parallel to what we want to do at TBP (Tau Beta Pi): bring engineers to the forefront of the modern world, not just as the mighty problem solvers that we are, but as the strong and ambitious leaders we are meant to be.”

- PIETRO ANTONIO CICALESE
Undergraduates from across the nation spent two weeks this summer at the Cullen College of Engineering and the BRAIN Center at the University of Houston gaining research experience, learning valuable lessons and building their academic careers.

The Cullen College currently has two Research Experience for Undergraduates (REU) programs funded by the National Science Foundation. It awarded UH researchers $790,000 for three years to reach students early in their college careers. The two REU programs are Materials for Sustainability in Energy and Manufacturing, now in its final year, and the Neurotechnologies to Help the Body Move, Heal and Feel Again, which is in its second year.

The Cullen College summer REUs opened new doorways for many of the 26 participating undergraduates.

"Entering the program, I was unsure if research was right for me or if I would enjoy industry more. Essentially, I was using this experience to determine the right path for me," said Jackson Levine, a senior at Tulane University double majoring in biomedical engineering and manufacturing, now in its final year, and the Neurotechnologies to Help the Body Move, Heal and Feel Again, which is in its second year.

The Cullen College summer REUs offered new doorways for many of the 26 participating undergraduates.

"I learned that research is my passion and I can confidently say that, after this REU, I plan to pursue a Ph.D. in the field of neurotechnology," said Levine, who worked on a research project investigating the use of vibrations to improve the gait of people suffering from Parkinson's disease, spinal cord injuries and other similar chronic conditions. He was excited about contributing to his first research paper. "I actually got to click the button to submit the paper. This is the first of hopefully many papers, so I will remember that moment," Levine said.

The programs introduced students to the realities of research work, which can often be long-drawn-out and laborious, and do not always turn out as expected.

"Research requires determination to discover and adapt to challenges presented along the way," said Rebecca Barry, an engineering sophomore at Providence College who worked with Alami Karim, Dow Chair and Welch Foundation Professor in chemical and biomolecular engineering, in the REU focusing on sustainable materials.

She was surprised by how much she learned despite starting with minimal information about graduate work, research or polymers. By working "in a polymer-based lab and with Ph.D. students, I not only understood the challenges in the specific field of research, but also the realities of a Ph.D. program," she said. "I have gained insights... for both industry and academia."

Barry spent the summer in Karim's lab polishing thin films and observing their structure. She got to operate equipment, collect and analyze data, present her research and more.

"Presenting my research in a lab meeting was exciting because it reinforced the communication skills which were emphasized throughout this program," Barry said. "The professor and Ph.D. students all commented on my work and I was able to learn from them. I have gained valuable research experience and communication skills this summer."

Other students knew what they wanted to do and attending a UH Cullen College REU was a strategic choice.

"Although I applied to dozens of summer programs and internships, UH's program stuck out to me due to its specificity in the field of neurotechnology," said Abigail Turcheck, a biomedical engineering sophomore at Arizona State University (ASU). "I would like to work in neural engineering after graduating, so I thought this would be the perfect program to prepare me for research in this field. Additionally, UH has a partnership with ASU with the BRAIN Center, which opens me to networking opportunities with professors and industries involved in neurotechnology upon my return to ASU."

Turcheck had the opportunity to work with Jose Luis Contreras-Vidal, who is a professor of electrical and computer engineering and the director of the Building Reliable Advancements in Neurotechnology (BRAIN) Center at UH. The BRAIN Center, a collaboration among Arizona State University, the University of Houston and industry members, was officially funded in 2017 with a $3.5 million grant from the National Science Foundation. Its mission is to develop safe, effective and affordable personalized neurotechnologies.

"After graduation, I hope to pursue a Ph.D. in neural engineering... and then work in the field of industrial research and development in neurotechnologies," she said. "This program has solidified my interest in research for a long-term career."

The UH engineers leading the two programs include Hahle Ardebili, Bill D. Cook Associate Professor of mechanical engineering, and Jacinta C. Conrad, Frank M. Tiller Associate Professor of chemical and biomolecular engineering, for the Materials REU; Contreas-Vidal, Cullen Distinguished Professor of electrical and computer engineering, and Stuart Long, professor of electrical and computer engineering and associate dean of the Honors College and Undergraduate Research for the Neurotechnologies REU. Maria Modelska with the Cullen College facilitated and managed both programs.

