PARAMETERS

Cullen College of Engineering Magazine • Fall 2021

DIVERSITY
PROGRESS
ACADEMICS
INNOVATION
SUCCESS
PRESTIGE
VISION
RESEARCH

CELEBRATING 80 YEARS OF ENGINEERING

UNIVERSITY of HOUSTON ENGINEERING
CELEBRATING 80 YEARS

LEADERSHIP
STRATEGY
SERVICE
FUTURISM
OF THE CULLEN COLLEGE
INGENUITY
PASSION
INCLUSIVENESS
Where do we come from, and where are we going? Both of these questions are ones that we rarely stop and ask ourselves, but they are nonetheless important ones worth meditating on. I often laud our momentum and upward trajectory, but the weight that these statements carry is largely arbitrary. We can’t truly appreciate what we’ve accomplished unless we measure it against the starting point.

The Cullen College of Engineering has transformed tremendously over the years. Since its founding in 1941, the college has grown from a humble 400 students to more than 4,000. Our facilities have expanded to cover one of the largest footprints on the UH campus. We’ve embarked on exciting new ventures locally with Houston Community College, and now internationally, with our most recent partnership with Dalian Maritime University in China. And perhaps, one of my greatest points of pride, is the enormous strides we have made with regard to diversity, equity and inclusiveness. The Cullen College of Engineering is now recognized as one of the most diverse institutions in the nation, according to the American Society for Engineering Education (ASEE).

Looking back through my last 13 years as Dean, our list of accomplishments is quite remarkable, especially when you consider all of the challenges we’ve had to overcome. In the last decade alone, our ranking has increased from no. 81 to 66 on U.S. News and World Report’s engineering graduate programs listings. Shifting perception is not easily done — it takes a great deal of time and resources to build a long-lasting reputation, but nonetheless we have defied the odds and made great progress in these efforts. Now that we have cracked into the mid-60s, reaching our goal of becoming a Top 50 institution is beginning to come into view. We have many exciting new initiatives in the works to help propel us forward in this mission, and I look forward to sharing these plans with you all in the coming months. Together, we will continue to take the Cullen College to new heights.

But for now, I would like to commemorate what has made us so great — our students, faculty, alumni and administration. In this special issue of Parameters, we celebrate our 80 years of history, featuring stories from Cougar alumni, professors and students. We also reflect on the strategic moves we have made to propel our reputation over the last decade and discuss goals for the future. I hope you enjoy reading through these stories celebrating our past, present and future. Cheers to another 80 years and beyond of excellence in research, innovation, entrepreneurship, student success and more!

Warm regards,

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

Cullen College Ranks in Top 12 for Two Diversity Metrics

The University of Houston’s Cullen College of Engineering is in the Top 15 for several metrics measuring diversity in the field of engineering, including a pair of no. 12 rankings for degrees awarded to Hispanic students and underrepresented minorities, the former of which was highlighted by a graph in the May 2021 issue of Connections from the American Society for Engineering Education.


According to that report, UH is 12th in Bachelor’s degrees awarded to Hispanic students, with 257. The university was also 12th overall in Bachelor’s degrees awarded to underrepresented minorities, with 315.
The Department of Engineering forms in 1934.

By 1939, engineering is one of the most popular departments at the University.

In 1941, the Department is established as its own College.

During this time, 397 students took classes in the new air-cooled Roy Gustav Cullen Memorial Building.

Over the next several years, engineering students account for \( \frac{1}{7} \) of University enrollment numbers.

In 1947, the co-op program is established to help students gain practical experience and supplement their studies. This program still exists today.

In 1967, the College is renamed to the Cullen College of Engineering, named after Mr. and Mrs. H.R. Cullen, the principal benefactors of the University of Houston.

In 1968, a building dedication ceremony is held for the brand new Cullen College of Engineering Building (now known as Building 1) on May 3. At the ceremony, a framed portrait of H.R. Cullen was unveiled on the first floor of the building, where it still hangs today.

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CAMPUS THEN & NOW

The Closed-Stream, Uniform Wind Tunnel Laboratory

Originally built in the mid 1960s by engineering students at the Cullen College, the wind tunnel was enclosed at its current home in the mechanical engineering department in the late 80s.

The tunnel is used to give a hands-on teaching experience, showing students first-hand how pressure distribution works. Student groups still use the tunnel today to test their prototypes and learn how their designs will hold up under wind conditions of up to 170 mph.

Cullen College of Engineering Building

The Cullen College of Engineering Building was built and dedicated in 1968, named for Hugh Roy and Lillie Cranz Cullen, principal benefactors of the University of Houston. Now known as Engineering Building 1 to most, many of the original labs and teaching spaces are still in use today.

The Cullen College is now housed across multiple buildings on campus, including but not limited to Engineering Building 2, the Science and Engineering Research Center, the Agrawal Research Building and the new instructional facility at UH at Katy.

The Pit

The first floor lobby area of Engineering Building 1, known to many as “the pit,” has always been a hub of activity for the Cullen College community.

To this day, students still gather in the pit to study and catch up between classes. The pit has also been home to many events, including the College’s Accepted Student Welcome Events, alumni-focused receptions and tailgate parties.

Keeping Up With The Times

Since its construction in the late 60s, many things in Building 1 have remained the same, but others have changed, including named laboratories and the addition of ladies restrooms. Many individuals credit the late Betty Barr, one of the College’s first female and most beloved faculty, for that upgrade.

ENGINEERING SNAPSHOTS

U.S. NEWS & WORLD REPORT
Ranking Data Through the Years:

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The Cullen College of Engineering’s official magazine, PARAMETERS, has evolved a great deal over the years. Its inaugural issue launched in September 1977, and was originally conceived as a shorter, more frequent publication to get alumni involved in the college.

Through the decades, it has undergone multiple makeovers and face lifts, shifted priorities and tactics, and has even won some awards along the way.

On the left is a look at some of Parameters’ most notable issues throughout the years.

**Behind the Scenes:**

Parameters is produced by the Cullen College’s in-house Communications team. Led by the College’s Associate Dean of Administration and Executive Director of Communications, in addition to the magazine, the team also creates and manages all sorts of marketing and communications collateral. Projects include but are not limited to the College’s extensive network of websites, promotional videos, direct mail pieces, news articles and most recently, virtual events. Many of these have won the department numerous awards from the American Marketing Association, Public Relations Society of America and others, including two recent awards for Parameters magazine:

- **American Marketing Association, Houston Chapter, Crystal Award** Best Newsletter (2016)
- **Public Relations Society of America, Houston Chapter, Excalibur Award** (Silver Distinction) Best Magazine (2020)

Read previous editions of PARAMETERS magazine online at: [www.egr.uh.edu/communications/publications](http://www.egr.uh.edu/communications/publications)
IN THE MEDIA SPOTLIGHT

INNOVATIONMAP SPOTLIGHTS NEW CAREER AWARD FACULTY MEMBER

Houston’s InnovationMap recently spotlighted Mehmet Orman, an assistant professor of chemical and biomolecular engineering, as a Houston area researcher who is revolutionizing health science innovation, in response to his recent Faculty Early Career Development Award from the National Science Foundation. Orman will use the award and grant money to study persister cells – those that go dormant and gain tolerance to extraordinary levels of antibiotics.

READ ARTICLE ONLINE AT: www.houston.innovationmap.com

BIOENGINEER.COM FEATURES NEW, AQUEOUS BATTERY RESEARCH

Bioengineer.com featured research earlier this year conducted by Xiaonan Shan, an assistant professor of electrical and computer engineering. Shan was the co-corresponding author of a paper recently published in Nature Communications, focused on the development of zinc-based aqueous batteries. The reported findings indicated that stable, high-performance, dendrite-free aqueous batteries can be created using a new 3D zinc-manganese nano-alloy anode and seawater as the electrolyte, which could greatly impact many applications, including energy storage and electric vehicles.

READ ARTICLE ONLINE AT: www.nature.com

HOUSTON CHRONICLE REVIEWS ‘COLOR FIELD’ BRAIN-ON-ART EVENT

After a long hiatus, the University of Houston Brain-Machine Interface Systems Team (UH BMIST), led by Jose Luis Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen Distinguished Professor and director of the NSF IUCRC BRAIN Center, began hosting its iconic interactive brain-on-art demonstrations last spring. The Houston Chronicle attended one such event, wherein students recorded their brain waves while interacting with UH’s public art installation, “Color Field.”

READ ARTICLE ONLINE AT: www.houstonchronicle.com

NATURE.COM HIGHLIGHTS POST-DOCTORAL FELLOW’S AI RESEARCH

Nature.com published an article featuring Rupali Mankar, a post-doctoral fellow in UH’s electrical and computer engineering department, for contributions to a project focused on how machine learning can serve to restore and reduce noise in micrographs. Listed as a “Technology Feature,” the full article, “Sharper signals: how machine learning is cleaning up microscopy images” can be read online.

READ ARTICLE ONLINE AT: www.nature.com

PHYSICSWORLD.COM SHOWCASES PROFESSOR’S RESEARCH ON NANOPARTICLES

PhysicsWorld.com covered research conducted by Wei-Chuan Shih, professor of electrical and computer engineering, in an article titled, “Tiny particles get the panoramic treatment.” The article details new technology, known as PANORAMA, developed by Shih, that identifies the make-up of nanoparticles as small as 25 nanometers in diameter.

READ ARTICLE ONLINE AT: www.physicsworld.com

ENGINEERING SNAPSHOTS
Mountziaris Joins UH as William A. Brookshire Department of Chemical and Biomolecular Engineering Chairman

BY STEPHEN GREENWELL

The University of Houston’s Cullen College of Engineering welcomed Triantafillos “Lakis” J. Mountziaris earlier this year as the new department chair of the William A. Brookshire Department of Chemical and Biomolecular Engineering.

Mountziaris officially started at the university in January. Before joining UH, Mountziaris was at the University of Massachusetts-Amherst as a professor. Prior to that, he served for four years as the Process Systems, Reaction Engineering and Molecular Therodynamics Program Director at the National Science Foundation. For eight years, from June 2007 through November 2015, Mountziaris was the director of the UMass NanoMedicine Institute, a multi-campus research center.

Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering, highlighted the impressive academic and research credentials Mountziaris has.

“Dr. Mountziaris brings a wealth of experience and knowledge to our college,” Tedesco said. “I expect great things from his forthcoming leadership of the William A. Brookshire Department of Chemical and Biomolecular Engineering, including the expansion of our research enterprise, the growth of our graduate programs, and much more. His expertise in research and academia makes him an ideal candidate for the continued leadership of one of our top performing departments.”

Mountziaris has more than 30 years of experience as a professor between UMass-Amherst and the State University of New York at Buffalo. He has also overseen and supported 24 doctoral advisees, and received authorship credit for more than 80 research papers. He has also edited two books, received three U.S. patents and has been awarded grants totaling more than $18 million for his research work.

In addition to his experience as a professor and researcher, he has been honored by a variety of organizations for his work. Most recently, he served as the chairman in 2018 and 2019 of the Congressional Review Committee that evaluated the status of the U.S. Department of Energy’s Solid Oxide Fuel Cell Program. Mountziaris has been a guest lecturer for a variety of higher learning institutions and prestigious organizations – Princeton, the Institute of Chemical Engineering Sciences in Greece, Northeastern University, the American Institute of Chemical Engineers, and at the Ninth World Congress of Chemical Engineering in South Korea, to name a few.

Mountziaris is a fellow of the American Institute of Chemical Engineers. He is also a member of the American Chemical Society, the American Association for the Advancement of Science, the American Society for Engineering Education, the Electrochemical Society and the Materials Research Society.

Mountziaris earned his doctorate in chemical engineering from Princeton University in 1989. He received his M.A. in chemical engineering from Princeton in 1986, and his undergraduate diploma in 1982 from Aristotle University in Thessaloniki, Greece. From 1987 to 1989, he served as a postdoctoral fellow in the Department of Chemical Engineering and Materials Science at the University of Minnesota in Minneapolis.

LEARN MORE ABOUT DR. MOUNTZIARIS AT: www.egr.uh.edu/news

Mountziaris has overseen and supported 24 doctoral advisees, and received authorship credit for more than 80 research papers. He has also edited two books and received three U.S. patents. Additionally, he has received grants totaling more than $18 million for his research work.

LEARN MORE ABOUT
DR. MOUNTZIARIS AT:
www.egr.uh.edu/news
Roberto Ballarini, Ph.D., Thomas and Laura Hsu Professor and Chairman of the Department of Civil & Environmental Engineering, is excited about his new role as Director of the University of Houston-Dalian Maritime University Institute (UH-DMU). Through the Institute, the Cullen College of Engineering offers undergraduate degrees in mechanical, civil, and electrical engineering in partnership with Dalian Maritime University (DMU). Students who have enrolled in the Institute can either fulfill all their degree requirements at Dalian, or spend their junior and/or senior years in Houston. Ballarini is very enthusiastic about the potential benefits of this partnership.

“The first cohort is comprised of 175 students who just completed their freshman year. But the plan is that when we reach steady state, there will be 1,200 students enrolled,” he said. “As a reference, that’s approximately a 30 percent addition to the undergraduate enrollment in the Cullen College of Engineering.”

As part of the agreement, all courses are taught in English; one third of which will be taught by UH faculty and two thirds by DMU faculty. Students will officially be co-enrolled at UH, and will therefore be provided opportunities such as design competitions, undergraduate research, participation in student chapters of their respective professional societies and more.

Ballarini noted that the initial discussions that led to the Institute began in 2017, when UH was approached by the President of DMU and his leadership team. While DMU has created partnerships around the globe with other universities, the Cullen College is the only engineering program that DMU has partnered with. DMU cites this decision being due to UH’s excellent reputation in teaching and research, and its presence in Houston’s vibrant engineering and business economy. Ballarini views the exclusive partnership as an honor.

Ballarini stated that there were several reasons why UH decided to work with DMU. “The partnership allows the Cullen College to export the paradigms of education that we created, and greatly increase our impact on the education of future generations of engineers. In fact, numerous universities, not only in China, but around the world, are looking to incorporate best practices from American engineering colleges, so they can improve their own educational programs.” In addition to the dissemination of teaching methods, Ballarini believes that “international cooperation through research and education is very valuable to the global community because it fosters friendship, cooperation and synergy.” Such activities are especially important during these turbulent times. “I very much like the faculty and staff at DMU. They have a good spirit, they really appreciate us, and we appreciate them. I very much enjoy interacting with them,” he explained.

Ballarini has visited Dalian on numerous occasions, and was impressed with the beauty of the city and its coastline, stating that the people of China have made and continue to make major investments in education and research. He noted that when he first visited in 2017, DMU had one huge library, but that since that visit, it has built two more, just one example of the university’s burgeoning expansion projects.

Delivering three degrees on a foreign campus presents significant challenges, including the recruitment of faculty and lecturers to teach in China. “We are currently teaching our share of courses online because of the global pandemic. But soon enough we will send our faculty to teach on the DMU campus. There are other challenges, but I am confident that the Institute will thrive. I’m always looking for new challenges,” Ballarini said.
The stature of the Cullen College of Engineering increased again, improving its ranking by one in the latest edition of U.S. News & World Report, up to the No. 66 rated graduate engineering program in the country.

The College has improved steadily over the past decade. In 2011, the College was ranked No. 78. By 2018, it was up to No. 69. Last year, the school was No. 67.