Spearheading the REU programs is their way of nurturing a new generation of researchers.

"Nationally there is a critical objective to increase the number of students pursuing careers in the STEM fields," said Ardebili. "I hope participating in the REU program will inspire students to continue in the science, technology, engineering and mathematics (STEM) fields."

Conrad said analysis of data collected from post-program surveys indicates that research experience at the UH Cullen College is having a positive effect.

"The REU program is especially valuable for undergraduates from universities without graduate programs or high levels of research," she said. "The exposure such students receive to cutting-edge research at UH propels them to apply to graduate schools, and their lab experience helps them gain admission. In the end, this training enables these students to pursue rewarding careers in engineering."

Contreras-Vidal agreed. "At the end of the experience students will understand the role of an engineer in society and be aware of the different opportunities available to help them build a meaningful career," he said.

The visiting students shared some advice encouraging Cullen College Coogs to consider summer REU programs offered around the nation:

• Participate in an REU program even if you are not considering academic research as a career. It can help hone your technical skills in the field and your ability to be self-sufficient in a work setting.

"I learned that research is my passion and I can confidently say that, after this REU, I plan to pursue a Ph.D. in the field of neurotechnology."

JACKSON LEVINE
ALUMNI

“Coming back to the system that gave me my education makes it very special and at the same time very important to make a difference here.”

- MIGUEL GONZALEZ

UH Cullen College Alumnus

MIGUEL GONZALEZ

Leads UHCL’s College of Science And Engineering

BY RASHDA KHAN

UH Cullen College of Engineering alumnus Miguel A. Gonzalez (’83, MSIE ’85, Ph.D. IE ’95) recently took the helm as the new dean of the College of Science and Engineering at University of Houston-Clear Lake. He will also serve as a professor of engineering.

Accepting the appointment brought Gonzalez full circle to his roots. For him, his new job is more of a homecoming.

“I have always been a very mission-driven person, so being able to make a difference in supporting the mission of the institution and the University of Houston System is very important to me,” he said. “It’s coming back to the system that gave me my education, this is where I started my career in academia … it makes it very special and at the same time very important to make a difference here.”

Gonzalez earned his bachelor’s and master’s degrees in industrial engineering as well as his Ph.D. in the same discipline from the UH Cullen College of Engineering. It’s also where he got the teaching bug after working as a teaching fellow during 1983-85. He served as an instructor of industrial engineering 1986-88 and 1993-95, and then as a visiting assistant professor for part of 1995 at the Cullen College.

“I started as freshman in 1978 and finished up as a faculty member at the UH Cullen College. That, along with my industrial experiences, prepared me for what I’m doing today,” Gonzalez said. “I owe the college a lot and I have a lot of fond memories.”

From 1986 to 1994, Gonzalez joined the family business Citro Mexico, one of Mexico’s largest citrus processing operations. There he served in various roles, rising to the position of Citro Mexico’s president and chief corporate executive officer. He also served as assistant professor of industrial and systems engineering at the University of Memphis from 1996 to 1998.

Prior to joining UH-Clear Lake, Gonzalez spent 20 years at the University of Texas Rio Grande Valley (UTRGV) and its legacy institution in Edinburg, The University of Texas-Pan American (UTPA). He served as an assistant professor and then director of UTPA’s manufacturing engineering program.

Later, Gonzalez was involved in several initiatives in the community, including serving as director of the Rio Grande Regional Center for Innovation and Commercialization. Through these activities, he fostered University partnerships with existing and developing industries — something he also wants to do at UHCL.

Gonzalez eventually became an endowed professor; dean of UTPA’s College of Engineering and Computer Science; and associate vice president for research at what is now the UT Rio Grande Valley — a result of UTPA’s 2015 merger with UT-Brownsville.

He brings all this vast and diverse experience to his position at UHCL with the aim of making a difference. He wants the college to support students, the institution and the surrounding community by building on existing programs and forging new partnerships to make the most of opportunities.

But his driving force is student success.

“The focus is on actually helping students succeed, that’s why I got into academia,” Gonzalez said. “It is not just about getting students into the institution, but making sure they’re getting a quality education and getting them successfully graduated … [and] we’ll have to work on activities that makes them successful after graduation.”

He paused for a moment of reflection. “I lived it as a student within the UH System and I was mentored in such a way that we were able to do some very good things,” Gonzalez said. “I know this is going to be pretty much in that tenor.”
Megan Goh (BSEE ’18), a 2018-2019 Fulbright grant recipient, is conducting research in Germany. She is studying how and when infantile brain disorders occur in animal models using photoacoustic imaging.

Her lab is located in the Helmholtz Zentrum Muenchen, an international research institute associated with the Technical University of Munich (TUM), which is known for its inclusion of many different institutes and for its collaborative approach to science.

“I feel like I have been exposed to so many alternative, interconnected fields,” she wrote. “I have been able to learn so much.”

Goh majored in biomedical engineering at the University of Houston Cullen College of Engineering because of her experience with sports injuries and working with medical professionals to heal and get back to her beloved soccer.

“I wanted to be able to help other people in my situation,” she said. “So going into biomedical engineering was the best fit for me. It was kind of a marriage between problem solving and the medical aspect, which has played a pivotal role in my personal life.”

She won the Houston Scholars Program’s competitive independent research grant three times and used it to investigate how concussions might affect biomechanical properties of the brain in rats. Goh’s poster presentation on the project received the Audience Favor- ite Award at the UH Undergraduate Research Day.

“I have been blessed with a lot of opportunities and have nothing but good words for my UH experience.”

- MEGAN GOH

Additionally, Goh worked as a biomedical engineering undergraduate fellow in the Bio- medical Imaging Optics Lab led by UH profes- sor Kirill Larin and served as a Harris Meth- odist Hospital intern.

Goh said her time at UH was a blessing. “I had a wonderful time in college where you just get to be a student and engage in all different kinds of experiences,” she shared. “I have been blessed with a lot of opportunities and have nothing but good words for my UH experience.”

A person used to making most of every oppor- tunity that comes her way, Goh is busy learning all she can from her Fulbright experience, making friends and exploring Germany. ☺

Mr. Hickman was fond of his time at the University of Houston and felt that his engineering education provided him with a solid foundation for a successful career. His legacy will continue to live on through the students with the establishment of the Herbert D. and Suzanne C. Hickman Endowed Scholarship in electrical engineering.

“Mr. Hickman was fond of his time at the University of Houston and felt that his engineering education provided him with a solid foundation for a successful career,” said Rus- sell Dunlavy, assistant vice president of Uni- versity Development.

“His legacy will continue to live on through the students with the establishment of the Herbert D. and Suzanne C. Hickman Endowed Scholarship in electrical engineering,” Dunlavy added. “Mr. Hickman chose to make this gift by leaving the university in his estate plans and we are extremely thankful for his generosity.”

Originally from the Midwest, Hickman worked in the oil fields in Pampa, Texas, for Schlumberger when he decided to pursue a college degree to help advance his career. He landed a full-time position with Schlumberger in Houston and chose to attend evening classes at the Cullen College.

His wife, Suzanne, worked to help support Hickman’s education. But he also won a scholar- ship from the Thomas and Richard Franklin Scholarship Fund, which was created by a generous bequest to UH. The couple appreci- ated the scholarship, and Hickman vowed to one day give back to UH in a similar way.

As a student, Hickman was very involved with the campus community and won the National Society of Professional Engineers (NSPE) Outstanding Student of the Year Award. During his last year as a student, Hickman won a scholarship sponsored by Western Electric.

After graduating with a bachelor’s degree in electrical engineering in 1959, Hickman worked for Western Electric for 27 years. On retiring, Hickman and his wife moved to Colo- rado Springs, Colorado, where they had vaca- tioned as children.

Hickman died at the age of 86 in 2017 and the gift received through his estate planning will be used to establish the Herbert D. and Suzanne C. Hickman Endowed Scholarship. The first awards are anticipated in 2020.

“Herbert Hickman’s story and generosity is an important part of the UH story – helping working students achieve their dreams,” said Badri Roysam, Hugh and Lillie Cranz Cullen Univer- sity Professor and department chairman of electrical and computer engineering.