“The continued recognition of the Cullen College of Engineering in rankings like U.S. News & World Report is a sign of the hard work of the staff and faculty to provide a productive learning environment for students,” said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UCLA Cullen College. “I am proud to oversee the continued growth and refinement of our college’s offerings.”

The Cullen College of Engineering’s Petroleum Engineering Department is also new to the list of the nation’s top 10 in its field, as it improved from No. 11 to No. 8, Mohamed Soliman, the William C. Miller Chairman for Petroleum Engineering, is pleased about the progress it has made since being established as an independent department in 2016.

“Achieving this milestone is due to the hard work of everyone in the department — faculty, staff and students,” Soliman said. “Our faculty are producing top research and attracting funding from industry, both national and international companies, and national organizations. Our students and student organizations are very active, winning many awards, organizing activities with industry and getting involved with national labs. Our staff is doing a superb job supporting these activities.”

The biggest individual jump by a department was Biomedical Engineering, from No. 86 to No. 70. The rankings for the other departments at the Cullen College of Engineering are:

- **Chemical and Biomolecular Engineering:** 33
- **Civil Engineering:** 65
- **Electrical Engineering:** 77
- **Environmental Engineering:** 65
- **Industrial Engineering:** 54
- **Materials Engineering:** 83
- **Mechanical Engineering:** 83

As of Fall 2020, the Cullen College of Engineering had about 3,200 undergraduate students enrolled, as well as 499 students pursuing master’s degrees and 190 doctoral students. Degrees are offered in biomedical, chemical, civil, computer, electrical, environmental, geosensing systems, industrial, mechanical and petroleum engineering. The college also offers interdisciplinary graduate programs in subsurface, aerospace, space architecture, materials and computer and systems engineering.

The University of Houston received a $4.5 million gift from the Thomas Michael Panos Family Estate to establish an endowed chair in the Cullen College of Engineering, a scholarship endowment available to students throughout the University, and an endowed lecture series focused on equity and social justice, which will reside in the College of Liberal Arts and Social Sciences. An additional $2 million has been matched by the University’s new “$100 Million Challenge” Aspire Fund. This is the first matched gift since the fund was established, making the total impact of the Panos Family Estate gift at least $6.5 million.

### Panos Gift Breakdown:

- **$2 million** creates the Panos Family Endowed Chair in Mechanical Engineering. The gift was matched one-to-one by the “$100 Million Challenge,” doubling the impact. A search is under way for the endowed chair who will be a faculty member in the Department of Mechanical Engineering in the Cullen College of Engineering, with a focus in the area of sustainable energy and energy security.

- **$3 million** establishes a scholarship endowment to support need and merit-based scholarships for full-time undergraduate or graduate students across the University. UH is currently accepting applications for the scholarship in the 2022 academic year.

Donors who commit $2 million to establish a new endowed chair will have their gifts matched by the anonymous donor, doubling the investment to create a $4 million endowed chair. Similarly, $1 million gifts for new endowed professorships will be matched to create $2 million endowed professorships.

By Stephen Greenwell
Larry and Gerri Snider
Gift $1M for
FIRST Industrial Engineering Endowed Chair

BY CHRIS STIPES

University of Houston alumnus Larry Snider achieved great success throughout his career as an engineer, leading companies and optimizing systems around the world. Now enjoying retirement, the Sniders’ legacy will live on for generations with a $1 million gift to the Cullen College of Engineering to establish the R. Larry and Gerlene (Gerri) R. Snider Endowed Chair in Industrial Engineering – the first fully funded endowed chair in the department’s history.

The Industrial Engineering program offers excellent educational training to approximately 300 undergraduate and graduate students interested in careers that apply mathematics to improving systems around the world. Now enjoying retirement, the Sniders have been passionate supporters of the University and steadfast proponents of hard working students, currently funding three scholarship awards at the Cullen College, one for Native Americans, in honor of Larry’s membership in the Cherokee Nation, and two scholarships for women in honor of their daughters Melody Kathryn and Rebecca Lee.

Larry’s distinguished career took him and his family to many major cities in the United States and around the world. His career began at Sheffield Steel & Kaiser Steel where he held senior engineering positions and later joined Basso Allen Hamilton as a consultant, before progressing to vice president in charge of the Production Inventory Control Division. Larry then joined Peat Marwick Mitchell as Houston partner in charge of commercial consulting before leaving to become president/COO of Sterling Electronics. Snider worked as the president/CEO of RAPACO Energy, establishing it as an active coal mining company. Upon the sale of the company, Larry returned to his first love of consulting as managing consulting partner for Coopers Lybrand in the southwest region, the position from which he retired. Larry established RLS Professional Services LLC to continue consulting for companies he had previously served.

“We are very pleased to donate some of the financial resources God has provided us to create the endowed chair in Industrial Engineering since my degree in process engineering from the Cullen College Industrial Engineering Department provided me a very solid foundation for my career and our successful lives,” said Larry. “We pray this donation significantly enhances Industrial Engineering’s success in training future engineering leaders and makes a great impact on the world.”

Beginning March 1, 2022, the chair of the UH Department of Industrial Engineering, currently Gino Lim, will be appointed and known as the R. Larry and Gerlene (Gerri) R. Snider Endowed Chair in Industrial Engineering. Joseph Tedesco, dean of the Cullen College of Engineering, called the gift a “significant milestone” for the department.

“This is the first ever fully funded endowed chair for the Department of Industrial Engineering and to have such distinguished supporters continue to give back to the University is truly special. This gift will enable the program to grow to meet the evolving needs of industry. We are grateful for the Sniders’ incredible support,” said Tedesco.

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Larry has been the department chair since 2011, and calls industrial engineers the “most flexible” engineers on the planet because of their ability to collaborate across a wide range of sectors to find solutions. From writing algorithms to improve the efficiency of health care systems to working with municipalities to achieve faster recovery times from hurricanes and blackouts, IE professionals are problem solvers.

“We utilize data and applied mathematics to integrate machines with humans that ultimately enhance the quality of products and services. Through the Sniders’ gift, our ability to prepare students for future societal global challenges has been strengthened, and to that we say ‘thank you.’”

In 2015, the Sniders established a $4.2 million testamentary charitable gift annuity supporting the future success of the UH Cullen College of Engineering. Their latest gift enables the University to invest the funds to produce interest income while leaving the endowment’s principal untouched, thus ensuring sustainable financial support.

“The Sniders have elevated the Industrial Engineering department with their thoughtful and generous support,” said Eloise Brice, vice president for university advancement. “This gift ensures we can continue to retain the talent needed to advance the University and achieve our goal of becoming a Top 50 public university.”

Larry served as the UH Alumni Association President from 1990-1991, received the UH Engineering Alumni Association’s Distinguished Engineering Alumni Award in 1991 and the Lifetime Achievement Award in 2013. He and Gerri are also members of the Cullen College Bridgebuilder Society. LARRY AND GERRI SNIDER

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The University of Houston's Cullen College of Engineering and Houston Community College reached an agreement earlier this year to offer UH Engineering Academy courses at the HCC Felix Fraga Academic Campus on the east side of Houston on Navigation Boulevard.

The agreement established a co-enrollment program – the University of Houston Engineering Academy at Houston Community College Felix Fraga Campus – for students who will attend both institutions simultaneously. The program guarantees admission to the Cullen College for students who successfully complete the program requirements. In addition, the program provides an opportunity for both parties to work collaboratively to enhance the number of associate degrees awarded by HCC and baccalaureate degrees from the Cullen College of Engineering.

For UH, the program was approved by Joseph Tedesco, Ph.D., the Elizabeth D. Rockwell Dean of Engineering, and Paula Myrick Short, Ph.D., UH senior vice president for academic affairs and provost. The agreement was signed on the HCC side by Norma Perez, Ph.D., the Vice Chancellor of Instructional Services and Chief Academic Officer, and Melissa N. Gonzalez, Ph.D, the President of HCC-Southeast.

Tedesco identified the partnership as another way for the University of Houston to provide the engineering talent needed in today's world.

"We will always try to expand our opportunities to provide a strong engineering program to as many people as we can," he said. "Partnering with Houston Community College will strengthen enrollment and provide options for both institutions."

HCC Chancellor Cesar Maldonado, Ph.D., P.E., praised the partnership agreement.

"As an engineer, I must say that this dynamic partnership is truly near and dear to my heart. It signals a very important day for Houston Community College and the University of Houston," he said. "Our students working within this jointly planned curriculum will have a huge advantage in being well prepared to meet the stringent academic and practical challenges of earning their bachelor's degree. I could not be more excited for them, for HCC and UH."

"This is a great opportunity for the Cullen College of Engineering to further collaborate with HCC and maximize the success of students pursuing an engineering degree by creating a seamless education experience between the two institutions," Short said. "As the second UH/HCC Engineering Academy, both institutions will continue to increase the number of UH baccalaureate degrees and associate degrees awarded by HCC."

Jagannatha "J.R." Rao, the Associate Dean of Undergraduate Programs and Distance Learning, said there were multiple benefits to the agreement for the Cullen College of Engineering.

"This makes our 4-year engineering degrees accessible to more underserved and financially constrained students," he said. "There are also advantages for students – much smaller class sizes, intense advising from the UH and HCC team of advisers, a much lower cost for the first two years of education, and they can stay and study closer to home. Students can take advantage and transition to UH Engineering, even if they are not admitted to the Cullen College of Engineering as an incoming freshman."

Rao added that the agreement also had logistical benefits for UH.

"An additional big positive bonus is that our mechanical engineering program will benefit by having some new space for design education and projects," he said. "HCC has agreed to graciously give us space in their new STEM building."

The agreement runs for five years, beginning earlier this year on June 1, through Aug. 31, 2026. Engineering courses offered by the academy will only be taught by Cullen College faculty, but the agreement also encourages faculty from both schools to meet and share expertise about courses for professional development purposes. An Oversight and Coordination Committee, and a Steering Committee, consisting of individuals from UH and HCC, will also be established.

This is the second Engineering Academy established between HCC and UH. The first was created in Katy in 2020.
FOUR ADDITIONAL FACULTY MEMBERS
AWARDED PRESTIGIOUS

2021 FACULTY EARLY CAREER DEVELOPMENT (CAREER) AWARDS
FROM THE NATIONAL SCIENCE FOUNDATION

MEHMET ORMAN
Why Antibiotic-Resistant Cells Persist
BY LAURIE FICKMAN

Mehmet Orman, assistant professor of chemical and biomolecular engineering at the University of Houston Cullen College of Engineering, received a Faculty Early Career Development (CAREER) Award from the National Science Foundation earlier this year.

The CAREER award will provide Orman with $500,000 to study so-called persister cells - those that go dormant and then become tolerant to extraordinary levels of antibiotics. Antibiotic tolerance is one of the most critical global public health threats of the 21st century.

"Nearly all bacterial cultures contain a small population of persister cells," Orman said. "Persisters are thought to be responsible for recurring chronic infections such as those of the urinary tract and for creating drug-resistant mutants." Biofilms, a slimy buildup of bacteria (like dental plaque) cause most bacterial infections, and persister cells, produced in biofilms, might cause these buildups to be multidrug tolerant, too.

Orman’s goal is to figure out just what makes these persister cells tick, and to identify common mechanisms they exhibit from a variety of bacterial strains. Interestingly, persister cells go in and out of their state of hibernation, and Orman will take a close look at that.

"Persistor cell survival is marked by growth inhibition during antibiotic treatment and resumption of growth upon removal of antibiotics. Persisters are generally assumed to be dormant cells with a depressed metabolism," Orman said. In contrast, his hypothesis driving this project is that persisters have active but unique metabolic mechanisms that regulate the reversible switching and maintenance of these cells. As part of the project, Orman will also develop outreach programs and materials to reach underrepresented youth in fourth through eighth grades.

For Orman, the name of the cell fits well with his resolute persistence in studying them. Previously he developed the first methods to directly measure the metabolism of persister cells. He also developed cell sorting strategies to segregate persisters from highly heterogeneous bacterial cell populations. He will be using his methods in the NSF research project.

"The results will challenge paradigms regarding persister cell dormancy and metabolism, shed light on persister cell resuscitation mechanisms, provide platforms for studying the metabolic heterogeneity of persister cell subpopulations during and after antibiotic treatment, and integrate multiple lines of evidence to enhance our understanding of the eco-evolutionary aspects of bacterial persistence," Orman said.

KYUNG JAE LEE
Examining New Sources of Lithium
BY LAURIE FICKMAN

As the energy transition motors on to reduce the use of fossil fuels, the need for lithium has grown exponentially over the past decade because lithium-ion energy storage (i.e., lithium-ion batteries) powers both electric vehicles and renewable solar and wind electricity generation.

Kyung Jae Lee, assistant professor of petroleum engineering at the University of Houston, has received a Faculty Early Career Development (CAREER) Award from the National Science Foundation for $508,722 to contribute to the enhancement and diversification of the domestic supply of lithium for sustainable and renewable energy storage. Lee will examine lithium-rich rocks that contain oil and natural gas, like shale, to identify how they could be a valuable source of lithium.

NSF CAREER AWARDS ARE GRANTED TO HIGHLY PROMISING JUNIOR FACULTY MEMBERS WHO EXEMPLIFY THE ROLE OF TEACHER-SCHOLARS THROUGH
"Outstanding research, excellent education and the integration of education and research."
Recyclable Thermoset Polymers Research

SHAIJENDRA JOSHI

a new source of lithium-rich brines in petroleum source rocks for sustainable energy storage. “While water produced from organic-rich petro- 
leum and natural gas source rocks has been considered wastewater, it has been recently revealed as a potential source of substantial amounts of lithium. This opens new pathways to address the entire petroleum system and lithium in the upstream supply chain, thus laying the foundation for converting a source of oil and gas into a sustainable source of lithium.”

Despite the urgent need to meet the demand for lithium as an enabling material for sustainable energy storage technology for energy transition, the U.S. has limited domestic production of lithium in source rock brines, thus laying the foundation for converting a source of oil and gas into a sustainable source of lithium.”

He added, “The scientific challenge is rooted in unraveling the damage processes associated with the statistics of microscale defect structures resulting from the coupling between the chemistry and the mechanics of the vitrimers. Its technological relevance is rooted in the need for a predictive modeling and simulation framework to enable damage-tolerant vitrimers for structural applications.”

“I was happy, elated and humbled,” he said of receiving the award. “There is a long list of people who have helped shape my academic path, including my mentors. I particularly appreciate the support of Professor Pradeep Sharma, the Mechanical Engineering Department Chair, who made my transition to the U.S. three years ago comfortable, and my department colleagues, for a stimulating and collegial en- 
vironment. My family has been a strong posi- 
tive force all along, but most critically during the past three years here in Houston, as I pretty much reset my academic career.”

Joshi described the research that the CAREER award would enable the design and development of recyclable structural plastics, which could facilitate better new membrane separation processes for applications like purifying drinking water, recycling wastewater from the U.S. Army Research Lab through the Materials in Ex- treme Dynamic Environments (MEDE) Program.

“I am broadly interested in failure of materi- als,” he said. “Our current research focuses on understanding the mechanics of damage in advanced metallic materials, such as magnesium alloys, which are perhaps the lightest structural metals, nearly 60 percent lighter than alumi- num for the same material volume, using com- putational approaches.”

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He noted, “The research program is integrated into a broader educational goal of creating an immersive learning experience for underrep- resented student groups, including students with disabilities, an integration of granular art in education grades K-12, and development of a graduate course on the microstructure-sensi- tive failure of materials.”

DEVIN SHAFFER

Better filtration methods via new porous materials

BY STEPHEN GREENWELL

Devin L. Shaffer, Ph.D., an Assistant Professor in the Civil and Environmental Engineering Depart- ment, is the latest member of the faculty to receive a National Science Foundation CAREER award. Shaffer received $538,686 in funding for his proposal, “Two-Dimensional Covalent Organic Framework (2D COF) Membranes: A New Plat- form for Liquid Separations,” which will run through June 2026.

“I was excited to receive the news from NSF about funding for my CAREER proposal, and I am very grateful for five years of support for graduate student researchers,” he said. “I’m ea- ger to pursue this research in covalent organic frameworks, which are new materi- als that can efficiently separate complex liquids. I’m also looking forward to partnering with the teachHOUSTON program at UT to engage un- dergraduate pre-service STEM teachers in the research.”

Shaffer earned his doctorate from Yale in 2016. He was hired by the Cullen College of Engineer- ing in 2018, after his work as a postdoctoral fel- low in 2016 and 2017 in the Materials Science and Engineering Division at the National Insti- tute of Standards and Technology in Gaithers- burg, Maryland.

Before beginning at Yale, he worked as a pro- fessional engineer for Carollo Engineers, Inc., in Phoenix. He earned his Master’s in Environ- mental Engineering from MIT in 2003, and his B.S. in Civil Engineering from Oklahoma State in 2002.

Shaffer’s research could lead to better filtration methods via new porous materials.

“My research is focused on membrane separa- tions for liquids,” he said. “In the lab, we design and fabricate better polymeric membranes and test membrane separation processes for applications like purifying drinking water, recycling wastewater from the U.S. Army Research Lab through the Materials in Extreme Dynamic Environments (MEDE) Program.”

He was hired by the Cullen College of Engineer- ing in 2018, after his work as a postdoctoral fel- low in 2016 and 2017 in the Materials Science and Engineering Division at the National Insti- tute of Standards and Technology in Gaithers- burg, Maryland.

The financial support provided by Shaffer’s award will allow him to substantially expand his research, as well as grow the head count of his lab.

“The CAREER award will support two Ph.D. students and will involve eight undergraduate pre-service teachers in semester-long research projects,” he said. “The award will also enable a partnership with Dr. Mariam Manuel of the teachHOUSTON program for the pre-service teacher development.”

“I’ve really appreciated the support and en- couragement of my colleagues in the Civil and Environmental Engineering Department and the Cullen College of Engineering in my re- search and in pursuit of this CAREER award,” he added.  
The “Color Field” public art exhibition at the University of Houston has attracted art enthusiasts from all over since it launched last fall, but engineering doctoral student Alex Craik took a more scientific interest in the bright, large-scale sculptures. Wearing a brain imaging device that tracks eye blinks, head movements and footsteps – feeding the data in real-time to handheld tablets – he was there to investigate how his brain responds to art.

“I like space in art. So, I really enjoyed TYPOE’s ‘Forms from Life’ because of its open nature which allowed us to explore the pieces from different vantage points.”

Craik was among nine students from professor Jose Luis Contreras-Vidal’s neurohumanities class last spring to take a high-tech tour through the exhibition’s mile-long path across campus. Studies have shown that humans react both physiologically and psychologically to color, stimulating various emotions and hormonal activity. The experiment with Public Art of the University of Houston System – merging the visual arts and brain science – makes perfect sense.

“Color Field” tour ended, Ravindran told the group Sarah Braman’s piece “Here” was his favorite.

“Interestingly, looking at the brain data, I found that this piece elicited the highest value of alpha asymmetry, which is a measure of creative engagement. Also, my blink rate was significantly higher – which could suggest an increased level of dopamine activity, but more analysis needs to be done to discover what the data shows,” explained Ravindran, who one day hopes to develop technology that measures attention spans of individuals with disabilities.

For now, he and his fellow classmates will continue to interpret various frequencies from their headset data to better understand how they match to specific experiences and art exhibits.

Much like the art itself, it is hands-on learning with endless possibilities.
Discoveries Highlight

New Possibilities for Magnesium Batteries

BY JEANNIE KEVER

Magnesium batteries have long been consid-
ered a potentially safer and less expensive al-
ternative to lithium-ion batteries, but previous
versions have been severely limited in the pow-
er they delivered.

Researchers from the University of Hous-
ton and the Toyota Research Institute of North America (TRINA) reported in Nature
Energy that they have developed a new
cathode and electrolyte — previously the
limiting factors for a high-energy mag-
nesium battery — to demonstrate a mag-
nesium battery capable of operating at
room temperature and delivering a power
density comparable to that offered by lith-
ium-ion batteries.

As the need for grid-scale energy storage
and other applications becomes more pressing, re-
searchers have sought less expensive and more
readily available alternatives to lithium.

Magnesium ions hold twice the charge of lithi-
um, while having a similar ionic radius. As a re-
sult, magnesium dissociation from electrolytes
and its diffusion in the electrode, two essential
processes that take place in classical intercala-
tion cathodes, are sluggish at room temperature,
leading to the low power performance.

One approach to addressing these challenges is
to improve the chemical reactions at elevated
 temperatures. The other circumvents the diffi-
culties by storing magnesium cation in its com-
pex forms. Neither approach is practical.

Yan Yao, Cullen Professor of Electrical and Com-
puter Engineering at the University of Houston
and co-corresponding author for the paper, said
the groundbreaking results came from combin-
ing both an organic quinone cathode and a new
 tailored boron cluster-based electrolyte solution.

“We demonstrated a heterogeneous enoliza-
tion redox chemistry to create a cathode which
is not hampered by the ionic dissociation and
solid-state diffusion challenges that have pre-
vented magnesium batteries from operating
efficiently at room temperature,” Yao said. “This
new class of redox chemistry bypasses the need
of solid-state intercalation while solely storing
magnesium, instead of its complex forms, creat-
ing a new paradigm in magnesium battery elec-
trode design.”

Yao, who is also a principal investigator with
the Texas Center for Superconductivity at UH
(TcSUH), is a leader in the development of mul-
tivalent metal-ion batteries. His group recently
published a review article in Nature Energy on
the roadmap to better multivalent batteries.

TRINA researchers have made tremendous ad-
vancements in the magnesium battery field,
including developing highly recognized, effi-
cient electrolytes based on boron cluster anions.
However, these electrolytes had limitations in
supporting high battery cycling rates.

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“Tutusaus said the work suggests the next steps
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“Our results set the direction for developing
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The work is in part a continuation of earlier
efforts described in 2018 in Joule and involves
many of the same researchers. In addition to
Yao and Mohtadi, coauthors include first authors
Hui Dong, formerly a member of Yao’s lab and
now a post-doctoral researcher at the University
of Texas at Austin, and Oscar Tutusaus of TRINA;
Yanliang Liang and Ye Zhang of UH and TcSUH;
and Zachary Lebens-Higgins and Wanli Yang of
the Lawrence Berkeley National Laboratory. Leb-
ens-Higgins also is affiliated with the Bingham-
ton University.

“The new battery is nearly two orders of magni-
tude higher than the power density achieved by
previous magnesium batteries,” Dong said. “The
battery was able to continue operating for over
200 cycles with around 82% capacity retention,
showing high stability. We can further improve
cycling stability by tailoring the properties of the
membrane with enhanced intermediate trap-
ing capability.”

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Read Review Article:
Current status and future directions of multivalent metal-ion batteries

NATURE ENERGY: www.nature.com/articles
A Safer, Less Expensive and Fast Charging Aqueous Battery

BY JEANNE KEVER

Lithium-ion batteries are critical for modern life, from powering our laptops and cell phones to those new holiday toys. But there is a safety risk – the batteries can catch fire.

Zinc-based aqueous batteries avoid the fire hazard by using a water-based electrolyte instead of the conventional chemical solvent. However, uncontrolled dendrite growth limits their ability to provide the high performance and long life needed for practical applications.

Researchers reported in Nature Communications that a new 3D zinc-manganese nano-alloy anode has overcome the limitations, resulting in a stable, high-performance, dendrite-free aqueous battery using seawater as the electrolyte.

Xianxian Shan, co-corresponding author for the work and an assistant professor of electrical and computer engineering at the University of Houston, said the discovery offers promise for energy storage and other applications, including electric vehicles.

“It provides a low-cost, high energy density, stable battery,” he said. “It should be of use for reliable, rechargeable batteries.”

Shan and UH Ph.D. student Guangxia Feng also developed an in situ optical visualization technique, allowing them to directly observe the reaction dynamics on the anode in real time. “This platform provides us with the capability to directly image the electrode reaction dynamics in situ,” Shan said. “This important information provides direct evidence and visualization of the reaction kinetics and helps us to understand phenomena that could not be easily accessed previously.”

Testing determined that the novel 3D zinc-manganese nano alloy anode remained stable without degrading throughout 1,000 hours of charge/discharge cycling under high current density (80 mA/cm²).

The anode is the electrode which releases current from a battery, while electrolytes are the medium through which the ionic charge flows between the cathode and anode. Using seawater as the electrolyte rather than highly purified water offers another avenue for lowering battery cost.

Traditional anode materials used in aqueous batteries have been prone to dendrites, tiny growths that can cause the battery to lose power. Shan and his colleagues proposed and demonstrated a strategy to efficiently minimize and suppress dendrite formation in aqueous systems by controlling surface reaction thermodynamics with a zinc alloy and reaction kinetics by a three-dimensional structure.

Shan said researchers at UH and University of Central Florida are currently investigating other metal alloys, in addition to the zinc-manganese alloy.

In addition to Shan and Feng, researchers on the project include Huanan Tian, Zhao Li, David Fox, Lei Zhai, Akhilesh Kashima and co-corresponding author Yang Yang, all with the University of Central Florida; Zhenzhong Yang and Yingge Du, both with Pacific Northwest National Laboratory; Masyu Wang and co-corresponding author Zhenxing Feng, both with Oregon State University; and Hua Zhou with Argonne National Laboratory.

“Aromatics are major building blocks of polymers, or plastics, which turn up as everything from PET bottles for water to wrapping sheets, which is important to produce highly stable materials – an important feature in most industrially relevant applications,” said Martinez.

“These hierarchical catalysts show unprecedented improvement in catalyst performance with 4-fold lower rates of deactivation, five-fold increases in activity and nearly two-fold increases in selectivity,” according to Rimer.

In industry, petrochemical producers often must take turnarounds every two years or so to regenerate a catalyst or replace it altogether. The US, late first quarter to early second quarter usually sees several refineries take a two-week to two-month maintenance period to accommodate this. During that time, production and profit are lost. While these improved hierarchical zeolite catalysts will not end turnarounds altogether, their smaller but stable 30-60 nanometer size supplies comparable to commercial ZSM-5. However, their small size simultaneously improves selectivity and reduces carbon build up. This hints at longer periods between costly turnarounds and increased yield.

“This novel technique has the advantage of producing thicker well-formed sheets, which is important to produce highly stable materials – an important feature in most industrially relevant applications,” said Martinez.

“Until now, OSDAs were believed to be critical to synthesis of pillared zeolites, acting as templates to facilitate the formation of thin interconnecting nanosheets,” Rimer said. “But as we observed in this seeding process, these 30-60 nanometer nanosheets emerged from amorphous material and formed pillars without any template.”

“Previous attempts to produce these catalysts required costly organic agents and low yields were typically obtained, which greatly limited their commercial application,” Martinez said.
Attitudes about Climate Change are Shifting, Even in Texas

By Jeannie Keever

Longstanding skepticism among Texans toward the climate movement has shifted, and attitudes in the nation’s leading energy-producing state now mirror those in the rest of the United States.

About 80 percent of Americans – almost 81 percent of Texans – say they believe climate change is happening, according to new research by UH Energy and the University of Houston Hobby School of Public Affairs. Slightly lower percentages said they believe the change is driven by human activities.

Most said they are willing to pay more for electricity derived from natural gas produced without venting and flaring, electricity derived from renewable generation that factors in the cost of the grid, and low-carbon or carbon-neutral transportation fuels and other energy products.

“People are aware of climate change and believe it is real,” said Ramanan Krishnamoorti, chief energy officer at UH and a professor of Petroleum Engineering in the William A. Brockshire Department of Chemical and Bio- molecular Engineering. “That is true even in Texas, where people have been less likely to say they believe in climate change and, especially, change caused by human activities.”

But Krishnamoorti said researchers also found that while most people understand the link between climate change and fossil fuels, they are less sophisticated in their knowledge about potential solutions, from carbon taxes to emissions trading systems. Only 56 percent believe individual consumer choices are responsible for climate change.

The report, Carbon Management: Changing Attitudes and an Opportunity for Action, was released less than a month before the Texas Legislature convenes a session expected to address curbing methane flaring and other emissions. The Biden administration also is likely to consider more stringent environmental regulations, and a number of energy companies have committed to reducing their carbon footprints.

While large majorities said government, the fossil fuel industry and the transportation sector bear responsibility for climate change, fewer said individual consumer choices were responsible, said Gail Buttorff, co-director of the Survey Research Institute at the Hobby School, and Aparajita Cantú, Yewande O. Olapade, a post-doctoral fellow at the Hobby School, and Francisco Cantú, co-director of the Survey Research Institute at the Hobby School.

“We also found that more than 93 percent are willing to pay more for carbon-neutral energy, and 75 percent said they would pay between $1 and $5 more per gallon,” Buttorff said.

The researchers found generational differences in support for paying higher prices in exchange for carbon-neutral energy, with younger people generally more willing to pay a higher premium.

Francisco Cantú, co-director of the Survey Research Institute at the Hobby School, said demographic changes are likely one reason the study found few differences in attitudes between Texans and people elsewhere in the U.S.

“Texas has a growing population of young people, along with increased migration both from other states and other countries,” Cantú said. “That, along with major changes that are already underway in the industry, from the growing use of renewables to industry pledges to decarbonize, suggests regulators could take advantage of the timing to lock in long-term climate strategies.”

In addition to Krishnamoorti, Pinto, Buttorff and Cantú, Yewande O. Olapade, a post-doctoral fellow at the Hobby School, and Aparajita Datta, a doctoral student in the Department of Political Science, were involved in the work.

The survey was conducted online last October, surveying 1,000 people age 18 and older living in all 50 states and the District of Columbia. An additional 500 residents in Texas were surveyed.
The synthetic chemicals known as PFAS, short for perfluoroalkyl and polyfluoroalkyl substances, are found in soil and groundwater where they have accumulated, posing risks to human health ranging from respiratory problems to cancer.

New research from the University of Houston and Oregon State University published in Environmental Science and Technology Letters suggests why these “forever chemicals” – so called because they can persist in the environment for decades – are so difficult to permanently remove and offers new avenues for better remediation practices.

The work focused on the interactions sparked when firefighters use firefighting foam, which contains PFAS, to combat fires involving jet fuel, diesel or other hydrocarbon-based fuels. Firefighter training sites are well-documented sources of PFAS pollution.

Konstantinos Kostarelos, a researcher with UH Energy and an associate professor in the Cullen College of Engineering's Petroleum Engineering Department, is the corresponding author for the work. He said the interactions form a viscous water-in-oil microemulsion, which chemical analysis determined retains a high level of the PFAS.