“This support will allow us to provide scholar- ships to well-deserving UH students studying electrical engineering, which is a vital profes- sion to help the United States succeed in the competitive global environment of today and the future.” 🌍
I offer my photo of a 4-4-0 locomotive: The four small idler wheels in front steer it around bends. The engine drives the four large wheels. And it has no idler wheels behind. Designer Henry Campbell of Philadelphia put it into production in 1839, and it dominated 19th century rail service all the way into the 20th century. People called it the American type of locomotive.

Now here’s the zinger: Houston’s Great City Seal proudly displays this engine. That seems to make sense. We’re America’s second largest port; and rail carries most of the freight. Yet today here sits Houston’s seal with its remarkably modern locomotive! We finally did get a locomotive 12 years after the seal. The embryonic Buffalo Bayou, Brazos, and Colorado Railway bought a far more primitive, second-hand 4-2-0 engine, in 1852. They added a 4-4-0 two years later, and we finally had the locomotive that dreamers put on the city’s seal 14 years before.

Houston was then just four years old. The Allen brothers, John and Augustus, came to the new Republic of Texas in 1836. They bought up 10 square miles of land adjacent to Harrisburg, Texas. Then they set out to form a major city on Buffalo Bayou. We took Sam Houston’s name the next year. For a while, we even served as temporary capital of the Republic of Texas. The Allen brothers proclaimed that Houston would be the region’s “great commercial emporium.” And Augustus Allen hired the riverboat Laura to make the trip up the Bayou from Galveston in 1837. Buffalo Bayou would now become the watercourse for Galveston’s goods. But where to go from here? Rail had to be the answer, and rail was hardly invented. Yet today here sits Houston’s seal with its remarkably modern locomotive! We finally did get a locomotive 12 years after the seal. The embryonic Buffalo Bayou, Brazos, and Colorado Railway bought a far more primitive, second-hand 4-2-0 engine, in 1852. They added a 4-4-0 two years later, and we finally had the locomotive that dreamers put on the city’s seal 14 years before.

The Allen brothers’ idea was in motion at last, though neither lived to see Buffalo Bayou dredged to form a ship channel all the way into Houston. Neither saw 6,000 miles of track laid in Texas during the 1880s. Or did they? Those two young brothers, after all, really did see a great city — where only flat, hot, inhospitable expanse stretched off to infinity in every direction.

A Great Northern 4-4-0 William Crooks locomotive from 1861, in the Lake Superior Railroad Museum in Duluth, Minn. — and on the city seal of Houston.

VIEW MORE PHOTOS AT enginespics.smugmug.com
The 2019 UH Cullen College of Engineering Alumni Awards Gala was held at the Bayou City Event Center on Thursday, June 6, 2019. The annual event, hosted by the Engineering Alumni Association (EAA), celebrates the professional achievements and contributions of college alumni and faculty. Honorees included Ryan J. Baird (BSEE ’01), Charles M. Grichar, P.E. (BSCHE ’76), William A. Brookshire, Ph.D. (BSCHE ’57), Carol K. Schmidt, P.E. (BSCHE ’97), Debora Rodrigues, Ph.D., Heidi Alderman and The Honorable Dennis R. Paul, P.E. (BSCE ’86, MSCE ’90).
Over 100 companies came to the University of Houston campus to recruit engineering students for internship, fellowship and full-time positions at the Engineering Career Fair in September. More than 1,800 UH engineering students attended the fair, many of whom conducted or scheduled interviews with company recruiters. This year’s fair attracted sponsorships and recruiters from LyondellBasell, Shell, Schlumberger, ExxonMobil, P&G, Daikin, Ineos, Sulzer, Oxy, Phillips 66, Enterprise Products and many more top companies.
UH Engineering kicked off the Offshore Technology Conference at the 31st annual UH Offshore Industry Crawfish Boil held on Sunday, May 5. Alumni, faculty, students and industry leaders gathered to network and mingle as they enjoyed crawfish, barbecue and live music.

The Engineering Alumni Association (EAA) held its annual meeting on Aug. 22 at Saint Arnold’s Brewery. This event furthers the EAA’s mission of championing, supporting and uniting the Cullen College’s students, faculty and alumni.

Attendees enjoyed free craft beer, tacos, raffle prizes and updates about the Cullen College throughout the evening.
To learn more about events and outreach at the Cullen College, visit www.egr.uh.edu/events or follow us on social media!

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17 NSF CAREER AWARDS

ENGINEERING EXCELLENCE

Since 1941