Unlike many emulsions of oil and liquid, which separate into their component parts over time, these microemulsions – comprised of liquids from the firefighting foam and the hydrocarbon-based fuel – retain their composition, Kostarelos said. “It behaves like a separate phase: the water phase, oil phase and the microemulsion phase. And the microemulsion phase encapsulates these PFAS.”

Experimental trials that simulate the subsurface determined about 80 percent of PFAS were retained in the microemulsions when they flow through the soil. “If they passed through easily, they wouldn’t have been so persistent over the course of decades.”

Produced during the post-World War II chemical boom, PFAS are found in consumer products ranging from anti-stain treatments to Teflon and microwave popcorn bags, in addition to firefighting foam. They were prized because they resist heat, oil and water – traditional methods of removing or breaking down chemicals – as a result of the strong bond between the carbon and fluorine atoms that make up PFAS molecules.

They have been the target of lawsuits and regulatory actions, and new chemical formulations have shortened their half-life.

In the meantime, the toxic legacy of the older formulations continues to resist permanent remediation. Kostarelos said the new understanding of microemulsion formation will help investigators better identify the source of the contamination, as well as stimulate new methods for clean-up efforts.

“It’s very viscous,” he said. “That’s very useful information for designing a way to recover the microemulsion.”

The project was funded by the Strategic Environmental Research and Development Program of the U.S. Department of Defense. In addition to Kostarelos, co-authors on the publication include Pushpesh Sharma of UH; and Emerson Christie, Thomas Wanzek and Jennifer Field, all of Oregon State University.
Living near a hazardous waste or Superfund site could cut your life short by about a year, reports Hanadi S. Rifai, John and Rebecca Moores Professor of Civil and Environmental Engineering at the University of Houston. The study, published in Nature Communications and based on evaluation of 65,226 census tracts from the 2018 Census, is the first nationwide review of all hazardous waste sites and not just the 1,300 sites on the national priority list managed by the federal government.

The analysis shows a decrease of more than two months in life expectancy for those living near a Superfund site. When coupled with high disadvantage of sociodemographic factors like age, sex, marital status and income, the decrease could be nearly 15 months, according to the analysis. Prior studies confirmed that those living near hazardous waste sites generally have greater sociodemographic disadvantage and, as a result, poorer health. The average life expectancy in the U.S. is 78.7 years, and millions of children have been raised within less than a one-mile radius from a federally designated Superfund site.

Lee, an associate professor in the Cullen College of Engineering’s Civil and Environmental Engineering Department, is the principal investigator for a grant, “Forecasting Inundation Extents Using VIIRS and SAR Imagery with Streamflow Forecasts From NOAA’s River Forecasting Centers/National Water Model and GEOGloWS.” The three-year project, tentatively budgeted for $513,804, was selected by the National Oceanic and Atmospheric Administration in December 2020.

Lee described how the lack of information in 2017 had a personal effect on him and his family. “During the night of August 30, 2017, [Lee] had to anxiously monitor throughout the night the rapidly rising water level over his front porch, every hour to make an evacuation decision,” he wrote. “The local TV news had announced that the U.S. Army Corps of Engineers (USACE) was starting to release water from the Addicks and Barker Reservoirs located upstream of his home in order to reduce the risk of a dam breach. However, there was a sudden hydrologic information blackout which lasted five days as the in-situ gauge to monitor water levels had been washed out. The next morning Lee and his family evacuated by boat from the floodwaters, thanks to the volunteer rescuers from the neighborhood using their own boats. If there was a source of predicted hydrologic-hydraulic conditions, Lee could have avoided his high-risk decision for his family.

Ideally, the project will allow for more accurate forecasting of flooded extents by applying the new so-called Forecasting Inundation Extents using REOF analysis (FIER) technique, developed by Lee’s group. The technique was first developed using synthetic aperture radar images that aren’t affected by cloud cover during the rainy season.

The researchers will focus on three test areas in United States – the Mississippi River Basin around New Madrid, Missouri for riverine flooding; the Red River Basin for snowmelt-induced flooding; and southeastern Texas, including the Houston metropolitan area, for pluvial (rainfall-based) flooding.

“[This NOAA project is to experiment with our idea of applying the FIER technique to a stack of historical VIIRS imagery that have cloud covers, and extract the inundation signal only over three flood-prone regions in the U.S. as test studies],” Lee said. “Eventually our goal is to provide cloud-free forecasted inundation extents, being coupled with forecasted streamflows from NOAA’s National Water Model and GEOGloWS streamflow forecasting system, or forecasted river levels from National Weather Service (NWS) River Forecast Centers. Once our test studies are successfully performed, our long-term goal is to have this eventually implemented for operational uptake by NOAA and provide forecasted inundation extents along with currently operational streamflow/river level forecasts.”

Co-investigators include Gustavious Williams and E. James Nelson at Brigham Young University, and William Straka III from the Cooperative Institute for Meteorological Satellite Studies at the University of Wisconsin at Madison.
Analysis revealed that out of 12,717 census tracts with at least one Superfund site, the adverse effect of this presence was more severe on the ones with higher sociodemographic disadvantage. For instance, the presence of a Superfund site in a census tract with smaller than median income ($52,580) could reduce life expectancy by as much as seven months.

While many studies have broken down mortality rates associated with different diseases, only a few have paid attention to hazardous waste and Superfund sites and their potential impact on mortality rates.

Other recent national studies showed a significant correlation between the residential proximity to Superfund sites and the occurrence of non-Hodgkin’s lymphoma, especially among males. In Texas, the Texas Department of State Health Services recently examined a cancer cluster in downtown Houston around a former railroad creosote treatment facility, finding the observed number of childhood acute lymphoblastic leukemia cases was greater than expected based on cancer rates in Texas.

The study presents a nationwide geocoded statistical modeling analysis of the presence of Superfund sites, their flood potential, and the impact on life expectancy independently and in context of other sociodemographic determinants. Life expectancy is one of the most basic indicators of public health. Studies show a 1 percent increase in life expectancy could lead to a 1.7 percent to 2 percent increase in population.

Among the 50 states there were 1,303 Superfund sites. The states with the most Superfund sites are:

- New Jersey (113 sites)
- California (97 sites)
- Pennsylvania (95 sites)

Source: www.ballotpedia.org

The study provides a significant contribution to our understanding of the impact of hazardous waste and Superfund sites on population health. The results highlight the need for further research to explore the long-term effects of exposure to hazardous waste on human health and well-being.
Cullen College of Engineering professor Stanko R. Brankovic, Ph.D., of the Electrical and Computer Engineering Department, is the corresponding author for a new, multi-department perspective paper on potential advancements in catalyst synthesis.

The published work is a result of multifaceted effort among UH researchers to perfect and understand a new phenomenon for monolayer deposition and to present its practical importance to the relevant fields of catalysis and electrocatalysis. According to the authors, “We point out a novel opportunity for catalyst monolayer and core–shell structures synthesis via the surface limited redox replacement (SLRR) reaction. It is enabled by discovery of an electroless Pb monolayer deposition phenomenon whose fundamentals and practical aspects are presented.”

“The particular benefit of this synthesis approach is for metal substrates which are not part of broadly conductive supports such as metal nanoparticles embedded in various oxides or zeolites. Examples of the catalyst monolayer deposition via SLRR of electrolessly deposited Pb monolayer are presented under the auspices of a two-step electroless atomic layer deposition process (e-less ALD). Each cycle of the e-less ALD produces a precise submonolayer amount of catalyst deposit demonstrating its potential for a broad range of applications.”

More exploration of the methods outlined in the article could “bridge the gap between the desired properties of catalyst and the required conditions for its synthesis.”

Brankovic Leads Multi-Department Research into Synthesis Via SLRR Reaction

BY STEPHEN GREENWELL


Additional authors, all from the University of Houston, include Nikhil Dole and Dongjun Wu from the Electrical and Computer Engineering Department; Lars Grabow, from the Chemical and Biomolecular Engineering Department; Kamary Ahmed from the Materials Science and Engineering Program; and Francisco Robles Hernandez, a graduate student in the College of Technology.

Lars Grabow

The research, nicknamed CEDAR, centers on catalytic deactivation, which is the loss of effectiveness in a catalyst over time. According to the project’s abstract, “the vision of this project is to advance chemical manufacturing productivity and energy efficiency by combating catalyst deactivation with robust predictive models based on new Dynamic Catalyst Science (DCS) methods supported by data analytics. Transient kinetics is at the heart of DCS which may employ the use of temperature, concentration or pressure transients to perturb the state of a chemical reaction system.”

UH and INL are partnering for both grants, with Grabow noting that their research interests often overlapped. He and his team at INL organized a workshop on Dynamic Catalyst Science in February 2020 at UH, for example, which led to networking between researchers from the participating institutions, the U.S. Department of Energy and private industry.

“The connection with the Idaho National Lab is strategic,” he said. “We collaborate with Rebecca Rushimi at INL because she is the leading U.S. expert in the use of temporal analysis of products (TAP) reactors for studying heterogeneous catalysts. There are only four TAP reactors in the U.S. and INL has two state-of-the-art systems.”

Grabow added, “With the TAP reactor we can deliver very small quantities of our reactants in a highly controlled fashion to the catalysts, and we can study the time-resolved response. This produces a lot more data per experiment than a typical reactor measurement. The large amount of data is necessary, because we want to use machine-learning techniques to improve our mathematical models of the process. My group’s contribution will lie in the development of kinetic models, again coupled to machine learning algorithms, to predict the deactivation behavior from TAP reactor measurements. The goal is to collect tons of data in a relatively short amount of time on the INL TAP reactor and then attempt to extrapolate to longer time scales. This will allow our industry partners to test their catalysts quicker and develop more robust catalysts that last longer.”

This industry component is often overlooked in academia, according to Grabow.

“Academia is obsessed with beating speed records of reaction rates, but we avoid the long-term stability question quite frequently,” he said. “One obvious reason is that many industrial catalysts have lifetimes of two to 20 years, and we can’t expect our graduate students to run 10-year experiments to see if a new catalyst lasts longer. Our alternative approach in the CE- DAR project would hopefully enable us to make this prediction in just one day! Yes, that’s wishful thinking, but we aim high.”

The Cullen College of Engineering, formerly a postdoctoral fellow in the Chemical and Biomolecular Engineering Department, is now a research associate at the University of Oklahoma.

Lars Grabow

The Cullen College of Engineering professor Stanko R. Brankovic, Ph.D., of the Electrical and Computer Engineering Department, is the corresponding author for a new, multi-department perspective paper on potential advancements in catalyst synthesis.

Read Article: Electroless Pb Monolayer Deposition – Prelude for Further Advances in Catalyst Monolayer Synthesis via Surface Limited Redox Replacement Reaction

University of Houston

Cullen College of Engineering
Tapping the Brain to Boost Stroke Rehabilitation

BY JEANNIE KEVER

Stroke survivors who had ceased to benefit from conventional rehabilita-
tion gained clinically significant arm movement and control by using an
external robotic device powered by the patients’ own brains.

The results of the clinical trial were described in the journal Neuroim-
age: Clinical.

Jose Luis Contreras-Vidal, director of the Non-Invasive Brain Machine
Interface Systems Laboratory at the University of Houston, said testing
showed most patients retained the benefits for at least two months af-
after the therapy sessions ended, suggesting the potential for long-lasting
gains. He is also Hugh Roy and Lillie Cranz Cullen Distinguished Profes-
sor of electrical and computer engineering.

The trial involved training stroke survivors with limited movement in one
arm to use a brain-machine interface (BMI), a computer program that cap-
tures brain activity to determine the subject’s intentions and then triggers
an exoskeleton, or robotic device affixed to the affected arm, to move in
response to those intentions. The device wouldn’t move if intention wasn’t
detected, ensuring subjects remained engaged in the exercise.

Using robotics in rehabilitation isn’t new, said Contreras-Vidal, co-prin-
cipal investigator of the trial and a pioneer in noninvasive BMI systems.
But robot-assisted exercise doesn’t generally engage the user, which is
critical for taking advantage of the brain’s plasticity to allow patients to
relearn movement.

“This project ensures the brain is engaged,” he said. “We know that if
the arm is moving, it’s because they are commanding it to move. That’s a
very powerful concept.”

By testing the subjects over a period of time before the trial began, re-
searchers were able to ensure that any changes or improvements were due
to the intervention. In addition to better arm movement, the researchers
reported that the subjects also showed improvements in using their hands.

“This is a novel way to measure what is going on in the brain in response
to therapeutic intervention,” said Gerard Francisco, professor and chair
of physical medicine and rehabilitation at McGovern Medical School at
The University of Texas Health Science Center at Houston and co-princi-
al investigator. “This study suggested that certain types of intervention,
in this case using the upper robot, can trigger certain parts of brain to
develop the intention to move. In the future, this means we can augment
existing therapy programs by paying more attention to the importance
of engaging certain parts of the brain that can magnify the response to
therapy.”

The trial was conducted at TIRR Memorial Hermann, where Francisco serves
as chief medical officer and director of the NeuroRecovery Research Center.
The project was a collaboration between UH, UTHealth, TIRR Memorial Herm-
ann, Houston Methodist Research Institute and Rice University.

In addition to Francisco and Contreras-Vidal, who is also director of the
BRAIN Center, a NSF Industry/University Collaborative Research Insti-
tute, researchers involved with the project include Nikunj A. Bhagat
and Zachary Hernandez with UH; Nuray Yozbatiran and Rupa Paranj-
ep with UTHealth; Zafer Keser, formerly with UTHealth; Jennifer L. Sul-
ivian, Colin Losey and co-principal investigator Marcia K. O’Malley with
Rice; and Robert Grossman with Houston Methodist Research Institute.
O’Malley is also Director of Rehabilitation Engineering at TIRR Memorial
Hermann.

The project was funded by the National Institute of Neurological Disorders
and Stroke and Mission Connect, part of the TIRR Foundation.

“Those of us who have studied the brain for so many years have antic-
pipated that its powers, combined with robotics and the brain-machine
interface, could offer unimaginable benefits to stroke survivors and other
patients with brain injuries,” said Grossman, professor of neurosurgery
at Houston Methodist. “This study is just the beginning of what will be
possible to treat stroke, spinal cord injuries and other traumatic brain
injuries in the future.”

The trial spanned a period of several years, partly because it took time
to find subjects who met the criteria and were both interested in partic-
ipating and able to make the required time commitment. Ultimately, 10
subjects between the ages of 41 and 71 were enrolled.

The therapy took place three times a week for four weeks. The final fol-
low-up testing was conducted two months after therapy ended, and Con-
treras-Vidal said it’s unclear if the benefits will persist long-term.

That leads to an ongoing project — Contreras-Vidal has a National Science
Foundation grant to design a low-cost system that would allow people to
continue the treatments at home.

“If we are able to send them home with a device, they can use it for life,”
he said.
With a survival rate of only five years, the most common and aggressive form of primary brain tumor, glioblastoma multiforme, is notoriously hard to treat using current regimens that rely on surgery, radiation, chemotherapy and their combinations.

“Two of the major challenges in the treatment of gliomas include poor transport of therapeutic across the blood brain barrier and undesired side effects of these therapeutics on healthy tissues,” said Majd.

An iron chelator known as Dp44mT (Di-2-pyridylidene-4, 4-dimethyl-3-thiosemicarbazone) is an effective medication known to get rid of iron needed by cancer cells, thus starving them.

Using clues from the tumors themselves, Majd developed a Dp44mT-loaded nano-carrier that would be drawn to glioma tumors, which present many IL13 (interleukin) receptors. Because the IL13 receptors are abundant, she added IL13 ligands onto its PDA-approven biodegradable polymer carrier (with the Dp44mT inside) so the receptors would lure the ligands, thus receiving the medicine.

Prior to this new carrier, the Dp44mT drug would be administered, but could go anywhere in the body, even places it is not meant to go. “It’s like an envelope with no address on it. It can land anywhere, and with toxins inside it could kill anything. Now, with our targeted delivery, we put an address on the package and it goes directly to the cancer cells,” said Majd.

Aggressive brain tumors also develop high levels of multidrug resistance making them near impossible to control aggregation and allows wild-type p53 to fight cancer, according to the researchers.

In normal cell conditions, the concentration of p53 is relatively low, so the probability of aggregation is low, he said. But when a mutated p53 is present, the probability increases.

“Experiments show the size of these clusters is independent of the concentration of p53,” Kolomeisky said. “Mutated p53 will even take normal p53 into the aggregates. That’s one of the reasons for the phenomenon known as loss of function.”

If even a small relative fraction of the mutant is present, it’s enough to kill or lower the ability of normal, wild-type p53 to fight cancer, according to the researchers.

The Rice simulations showed normal p53 proteins are compact and easily bind to DNA. “But the mutants have a more open conformation that allows them to interact with other proteins and gives them a higher tendency to produce a condensate,” Kolomeisky said. “It’s possible that future anti-cancer drugs will target the mutants in a way that suppresses the formation of these aggregates and allows wild-type p53 to do its job.”

UH graduate student David Yang is lead author of the paper. Co-authors are Rice graduate student Alena Kliindriik and alumnus Aram Davtyan; UH graduate student Arash Saeedi and alumni Mohsen Fathi and Mohammad Safari; and Michelle Barton, a former professor at the University of Texas MD Anderson Cancer Center now at Oregon Health & Science University. Vardazaryan is the MD Anderson Professor of Chemical and Biomolecular Engineering at UH. Sherman is an assistant professor of biochemistry and molecular biology at UTMB.

The research was supported by the National Institutes of Health, the National Science Foundation, the Congressionally Directed Medical Research Programs, the Cancer Prevention and Research Institute of Texas, the Melanoma Research Alliance, NASA, Rice’s Center for Theoretical Biological Physics and the Sealy Center for Structural Biology and Molecular Biophysics at UTMB.
An invention from University of Houston researchers to help children with walking disabilities won the Southwest National Pediatric Device Innovation Consortium’s Pediatric Device Prize at this year’s South by Southwest.

The award, which comes with $15,000 in funding, was one of two given by SWPDC in that category at this year’s SXSW. The UH device is the Pediatric Lower-Extremity Gait System (P-LEGS) which is a mobility assistant rehabilitation platform and diagnostic tool designed to help children with motor disabilities. It was chosen from a field of 18 entrants.

Jose Luis Contreras-Vidal, Ph.D., Hugh Roy and Lillie Cullen Distinguished Professor of Electrical and Computer Engineering and the director of UH’s BRAIN Center, is the principal investigator for the project. The project is supported by the National Pediatric Device Innovation Consortium’s Pedi- tric Device Prize at this year’s South by Southwest.

Contreras-Vidal noted that the project has been the result of a strong partnership between UH and other organizations. "We were excited and honored to have been selected by the SWPDC for this award," Eguren said. "The award will be valuable in helping us continue device development and testing."

Contreras-Vidal noted that the project has been the result of a strong partnership between UH and other organizations. "This project has been a collaboration with Dr. Gerard Francisco at TIRR Memorial Hermann, and the NSF IUCRC BRAIN Center, and supported by Mission Connect - A THR Foundation and the UH Chancellor’s Bridging Technology Fund."

The Pediatric Lower-Extremity Gait System (P-LEGS) is a modular device with a total of six motors that provide sagittal plane support in the hip, knee and ankle joints of each leg. It also has two non-motorized degrees of freedom at the hips to allow for weight shifting during walking. The walking pattern and level of support provided are customizable on a joint-by-joint basis to accommodate the unique needs of each child within the target clinical populations. The device is multifunctional and characterized as rehabilitation technology, assistive technology and as a diagnostic tool.

An advantage of the P-LEGS is its ability to “grow” with the child. Thanks to 3D printed braces that are made from digital scans of the child’s legs, costs are significantly reduced, and the device can be used for multiple children. When the child grows, the braces are rescanned and implemented in the device, causing the device to “grow” with the child.

Contreras-Vidal and Eguren said the goal is to provide children with a low-cost device that can be used outside of clinics and rehabilitation centers. Those children can then receive increased amounts of therapy, with the aim of improving their ability to independently care for themselves.

Despite having remarkable utility in treating movement disorders such as Parkinson’s disease, deep brain stimulation (DBS) has encountered researchers with a general lack of understanding of why it works at some frequencies and does not at others. A University of Houston biomedical engineer presented evidence in Nature Communications Biology that electrical stimulation of the brain at high frequencies (~100 Hz) induces resonating waveforms which can successfully recalibrate dysfunctional circuits causing movement symptoms.

"We investigated the modulations in local field potentials induced by electrical stimulation of the subthalamic nucleus (STN) at therapeutic and non-therapeutic frequencies in Parkinson’s disease patients undergoing DBS surgery. We find that therapeutic high-frequency stimulation (150–180 Hz) induces high-frequency oscillations (~300 Hz, HFO) similar to those observed with pharmacological treatment,” reports Nuri Ince, associate professor of Biomedical Engineering. For the past couple of decades, deep brain stimulation (DBS) has been the most important therapeutic advancement in the treatment of Parkinson’s disease, a progressive nervous system disorder that affects movement in 10 million people worldwide. In DBS, electrodes are surgically implanted in the deep brain and electrical pulses are delivered at certain rates to control tremors and other disabling motor signs associated with the disease.

Until now, the process to find the correct frequency has been time consuming, with it sometimes taking months to implant devices and test their abilities in patients, in a largely back and forth process. Ince’s method may speed the time to almost immediate for the programming of devices at correct frequencies.

“By the first time, we stimulated the brain and while doing that we recorded the response of the brain waves at the same time, and this has been a limitation over the past years. When you stimulate with electrical pulses, they generate large amplitude artifacts, masking the neural response. With our signal processing method, we were able to get rid of the noise and clean it up,” said Ince. “if you know why certain frequencies are working, then you can adjust the stimulation frequencies on a subject-specific basis, making therapy more personalized.”

DBS is also being explored for the treatment of many other neurological and psychiatric indications, including Obsessive-Compulsive Disorder.

Additional authors of the article are Ince’s doctoral student Musa Ozturk, and Ashwin Viswanathan and Sameer Sheth, from Baylor College of Medicine.
To speed up the learning process, the new network architecture could easily be implemented in a clinical setting, providing a simple, inexpensive and accurate screening tool for SSc.

“We believe that the proposed network architecture could easily be implemented in a clinical setting, providing a simple, inexpensive and accurate screening tool for SSc.”

For patients with SSc, early diagnosis is critical, but early diagnosis and determining the extent of disease progression pose significant challenges for physicians, even at expert centers, resulting in delays in therapy and management.

“Among several deep learning networks, Convolutional Neural Networks (CNNs) are most commonly used in engineering, medicine and biology, but their success in biomedical applications has been limited due to the size of the available training sets and networks.”

To overcome these difficulties, Akay and partner Yasemin Akay combined the UNet, a modified CNN architecture, with added layers, and they developed a mobile training module. The results showed that the proposed deep learning architecture is superior and better than CNNs for classification of SSc images.

“After fine tuning, our results showed the proposed network reached 100 percent accuracy on the training image set, 96.8 percent accuracy on the validation image set, and 95.2 percent on the testing image set,” said Yasemin Akay, UH instructional associate professor of biomedical engineering.

The training time was less than five hours.

Joining Metin Akay and Yasemin Akay, are paper co-authors Yong Du, Cheryl Sershen, Ting Chen and Chandra Mohan, all of University of Houston, and Menghua Wu and Shervin Assassi of the University of Texas Health Science Center (UT Health).

Though 40 million concussions are recorded annually, no effective treatment exists for them or for many other brain-related illnesses. In collaboration with Dragan Maric of the National Institutes of Health, Badri Roysam, Hugh Roy and Lillie Cranz Cullen University Professor and Chair of Electrical and Computer Engineering, and his team are working to speed up drug development to treat brain diseases and injuries like concussion by developing new tools.

“We are interested in mapping and profiling unhealthy and drug-treated brain tissue in unprecedented detail to reveal multiple biological processes at once - in context,” said Roysam. “This requires the ability to record high-resolution images of brain tissue covering a comprehensive panel of molecular biomarkers, over a large spatial extent, e.g., whole-brain slices, and automated ability to generate quantitative readouts of biomarker expression for all cells.”

At the National Institute of Neurological Disorders and Stroke, Maric developed the innovative imaging technique that can be readily implemented for widespread use with the potential to transform brain studies requiring comprehensive cellular profiling from single and serial slices of brain tissue. Roysam’s lab developed the computational image analysis methods based on deep neural networks. Roysam’s system analyzes the images on the UH supercomputer automatically and can reveal multiple processes at once - the brain injury, effects of the drug being tested and the potential side effects of the drug.

“Compared to existing screening techniques, using iterative immunostaining and computational analysis, our methods are more flexible, scalable and efficient, enabling multiplex imaging and computational analysis of up to 100 different biomarkers of interest at the same time using direct or indirect IHC immunostaining protocols,” reports Roysam.

The open-source toolkit approach is also adaptable to other tissues. Its development can accelerate systems-oriented studies by providing quantitative profiles of all the molecular and cellular players at once, in their detailed spatial context.

“We are efficiently overcoming the fluorescence signal limitations and achieving highly enriched and high-quality source imagery for reliable automated scoring at scale. Our goal is to accelerate systems-oriented studies of normal and pathological brains, and pre-clinical drug studies by enabling targeted and off-target drug effects to be profiled simultaneously, in context, at the cellular scale,” said Roysam.

The team’s work is supported by a $3.19 million grant from the NIH.
When a mosquito bites to nibble on you, it is not merely feeding on your blood, it is also injecting its saliva into your skin. If that saliva happens to be full of parasites carrying malaria or other diseases from its last victim, then most likely you will become infected, too.

The first-line treatment for malaria, caused by the F. Falciparum parasite, is artemisinin-based combination therapy, which provides a one-two punch. The drug artemisinin (derived from the P. Falciparum parasite, is artemisinin-based on its last victim, then most likely you will become infected, too.

**Examining the One-Two Punch of Malaria Drugs**

**BY LAURIE FICKMAN**

A new paper from Ross Faghhi, Ph.D., Assistant Professor of Electrical and Computer Engineering and the Director of the Computational Medicine Laboratory, and her doctoral student Rafiul Amin, describes how they have developed a novel inference engine to obtain brain information from raw electrodermal activity (EDA) recordings, eradicating previous challenges from earlier methods.

**Novel Reliable Brain Information Inference using Electrodermal Activity**

**BY STEPHEN GREENWELL**

A study led byan University of Science and Technology, who was described as "highly-sensitive skin-attachable sensor made of a stable, flexible piezoelectric thin film. The film is also free of hazardous elements, and it overcomes the limitations of current computer-vision-based eye-tracking systems. Piezoelectric strain sensors are highly sensitive as well. The sensor was cated from single-crystalline III-N thin film, by a layer-transfer technique that is highly sensitive and can detect subtle movements of the eye."

According to the paper, Ryu and his team developed a highly sensitive, noninvasive and skin-attachable sensor made of a stable, flexible piezoelectric thin film. The film is also free of hazardous elements, and it overcomes the limitations of current computer-vision-based eye-tracking systems. Piezoelectric strain sensors are highly sensitive as well. The sensor was cated from single-crystalline III-N thin film, by a layer-transfer technique that is highly sensitive and can detect subtle movements of the eye.

**Non-Invasive Eye-Movement Sensors**

**BY STEPHEN GREENWELL**

We initiated the research to develop a compact and non-invasive sensor for direct measurement of the ocular movement, as it is the promising objective indicator," he said. "Tracking of physiological parameters changes is proven to be inaccurate, as the indicators such as heart rate variability also vary with other states, including emotion, workload and physical fatigue. Brain wave evaluation by electroencephalogram (EEG) requires the intrusive and cumbersome procedures of the measurement. Currently developed eye-tracking systems (ETSSs) relying on a computer-vision-based system is difficult to be miniaturized. This problem is particu- larly challenging for moving individuals at work or while walking. We came up with an idea – Can we apply a similar operating principle of the previous sensor we developed to the detection of eye movements?"

Ryu said it was his student, Nam-In Kim, who suggested switching the area of the sensors from the eyelids and near the eyes, to the temple area, along with some other adjustments.

"The ideas worked perfectly," Ryu said. "The sensor attached on the temple area is sensitive enough to detect various movements of the eyelids and eyelashes."

"It is a great result, but monitoring could allow for more fruitful research into a variety of areas, especially when it came to early detection of serious health issues."

"The human eyes are one of the most con- nected organs to the brain through nerves and muscles," he said. "Therefore, many brain-re- lated diseases are accompanied by abnormal eye movements. We are further developing the sensors to detect the early symptoms of brain-related diseases, such as ADH, Parkinson’s disease, traumatic brain injury and other issues. Also, we plan to extend our sensor development to measure the level of human stress and to help diagnose a growing trend of fatigue and stress monitoring of individuals in daily life."

**Non-Invasive Eye-Movement Sensors**

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"The human eyes are one of the most con- nected organs to the brain through nerves and muscles," he said. "Therefore, many brain-re- lated diseases are accompanied by abnormal eye movements. We are further developing the sensors to detect the early symptoms of brain-related diseases, such as ADH, Parkinson’s disease, traumatic brain injury and other issues. Also, we plan to extend our sensor development to measure the level of human stress and to help diagnose a growing trend of fatigue and stress monitoring of individuals in daily life."

**Flexible Nonhazardous Piezoelectric Thin Film**

"Highly-Sensitive Skin-Attachable Eye Movement Sensor Using Flexible Nonhazardous Piezoelectric Thin Film" was published by Ad- vanced Functional Materi- als in February. Addi- tional authors from UH include Ryu’s students Nam-In Kim, Jeon Cheon, Weijie Wang, Mina Moradnia and Sara Pouladi. Other listed au- thors include Min-Ki Kwon, a visiting scholar while on sabbatical from Chosun University, and Xiaohang Li, a professor at King Abdullah University of Science and Technology, who was involved in the infection and analysis of data with Ryu’s students.

According to the paper, Ryu and his team developed a highly sensitive, noninvasive and skin-attachable sensor made of a stable, flexible piezoelectric thin film. The film is also free of hazardous elements, and it overcomes the limitations of current computer-vision-based eye-tracking systems. Piezoelectric strain sensors are highly sensitive as well. The sensor was cated from single-crystalline III-N thin film, by a layer-transfer technique that is highly sensitive and can detect subtle movements of the eye.

Ryu said that the new findings are the result of targeted, application-driven research.

"My group has been exploring new-concept materials and device structures to find a new engineering solution in energy, electronic, photonic and sensing applications," he said. "One of the major objectives among them is to develop wearable and implantable sensors to measure physiological parameters for personal health monitoring systems, and to detect early symptoms of abnormality and dis- ease of the human body for medical diagno- sis and safety systems. We developed a sensor network that can measure pulse waves in var- ious arterial sites and demonstrated that it can continuously monitor "eye movement velocity and artery augmentation index, which are import- ant physiological parameters to detect several cardiovascular diseases."
“The new tape will be developed through collaboration between the University of Houston, Elemental Coatings and Boeing Corporation, and not only help to prevent structural damage to rotor blades and protect from erosive effects, but it will also help minimize ice buildup,” Ghasemi wrote. “This is a first-of-its kind product that builds on UH and Elemental Coatings’ established expertise around aviation ice prevention, address- ing known issues across rotorcraft programs.”

Ghasemi noted that his group has now worked several times with Boeing and the USAFRL.

“We have collaborated with Boeing and USAFRL before, and introduced this new ice-shedding coating for their aircraft wings,” he said. “The qual- ification and testing of the coatings are conducted by Boeing, while UH provided fundamental insight on the development of these coatings. Since my group has expertise in ice-shedding coatings, through presen- tation and brainstorming at scientific conferences, we have developed these connections with Boeing and USAFRL. It’s more than one year that we launched these collaborations, and we’ve conducted several joint projects together, totaling more than $500,000 in funding.”

Although he is now a professor in Houston, Ghasemi has first-hand experi- ence with the effect ice can have on everyday life in colder regions.

“I lived in Toronto and Boston, and I completely understand the impact of icing on technologies and daily life,” he said. “It is a continuous battle in the winter. Despite being a problem every winter, there has not been any solution to this problem so far. Through more than six years of R&D and several collaborations with industrial stakeholders, we have provid- ed a promising solution that has been currently used in few applications internationally and continue to be adopted in the industry. It has been a fruitfull journey to address this long-standing problem, bringing a better quality of life for people in the winter and working with our partners to extend adoption of this solution.”

The research builds upon previous work by Ghasemi’s lab on ro- tor protection tape for several different Air Force programs.

**Micro-CT for Advanced Materials Development**

Professors at the University of Houston’s Cullen College of Engineering received a $904,554 grant in fund- ing from the U.S. Air Force Research Laboratory to con- tinue developing anti-ice coatings for aircrafts. The funding was awarded for two proposals submitted, “Ice Sheding Coatings for Aircrafts” and “Novel Icephobic Coatings for Aircrafts”, led by Hadi Ghasemi, an associate professor of Mechanical Engineering. The work will be done in collaboration with Elemental Coatings, a corpa- ration established for Ghasemi’s lab’s commercial work.

“The idea of having bacteria in minerals is not new, but the unanswered question was: what are they doing in the mines?” Robles said. “By put- ting the bacteria inside an electronic microscope, we were able to figure out the physics and analyze it. We found out the bacteria were isolating single atom copper — in terms of chemistry, this is extremely difficult to derive. Typically, harsh chemicals are used in order to produce single atoms of any element. This bacterium is creating it naturally that is very impressive.”

As useful as copper is, the process of mining the metal often leads to toxic exposures and challenges on drawing out substantial volume for commercial use. Approximately one billion tons of copper are estimat- ed in global reserves, according to the Copper Development Association Inc., with roughly 12.5 million metric tons per-year mined.

According to Selva’s proposal, “Micro-CT combines x-ray ab- sorption imaging with a single or multiple axes goniometer, advanced 2D solid state detectors and advanced x-ray sources to obtain a sequence of position-dependent images or frames. Based on the knowledge of spatial orientation of each frame, a 3D image of a sample under investigation can then be com- puted, based on reconstruction of the original 2D frames into a 3D map.”

In the awarded proposal, Selva identified seven different application areas that Micro-CT equipment would help the research at the University of Houston. Some specific uses for the Micro-CT highlighted by Selva included the ability to use the new technology as a characterization tool for the development of high-performance superconductor wires and high-energy density and safer lithium solid-state batteries; as an education tool for quality assurance and control manufacturing; and as a way to optimize smart thermal sensors.
The Cullen College of Engineering has changed drastically over the years. The Department of Engineering, as it was known then, formed in 1934, and over the next five years, quickly grew to be one of the most popular departments at the University of Houston. By 1941, it became designated as its own college within the University. In 1967, the college received its iconic Cullen naming distinction, and as they say, the rest is history.

Over the years, the college has continued to grow and evolve, establishing itself as a leader in engineering education, diversity efforts and research. With all of the constant upward momentum, it’s natural to look forward in excitement. Sometimes though, it’s just as important to pause to look back and marvel at how far we have come. The Cullen College is rich in history, more than 80 years of it, full of stories of change, trailblazing innovation and deep-rooted traditions.

In this issue of Parameters, we celebrate the history of the Cullen College and delve into who we were, currently are, and aspire to become.

Image courtesy of UH Archives. Information sourced from Mechanical Engineering professor emeritus Richard B. Bannerot’s research on the history of the Cullen College of Engineering; “In Time: An Anecdotal History of the First Fifty Years of the University of Houston” by Patrick James Nicholson; and research by Stuart A. Long, John and Rebecca Moores Professor of Electrical and Computer Engineering.
While the University of Houston itself dates back to 1927 as a junior college established by the Board of Education of the Houston Independent School District, the engineering school began to organize itself in the 1930s. HISD began transitioning the junior college to a four-year school in 1934.

The 110 acres that now comprise the main UH campus were acquired in 1936, and in 1937 and 1938, Houston oilman and philanthropist Hugh Roy Cullen began his first of many fundraising drives. The College of Engineering is established in 1941, and in the 1942 catalog, it is advertised alongside the other offered colleges – Arts and Sciences, Business Administration, Education, Community Service, Graduate School and Junior College.

At the January 13, 1941 meeting of the Board of Trustees, John Edward Hoff was appointed as an instructor of engineering effective February 3 of that year. His salary was $2,200 for nine months. Hoff was a volunteer tennis coach for more than 20 years, the first chairman of the Civil Engineering Department, and he remained a faculty member until his death in 1966. He is believed to be the first full-time faculty member appointed to “engineering,” which at the time was a department in the Division of Natural Sciences, and the first to gain tenure. A tennis complex was named in his honor in 1968.

By the June 16, 1946 meeting, there were five engineering faculty members – John Edward Hoff, J.B. Brundage, R.W. Lilliott, E.W. McMillin and Thomas Whitaker. However, Lilliott was a drafting professor, as that was under the umbrella of engineering at the time instead of architecture like it is today. The highest salary was $4,000 per month, close to the $4,300 high at the school, earned by football coach Jewell Wallace.

At the February 26, 1943 meeting of the UH Board though, the need for an accredited engineering school was recognized. While individual programs were recognized as providing technical proficiency, without an overall, comprehensive engineering program, UH had been unable to provide some war training courses in engineering subjects. The GI Bill was also being discussed at this time, and UH comptroller Walter William “Bill” Kemmerer recognized the need to have the accreditation in place for the expected surge of students.

UH president Edison E. Oberholtzer is sent to meet with the Navy and War departments. He reported that UH had received A-1 ratings for its training since 1939, and the armed forces recommended that more enlisted men be sent to the university. The accreditation process began for the departments and was accomplished by 1952, shortly after the College was divided more sharply by discipline.

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One of the engineering college’s most famous early members was D.G. “Dave” Williams. While he was hired in September 1947 for the engineering faculty, thanks to degrees in Chemistry and Chemical Engineering, he left that role to become UH’s golf coach. His teams won 16 national titles, and in his 27 years, 45 of his teams finished in the top three. Now known as the “Father of College Golf,” the Gulf Coaches Association of America named their Coach of the Year award after him.

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For the 1948-49 academic year, faculty size increased to 19. The next year, it would be 30 full-time employees, as the College and UH continued to ramp up drastically in size and scope. For UH, in a single year, enrollment jumped from 11,380 to 13,720, with roughly half the student body qualifying as veterans. The numbers would stabilize into a more normal growth curve over the next few years, and by 1954, engineering faculty numbered at 39.

The College of Engineering was formally divided into departments after a vote by the board at the June 10, 1950 meeting. A Petroleum Engineering Department building was proposed at this time at a cost of $150,000 for the equipment. It was later leave to get his doctorate at the University of Illinois and become UH’s golf coach. His teams won 16 national titles, and in his 27 years, 45 of his teams finished in the top three. Now known as the “Father of College Golf,” the Gulf Coaches Association of America named their Coach of the Year award after him.

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And for most of the past 39 years, David Dawlearn has served as the Lab Maintenance Supervisor for the successes and failures of those students, as well as providing his technical support and repair skills for the instruments used by faculty members. The most recent former chairman of the Chemical & Bio-molecular Department – Michael P. Harold, Ph.D. – was a graduate student and TA when Dawlearn started in 1980.

“Back in the day, we would show them the equipment and go, ‘Here it is, figure it out,’” Dawlearn said. “We would give them experiments that we didn’t know the answer to. It might not work. That would just blow their whole minds. ‘What do you mean you don’t know?’” He would tell the students, “If a technician can do it – meaning me – why would we need an engineer?”

Dawlearn said that the lab was always meant to emulate real world conditions and problems, not a pristine place to conduct perfect research. “We used to not let them pick their lab partners, because when you pick lab partners, you get two people who think the same way and then they can’t solve the problem,” he said. “When you’re in the real world, you can’t pick your co-workers. We try to get them as close to the real world as possible. You try to get someone who’s book smart and who’s got practical sense and throw them in there together.” Dawlearn noted that his favorite students were usually the ones who had more practical instincts for fixing things. He recounted one student, who had spent time working on a nuclear sub and was now earning a Master’s degree, attempting to reason with two others who hadn’t worked in the field at all yet.

“They were arguing about some RPM meter on a piece of equipment that was like, five digits past the decimal point, that last little digit kept flickering. They just kept arguing, and he went down to it, covered the last visible digit with his hand and said, ‘Well, it looks stable to me.’”

For another experimental setup with a hydraulics tray, Dawlearn pointed out that it had a small leak. “If you have a leak that’s non-life threatening, you’re not going to shut down,” he said. “It’s going to cost you a million dollars a day. You give the students a stopwatch. What percentage of the total flow is there? Calculate it. Things leak. In the real world, you limp along until you have a shutdown, and then you fix things. You’re not getting 100 percent diversion, but 95 percent is good enough. If you shut it down early, you’re getting no money.”

At one point, Dawlearn said that recruiters and job interviewers wouldn’t ask about GPAs for chemical and mechanical engineers graduating from the program – they were only interested in their grades for labs, to know how they would do in a practical setting.

Although computers are now used for many of the experiments, Dawlearn said they still have equipment that isn’t software-based. He noted that they had a significant number of students hired by international firms, and they had to know how to identify and use analog or digital equipment that might still be used in the field.

Of course, the pandemic presented a new challenge. For that, Dawlearn noted that professors still managed to facilitate experiments with “human robots.” Students gave instructions to their teaching assistants, who then set the experiments up to allow them to watch.

The oldest piece of equipment in the lab dates back to about 1957 – a four-level distillation column. Dawlearn said that a returning alumna told him that it was a working trade show exhibit that was donated to the university afterward.

“Starting with biodiesel, we knew we needed biodiesel. But we didn’t want to do it. We knew we needed to do it, but we didn’t want to do it,” Dawlearn said, reflecting on the lab’s history. “That’s what really set us apart. We put in the extra time and you got to do real engineering.

“We’ve bought things before, and ended up replacing everything on it,” Dawlearn said, reflecting on how much use they get from the equipment. Dawlearn was first hired thanks to a random connection. His stepfather was a barber at UH for 47 years, and he was cutting the hair of a supervisor of Dawlearn’s eventual boss. That supervisor mentioned that they needed another machinist, and Dawlearn applied for and got the job. Dawlearn left for a similar job in Arizona in 1990, but he rejoined UH after 18 months.

“I really missed working with the students,” he said of his time away. “That’s what really set us apart. We put in the extra time and you got to do real engineering. We would see an article about biodiesel, and decide to do it from scratch. Some of them made it, some of them made soap, which is a byproduct of biodiesel. But it was always hands-on and they learned. If someone just gives you the answer, what good is it?”

Much of the equipment in the lab over the years was self-made, or heavily modified. “We’ve bought things before, and ended up replacing everything on it,” Dawlearn said, reflecting on how much use they get from the equipment.

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"What makes it unique are these distillation trays, so that you can see what's going on," he said while running a demonstration of the working machine with air and water. "We've put Humpty Dumpty back together a few times here."

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Where are we going and how do we get there?

We spoke with Cullen College leadership to gain their perspective on these ever important questions. Join us as we reflect on the last decade of Dean Joseph Tedesco’s tenure and explore ideas for the future. Read on to see how the College is planning to engineer the future of Houston and beyond.
The Pursuit of Excellence

Reflecting on the 13 years he’s spent in his current role, Joseph W. Tedesco, Ph.D., Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering, acknowledged that there has been fantastic growth already, but he sees the potential for even more.

“Beyond attracting students with great academic records, we’ve also worked hard to serve a wide range of populations. I’m proud that the College recently finished in the Top 15 for degrees awarded to Hispanic students and underrepresented minorities in the most recent American Society for Engineering Education’s Engineering and Engineering Technology by the Numbers report, the standard for reporting colleges.”

As the Cullen College of Engineering transitions to a new strategic plan, growth will continue to be an important cornerstone. Tedesco said the push is still on for the College to convert its momentum in recent U.S. News & World Report rankings to a Top 50 status overall.

“We must and will continue to pursue excellence and maintain our unprecedented growth,” he said. “The mission of our College remains serving the greater Houston area, advancing the state of knowledge through research and scholarly work, facilitating the transfer of new technology worldwide, playing a key role in the economic development of the region, and benefiting the public by providing the students who will work in industry and staff oversight boards. I’m proud to have been a part of this university for the past 13 years, and I’m excited about the programs that we will continue to develop in the future.”

“I’m proud that during my tenure, the Cullen College of Engineering has been recognized as a Tier One Research University, undergradu- nate admission has more than doubled, and we have grown our tenured and tenure-track faculty members, a substantial increase from the 91 when Tedesco was hired. In that same time frame, the number of National Academy of Engineering members has increased from five to 15. Annual research funding has increased from $11.5 million in 2007 to more than $35 million in 2020.”

“Research strengthens the teaching and learning environment, and invigorates the student body as well,” Tedesco said. “Top class under- graduate, masters’ and doctor- al students need to be engaged in research to reach their full poten- tial, which generates the best re- sults from our professors as well.”

The Cullen College of Engineering enrolled more than 3,000 under- graduate students and 1,000 grad- uate students for the 2020-21 aca- demic year. The numbers will only continue to grow thanks to co-en- rollment initiatives with Houston Community College and Dalian Maritime University in China, in addition to the satellite campus in Katy.

However, Tedesco stressed that there must not be a compromise when it came to the quality of the students admitted, or the educa- tion given to the student. Under- grad enrollment was 1,374 in Fall 2008 – about a third of the cur- rent student body – but SAT stan- dards have increased as well, and the Honors Engineering Program was established in 2010. For stu- dents beginning in Fall 2013, the College’s six-year graduation rate was 71.4 percent, a record high and within the Top 25 percent of engineering programs nationally.

“We have worked diligently to re- cruit more excellent students into the Cullen College of Engineering programs, and the results have been dramatic,” Tedesco said. “Beyond attracting students with great academic records, we’ve also worked hard to serve a wide range of populations. I’m proud that the College recently finished in the Top 15 for degrees awarded to Hispanic students and underrepresented minorities in the most recent American Society for Engineering Education’s Engineering and Engineering Technology by the Numbers report, the standard for reporting colleges.”

The University of Houston was list- ed as the 7th best public university when it came to return on invest- ment, according to a report from CNBC and PayScale. The Cullen College of Engineering is a large factor in that ranking, with median salaries for entry-level graduates ranging from $55,000 to $99,000, and growth for engineering jobs projected at 11 percent through 2023 – more than 249,000 jobs worldwide, and 14,925 projected jobs in Houston alone.

To be in this position, the College has substantially increased its budget for research and retention of professors during Tedesco’s tenure. As of now, there are 141 tenured or tenure-track faculty members, a substantial increase from the 91 when Tedesco was hired. In that same time frame, the number of National Academy of Engineering members has increased from five to 15. Annual research funding has increased from $11.5 million in 2007 to more than $35 million in 2020.

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"I have been here since then, and I have very much enjoyed my time here – my personal growth and the growth of the college and the university have been exciting and rewarding to experience," he said. "Particularly, I would say in the last 10 to 15 years, I think there has been such tremendous growth in the city and our campus as a whole."

Rao has personally noticed how the reputation of UH has changed in the Houston metro and suburbs.

"I live in Sugar Land, which is in the Fort Bend ISD and has some very nice schools, and at the time of 1990 and 1991, we would occasionally get a highly rated student from the suburban school districts," he said. "Now, we routinely get top, highly accomplished students from all of our suburban districts. That's just a small nugget, but it tells you about the growth that we have had in our Tier One journey." 

Rao noted that one shift has been UH positioning itself as more than an inner city, commuter school.

"We are so much more than a residential university," he said. "I believe for the freshman class, close to 75 percent now stay on campus, even though we are very urban school and very friendly to commuters as well. That has been a big change."

This has come with changes to the physical structure of campus as well.

"In the last 10 years, our campus has literally transformed. My alums from 15 years come to visit, and they almost need a GPS to navigate around the new buildings and new facilities," he said, laughing. "We were always a very pretty campus, with beautiful trees and landscaping, but now the facilities are starting to match that standard as well."

Rao pointed to new majors like Petroleum and Biomedical engineering as being attractive. However, he added that the geography and stature of Houston would always give it an edge on other colleges and universities.

"Every time I get a chance to speak to prospective students or parents, I get to say to them what I would not be able to say to a similar audience at my alma mater at Michigan in Ann Arbor, which is that we have the blessing of geography here. In my view, there is not a sweeter spot for a student to get an engineering degree and start a career than this part of Texas. Houston has long had the energy industry, but now it is much more diversified. And it isn't just after graduation, but it tells you about the growth of the college and universities.

"We have benefited from being a Tier One university and UH outside of engineering, knocking on the doors and saying, 'I want to change my major into engineering and I'm doing preparatory work.'"

Continuing to grow, while improving existing facilities and building new ones to support that growth, will be the biggest challenge moving forward. Rao said he's excited about the possibility of more engineering academies and partnership agreements with schools, whether they're local – like Houston Community College, Lone Star and San Jacinto – or international, like at the Dalian Institute in China.

"The academy model we're developing is taking it one step further. It's a dual enrollment model, and students have ID cards in the market so they can tell family and friends, 'Hey, I'm a UH engineering student from day one. I'll be taking a lot of classes with HCC, but I'm taking engineering classes with UH of it.' I would put that near the top of my initiatives, to stay busy and active developing those agreements."
Hanadi Rifai, the Associate Dean of Research & Facilities and the Director of the Environmental Engineering Graduate Program, when she took the position, she didn’t want to just improve the quality of the research being done at the Cullen College of Engineering – she also recognized the importance of the people doing the research.

The effort has paid off, as both the amount of research done by professors at the Cullen College of Engineering and the make-up of the faculty have dramatically improved. In 2008, the College had eight female faculty members – the fall 2020 headcount was 43. The College now has yearly research expenditures of $35 million – an increase of an average of about $2.1 million per year from a decade ago – with more than 120 active laboratories and 29 centers, institutes or industry consortiums.

“When I joined the university, there was hardly any female faculty” that were on tenure-track.

“In addition to strengthening our faculty ties to industry, some of the things we’re proud of are bringing the Durga D. and Sushila Agrawal Engineering Research Building online, and providing a new building for petroleum, building the Katy campus, and fundamentally improving the buildings already within the college, like Engineering 1 and 2, where we’ve done internal improvements and projects. We also have a strong footprint in research at the UH Technology Bridge, in terms of the laboratories that are out there.”

In fitting with the university’s overall comprehensive plan, Rifai saw opportunities for the Cullen College of Engineering to work with colleagues in other colleges for multi-disciplinary research.

“For research, you have to work within the bigger picture of the campus and the university, not just the college of engineering,” she said. “We’re not one or two federal agency-centric anymore. We’re diverse in how they fund us and who funds us. The faculty are heavily engaged in many institutes outside of engineering. They’re heavily engaged in the medical school, for example, and we’re interested in expanding the footprint there as well. We’d like to connect more strongly with the medical school and more entities in health and life sciences.”

Going forward, Rifai echoed the comments of several other members of leadership about the need for a robust population of graduate students. She wants the College to be able to attract and to support those students once they arrive as well.

“Other initiatives have been support- ing the population of Ph.D. gradu- ates,” she said. “We now graduate 80 to 100 Ph.D. candidates a year. We’d like to have a student success focused faculty that has spaces for studying, collaboration and entre- preneurship. Then, you’re closing the loop on all of the strategic planning initiatives. It makes in- teractions with industry more ac- cessible to undergraduates, thanks to being vertically integrated, and not just for the Ph.D. students.”

She added, “We’ve maintained a 10 percent per year over year growth rate, and we’d like to continue that. The college faculty are an amazing group of researchers, and so are our Ph.D. and Master’s populations. They’re part of the success we’ve achieved, and we couldn’t get where we are today without them, along with industri- al support. That’s helped make our journey so much easier and enjoy- able. We look forward to the next strategic plan, which we’re developing right now.”

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For Suresh Khator, the Associate Dean of Graduate Programs & Computing Facilities, setting sights on the top 50

For Suresh Khator, the Associate Dean of Graduate Programs & Computing Facilities, a vibrant supply of graduate students was imperative in raising the Cullen College’s profile.

Shortly after joining the college and four months as a member of the Industrial Engineering Department, he was asked by Dean Joseph Tedesco to take on his current role as Associate Dean, which he had also held at the University of South Florida. At the time, Khator said that there was less of an emphasis on recruiting and growing the graduate programs – that the office served more as just an authorization stop.

“The dean had the vision that we want to take this college to be one of Top 50 colleges in the country,” Khator said. “Graduate education plays an important role in that. We wanted to grow Ph.D. and the master’s program together, so that some of our master’s students can go on to pursue Ph.D.s.”

Khator also noted that a strong supply of graduate students was needed to fuel the research that faculty wanted to do, and also, to attract and retain faculty that wanted to do world-class research.

“Faculty have these ideas, but the ideas are carried forward by graduate students, bright Ph.D. and master’s students. They have to run the experiments in the lab or run the computational software. So, graduate education is a very important part. Faculty won’t come if there are no Ph.D. students or master’s students. They look at that. A vibrant graduate program is more or less a necessity if you want to have growth.”

For the Cullen College of Engineering graduate programs, Khator and the dean have set a goal to award 100 doctorates a year, and 500 master’s degrees a year.

“We are around 90 Ph.D. degrees right now,” he said. “And so, 100 is going to happen. And in order to graduate 100 Ph.D.s, you require an enrollment of more than 500, because it takes four to five years to graduate, and there is some attrition as well. Typically, the ratio you want for master’s to Ph.D. is two to one. So, we want about 1,000 master’s students.”

Khator noted that they likely would have hit these numbers already, but pointed to the an inhospitable environment for international visas the past four years and the pandemic as affecting enrollment. However, he expects a rebound as the world continues to recover from the latter issue. For example, in India, the demand for student visas is more than 100 percent compared to what it was two years ago.

Khator said the college would continue to make strong domestic and international connections, to recruit the best graduate students, regardless of their home country. While most international students have historically come to UH from China and India, they are also looking to form agreements with universities in other countries, such as Ecuador and Vietnam.

In his 13 years at the university, Khator noted that they’ve been able to establish three more doctoral programs – Biomedical Engineering, Petroleum Engineering and Geo-sensing Systems Engineering – and hope to establish another one soon.

“I’ve shepherded through the three doctoral programs, but I’m not the originator. It is the individual departments, but I’ve helped to champion them through the approval processes. We are now going to develop a Ph.D. program with the Chemical Engineering Chairman’s leadership in Engineering Education research, so that will be more pedagogical based.”

Khator added that the College will continue to expand its online offerings, noting that they are popular options for working engineers who want to enhance their skills and professional growth. They have also developed a master’s degree in Data Science in Engineering that would combine courses from the Cullen College of Engineering and the College of Natural Sciences and Mathematics.

He noted that the majority of the Ph.D. students are fully supported on the research grants of the faculty, and the provost provides the tuition and fees. Some students are also supported by their governments in China, Pakistan and Brazil. Master’s students, on the other hand, may earn scholarships and financial assistance, but it is not guaranteed. Consequently, the College has to cast a wider net to reach out to them and to recruit them aggressively.

“Our College has an unprecedented amount of momentum and extremely talented faculty,” Khator said. “I am excited to be part of the team that envisions building a Top 50 College in the nation.”

“We wanted to grow the Ph.D. and master’s programs together, they often go hand in hand.”

—SURESH KHATOR
When reflecting on the five years he’s spent with the University of Houston, Jerrod Henderson – the director of PROMES and an Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering – described it as a “fast track” for his career, starting with his first moments in July 2016.

“When we reflect on the five years he’s spent with the University of Houston, Jerrod Henderson – the Engineering – described it as a “fast track” for his career, starting with his first moments in July 2016. Henderson noted that this early contact with students is key to improving recruiting, retention and graduation rates, with the efforts feeding one another. In June 2017, he became the director of PROMES, which overlapped well with his existing duties.

“I got asked if I wanted to teach Chem E courses as well as first year, and I thought that was a great fit,” he said. “For us in the first-year program, it helped us see our students, and to prepare them for upper-level courses. We had that setup where we taught first year students, but we could also teach some of the other courses in our home discipline.”

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As director of PROMES, Henderson said he felt it was important to rebrand the program. He noted that in the past, students might use a facet of the program but trail off as they continued in their college career.

“A big thing for me was to increase the number of students, and we had a charge from the dean to serve all the students in the college,” he said. “Now, we refer to them as PROMES scholars. We want them to be involved throughout, and to talk about their experiences to the younger students.”

Henderson said that they are also revamping their residential summer camp programs, and making sure those students see UH as an attractive school to apply to and attend.

“In Fall 2020, we had one student show up at UH as a student who participated in our summer camp,” he said. “But for Fall 2021, we’re expecting five. If we keep it at this pace, we’ll see an increase in the number of students who use summer camp as a preview, and then subsequently enroll at UH.”

Henderson sees these PROMES scholars, as well as other graduates, as one of the most important factors in growing the UH brand.

“UH is well-known regionally, but I want to contribute to growing the brand nationally,” he said. “A lot of our PROMES scholars are from Houston, and it’s great if they can land a job here. But I also say to them, ‘Go somewhere else, so that you can spread that brand.’ I want PROMES scholars and graduates in Florida, North Carolina, everywhere, talking about the University of Houston and demonstrating the quality of our education with their work.”

Looking forward, Henderson is part of a group of administrators at the Cullen College of Engineering that is developing the Field of Engineering Education – delving into why people decide to become engineers, how they develop an “engineering identity,” and whether there are ways to spark that interest in the field early.

“I’m particularly interested in how people become interested in engineering, especially under-represented students,” he said. “This year, we were serving about 400 scholars, and all of our scholars that want it have received mentoring and coaching from myself, Minvera Carter and some PROMES alumni, but you know, there are some scholars that I’ve met with once a week for an entire school year, and that’s pretty time consuming, but it’s so rewarding to see them meet their goals.”

In addition to his work with PROMES, Henderson was also selected this year to join the Chemical & Biomolecular Engineering Department as a tenure-track Assistant Professor following a national search. In that role and as director of PROMES, he looks forward to continuing to work directly with students.

“We become really close to these students, and many of them spend hours with us, like our PROMES ambassadors.” He said, “This year, we were serving about 400 scholars, and all of our scholars that want it have received mentoring and coaching from myself, Minvera Carter and some PROMES alumni, but you know, there are some scholars that I’ve met with once a week for an entire school year, and that’s pretty time consuming, but it’s so rewarding to see them meet their goals.”

The research is complicated, because of all of the variables involved – it’s hard to pinpoint the effect of having another family member who graduated college, for example, or how mentorship correlates to future success. Henderson laid out how that line of research could help provide answers for hiring and retaining a more diverse faculty as well, with more members from underrepresented students.

“I think more scholarship [research] and innovative interventions are needed that strategically recruit, hire and support underrepresented faculty, students and staff. The work of scholars, including my work, in the field of engineering education point toward evidence-based approaches. It’s now up to institutions to implement some of these findings.”
By 2004, he had been promoted to the Associate Dean of Undergraduate Programs and Computer Facilities, and in 2007, he served as Interim dean, until Joseph Tedesco was hired. In 2008, he became Associate Dean of Administration and Research, a position he held through 2013. He served as Director of the Division of Undergraduate Programs and Student Success from 2015 to 2020, and he is still actively involved in the Honors Engineering Program, originally acting as Director in 2014.

As the Cullen College of Engineering has evolved, Claydon has overseen or helped to develop many of those growth areas, whether the metric is student success, enrollment or diversity.

"Along with Eugene Chiappetta, Stuart Long, Hanadi Rifai and Pradeep Sharma, I helped to administer and start the NSF-funded GK12 program at UH from 2011 to 2016," he said. "The major goal of the GK12 program was to enhance the professional growth of Ph.D. Fellows so they can take a significant role in promoting a scientifically, technologically and mathematically literate society. In addition, the Fellows will be better able to make policy recommendations to government agencies and political entities. The program started with a vision of promoting a generation of leaders to teach, to train the next generation and to be positive leaders in the community. GK12 is a success for the University of Houston and the students involved, and it provides a model for other programs to follow.

Claydon also pointed at the NSF Research Experience for Teachers, which ran from 2007 to 2016 and distributed $800,000, as another program that he was proud of overseeing during his time at UH.

"This program was awarded the President of the United States’ Higher Education Community Service Award in 2013,” he said.

Going forward, Claydon identified the need for improvements to facilities and buildings, and better budgeting and prioritized spending, as challenges facing the College. However, he was also proud of the progress the College had made when it came to graduation rates and other metrics.

"We’ve increased the undergraduate graduation rate from 46 percent to 71 percent from 2015 to 2020,” he said. “We’ve tripled the size of the Honors Engineering program, from 200 to 600 students, in a similar time frame. As we continue to grow, we’ll need the space and technology to provide a fertile learning environment for these students.”

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This year, there were seven recipients:

- Junjiang Yu, senior faculty member, Mechanical Engineering
- Sergey Shevchukyan, senior faculty member, Biomedical Engineering
- Taewoo Lee, junior faculty member, Industrial Engineering
- Rodolfo Ostilla Monico, junior faculty member, Mechanical Engineering
- Megan Robertson

The nominees are outstanding teaching and service to students. This year’s recipient is Di Yang of Mechanical Engineering.

The Career Teaching Award is given intermittently, and recognizes faculty members who have shown a lifetime commitment to students. Yi-Chao Chen of Mechanical Engineering was honored this year.

The William A. Brookshire Teaching Excellence Award recognizes faculty members that demonstrate an unwavering commitment to the highest levels of teaching excellence. These faculty provide the highest caliber of instruction and mentorship to students while creating a unique and structured learning atmosphere, positively influencing the lives and careers of students.

This year’s two recipients are:
- Reagan Herman, Civil and Environmental Engineering
- Hollie Love, Mechanical Engineering

The Teaching Excellence Award recognizes outstanding teaching and service to students.

This year, there were seven recipients:
- Megan Robertson, faculty, Chemical and Biomolecular Engineering
- Rodolfo Ostilla Monico, faculty, Mechanical Engineering
- Devin Shaffer, faculty, Civil and Environmental Engineering
- Harish Krishnamoorthy, faculty, Electrical and Computer Engineering
- Yaping Wang, instructional faculty, Industrial Engineering
- Sadaf Pustchi, teaching assistant, Biomedical Engineering
- Silong He, teaching assistant, Mechanical Engineering

This year’s recipients are:
- Aseem Chawla, Chemical and Biomolecular Engineering
- Musta Ozurt, Biomedical Engineering

The Andrea Prospertetti Research Computing Faculty Award recognizes tenure and tenure-track faculty in the Cullen College of Engineering who have demonstrated a singular achievement in the prior calendar year in the broadly defined topics of scientific computing and data science. This year’s winner is Lars Grabow of the William A. Brookshire Department of Chemical and Biomedical Engineering.

In addition, the Andrea Prospertetti Research Computing Faculty Award recognizes graduate students and postdoctoral researchers who have made outstanding contributions to research in science and high-performance computing as well as their applications.

This year’s recipients are:
- Kosef Moazzafi, Mechanical Engineering
- Jiahao Ding, Electrical and Computer Engineering

The Rising Innovator Award recognizes efforts by faculty in innovation and entrepreneurship at UH. The nominee must be a tenure-associate professor with a track record of mentorship of students and postdocs in innovation and entrepreneurship. The nominee must demonstrate innovation and efforts in transferring technology to practice. Hadi Ghasemi of Mechanical Engineering won this year’s award.

The Early Innovator Award recognizes efforts by tenured-track faculty in innovation while at UH. The nominee must be an assistant professor in the tenure track for a minimum of three years, with a record of mentorship of students, and in innovation. This year’s winner is Jiefu Chen of Electrical and Computer Engineering.
Huang said he shared his post-GE goals with Kaushik Rajashekara, a Distinguished Professor of Engineering in the Electrical and Computer Engineering Department, who is also a member of the NAEd_IEEE and SAE.

"He has been a member of the NAEd for years, and he also came from the aerospace industry, although he came in at much younger age. I understood my degree and was very supportive, and he introduced me to the department chair Professor Badri Roysam," Huang said. "I then had an opportunity to meet with the Dean of the engineering school, Dr. Joseph Tedesco, and then I was offered this position."

Huang said he was excited to help students through the next transition phase of the aerospace industry.

"Aerospace is experiencing a major advancement or revolution – electrification, including more electrical aircraft (MEA) and hybrid electrical propulsion (HEP), and addressing the challenges of energy conservation and environmental challenges, such as pollution, noise and greenhouse issues," he said. "Regarding what is electrification, long story short, MEA refers to electrifying the aircraft systems – hydraulic systems and pneumatic systems – while HEP is a big step further – electrifying the engine that provides the aircraft propulsion. This whole electrification is and will be opening up huge opportunities for the young engineering generations in the next few decades to come. Renewable energy is one of the aspects in MEA and HEP."

Huang’s first course offering will be ECE5388, Renewable and Efficient Electric Power Systems.

"Although aerospace is not a focus in this course, the concepts utilizing renewable energies will be very adaptive to aerospace," he said. "Utilizing renewable energy is a big trend, and learning about it is important for the generations to come. Obviously new engineering generations need to be ready for this major trend and challenge."

Huang is also working on a new book that can be used by this generation of students.

"One of my goals is to co-author a new book and start a new course, Electrical Power Systems and Components for Modern Aircraft Electrification, after the book is ready," he said. "The purpose of these is in line with my primary motivation – helping young engineers who just came into the aerospace field and the electrical power industries that will accelerate their learning curves and maximize their abilities."

Huang received his doctorate in electrical engineering from the University of Colorado at Boulder. He received his M.S. in electrical engineering from Hohai University in Nanjing, China, and his B.S. in electrical engineering from Tsinghua University in Beijing, China.

When it came to his professional accomplishments, Huang pointed to the citation he received from the NAEd “for contributions to advances in electric machines and power electronics technologies for aerospace electrical systems.” His team at GE also had a list of accomplishments that he was particularly proud of:

• The world’s first aircraft main engine starter and generator (S/G) (15kW) with regenerative and sensorless commutation capabilities for Aerospace.

• The world’s first aerospace 1 MW dual spool electric power extraction (22kW from the high spool and 750kW from the low spool) from a GE F110 engine.

• The U.S.’s first Silicon Carbide (SiC) based aircraft electric power system, including all subsystems having been utilized in the two new U.S. air vehicles developed by a major U.S. aircraft manufacturer.

• The aerospace industry’s first +/-270V DC aircraft electrical system and vehicles developed by a major U.S. aircraft manufacturer.

• The world’s first ADDITIVE manufacturing technology based aircraft synchronous electric generator (120kVA).

• The world’s first MW power, kV voltage, high altitude electric motor utilized to drive an aircraft propulsive power.

• The world’s most advanced electrical power integrated systems center (EPICenter) in GE Aviation in Dayton, Ohio.

"I am very pleased that for almost all of these I was able to conceive the concepts, invent the ideas, provide the technical leadership, and closely work with the team to work through the critical issues to achieve success," he said. "I will share my experiences of these things in the courses that I will teach at the UH whenever appropriate."
I've only been at UH for four years, but I've had the opportunity to dream big and have received so much support to do so from Minerva Carter, Dean Joseph Tedesco, Dr. Fritz Claydon – my first supervisor at UH – Dr. Rosalinda Henderson, Monique Jones, Rachell Underwood, Dr. Hanadi Rifai, and Dr. John Hendi Harald to name a few," he said. "I come up with lots of ideas, find funding to support the ideas, and these folks have helped me make the dreams come true.

Henderson also identified a few of the efforts he's been proud of in his time at UH. For example, Henderson is the co-founder, with Rick Greer, of the St. Elmo Brady STEM program, which is now at three schools in Houston.

"I helped initiate a faculty-led engineering learning abroad experience, first in Brazil in 2016 and earned the IEEE (Council on International Educational Exchange) grant to send students to Ghana," he said. "We've been able to provide paid opportunities for engineering students to conduct Engineering Education Research, and I'm proud of being the director of the Program for Mastery in Engineering Studies, our amazing PROMES Scholars, and the things we've been able to accomplish in just three years."

Going forward, Henderson said he is focused on growing the PROMES program from about 20 to 600 scholars in the next five years, as well as branching into new programs.

"I am a part of a team that is planning to develop an Engineering Education Department at UH, which is my research area, and I'm excited that we have administrative support to make this happen," he said. "I'm excited that this is recognized on our campus as a viable area of scholarship. We've also developed a support program for PROMES Scholars who are interested in graduate school. We look forward to sending at least five PROMES Scholars per year over the next five years to graduate school."

A professor at the University of Houston's College of Engineering earned yet another national distinction, as his work in providing unique learning experiences for students was recognized by the Career Communications Group's U.S. Black Engineer and Information Technology magazine, and the Council of Engineering Deans of the Historically Black Colleges and Universities.

Akay Tabbed For IEEE EMBS President

BY STEPHEN GREENWELL

Metin Akay, the founding chairman of the Biomedical Engineering Department and the John S. Dunn Endowed Professor of Biomedical Engineering at the University of Houston's Cullen College of Engineering, was named the president of the Institute of Electrical and Electronics Engineers (IEEE) Engineering in Medicine and Biology Society (EMBS).

"I am honored and humbled to be elected as the President of IEEE Engineering in Medicine and Biology Society," Akay said. "IEEE EMBS is the largest international organization, with more than 12,000 members, that brings together engineers, physicians, and scientists to tackle global challenges through healthcare innovations. The parent society, IEEE, is the largest international organization, with more than 400,000 members, and is dedicated to increasing global public awareness on the impact of biomedical engineering innovations in healthcare with the participation and collaboration of engineers, scientists, physicians, healthcare professionals, and industry leaders."

Akay's term runs through December 31, 2022. Akay has already begun working on initiatives to fight the current pandemic that he will be continuing with other researchers and professionals in 2021 and beyond.

"I have already envisioned and implemented the most comprehensive and public Grand Challenge Forum in COVID-19 with Drs. Shankar Subramaniam (UCSD), Paolo Bonato (MIT/Harvard), Colin Brennan (Cellbio Inc.) and with the participation of many other researchers. I am very excited about this," he said. "The very successful COVID-19 forum was held in November, and highlighted and discussed the challenges and opportunities in COVID-19 screening, tracing and treatment. We strongly believe that this forum has helped to build a platform that strengthens our collective capability to exchange ideas as well as share, access and manage data, models and latest reports related to public awareness of the role of biomedical engineers and healthcare innovations in our global community. I have the vision, passion, and network to achieve these goals."

A professor in the Cullen College of Engineer's Department of Civil and Environmental Engineering was recognized by two international organizations for his contributions and research.

Thomas C. Hsu, the Moores Professor of Civil Engineering, received the 2020 Distinguished Achievement Award from the Society of Earthquake Engineering of the Republic of China, Taiwan, and the Structural Engineering Society of the Republic of China, Taiwan.

In a statement for the achievement, officials from the organizations identified his nearly 60 years of research in mechanical performance of reinforced concrete structures as a key component for the honor.

"The Unified Theory of Concrete Structures (2010, John Wiley) proposed by Professor Hsu introduced the fundamental nonlinear relationship of constructional materials and has been implemented into existing finite element simulation software," the statement reads. "Based on high-performance computing, the proposed theory can be applied to conduct design and analysis of various infrastructure systems, including buildings, highways, bridges, marine platforms and containment in nuclear power plants. The fundamental theory of shear and torsion performance of reinforced concrete structures is comprehensively and completely well established and the innovation in engineering structure design practice is promoted. This theory has a profound impact on the research and development of civil and structural engineering."

Hsu thanked the societies for giving him the honor, as well as his colleagues at the University of Houston for providing an environment that allowed his research to flourish.

"This award is a result of more than 20 years of research cooperation between THSR (Thom- as T. C. Hsu Structural Research Laboratory) in Houston and NCREE (National Center for Research in Earthquake Engineering in Taiwan)," he said. "I very much appreciate the strong support to this international cooperative research provided by Dean Joseph Tedesco of the Cullen College of Engineering, Civil and Environmental Engineering Chairman Rober- to Ballarini, as well as others. I have worked at University of Houston for 47 years and have many fond memories of cooperating with col- leagues in and outside of the college."

Officials also noted that Hsu has given lectures at the National Taiwan University in 1978 and 2010, and setup engineering courses that have contributed to the training of high-level technical talents important for the country. Hsu also established collaborations between researchers in the United States, Taiwan, and Italy on a long-term seismic engineering project.
Three University of Houston Cullen College of Engineering researchers were named Senior Members of the National Academy of Inventors (NAI) for 2021.

Hien Nguyen, assistant professor of electrical and computer engineering; Jeffrey Rimer, Abraham E. Darlend Endowed Chair, William A. Brookshire Department of Chemical and Biomolecular Engineering; and Gangbing Song, assistant professor of electrical and computer engineering, are among 61 academic inventors from around the country chosen for the prestigious honor for their remarkable innovation-producing technologies and growing success in patents, licensing and commercialization.

“This national distinction honoring the research and scholarship of Drs. Nguyen, Rimer and Song is emblematic of the reputation for innovation fostered at the Cullen College of Engineering,” said Paula Myrick Short, senior vice president of academic affairs and provost at UH. “Congratulations to these three outstanding faculty members for this well-deserved recognition.”

Professor Nguyen’s work is at the nexus of biomedical data analysis and artificial intelligence (AI). He is passionate about inventing novel algorithms to address physicians, biologists and patients’ compelling needs.

“My recent projects aim to develop novel AI principles for analyzing microscopic, histopathological and radiologic images,” Nguyen explained. “Being selected as a senior member of NAI will allow me to access an excellent collaborator network to further pursue my current research interests.”

Professor Rimer is known for his expertise in the processes behind crystal growth and formation, which impacts everything from drug delivery and the production of chemicals and fuels to pathological diseases such as kidney stones and malaria.

“I am extremely honored to receive senior membership in the NAI,” Rimer said. “Being affiliated with this prestigious organization will afford new opportunities for innovation and expanded research activities by engaging with a global network of highly accomplished inventors.”

In his Smart Materials and Structures Laboratory at UH, professor Song researches the development of actuator systems for aerospace, biomedical and oil exploration applications as well as sensor systems for biomedical research, oil exploration and structural health monitoring. The lab has also developed fiber optics-based displacement sensors for orthopedic research and fiber optic sensors for dynamic measurements.

“It is quite an honor to be a senior member of NAI. I am proud the inventions of Smart Materials and Structures Laboratory have been recognized,” Song said. “UH offers a fertile ground for research and invention to grow. I appreciate the contributions from my past and current students, postdoc associates, academic and industrial collaborators, and visiting scholars to my lab.”

The ability to nominate an individual for NAI Senior Member recognition is an exclusive opportunity afforded solely to NAI Member Institutions to recognize their outstanding innovators. These organizations themselves are widely regarded as innovation powerhouses which continuously promote and foster the spirit of innovation.

The recognition of intellectual and practical output of our professors is yet another confirmation of the pivotal role UH faculty play in addressing critical societal and technological challenges said Amr Elkhall, vice president for research and technology transfer at UH.

“Creating new knowledge that underpins addressing today’s challenges is at the core of our institution’s mission. The recognition of Drs. Nguyen, Rimer and Song by the National Academy of Inventors highlights outstanding research endeavors that each is undertaking,” he said. “It also highlights the important role UH plays in advancing innovation to improve the quality of life in its region, state, nation and further afield.”

This latest class of NAI Senior Members represents 36 research universities, government, and nonprofit research institutes. They are named inventors on over 67 issued U.S. patents.

“NAI Member Institutions support some of the most elite innovators on the horizon. With the NAI Senior Member award distinction, we are recognizing innovators who are rising stars in their fields and the innovative ecosystems that support their work,” said Paul R. Sanberg, NAI president. “This new class is joining a prolific group of academic visionaries already defining tomorrow.”

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Cullen College of Engineering welcomes 12 new hires

BY STEPHEN GREENWELL

In addition to July’s NAE hire of Hao Huang, the Cullen College of Engineering welcomed 12 new professors and lecturers for the 2021-22 academic year, as part of its continuing effort to grow the faculty and to provide high-quality instruction for undergraduate and graduate students.

The following list of hires is organized by department and then name, both in alphabetical order.

Chemical and Biomolecular Engineering: Jerrod Henderson, assistant professor. Henderson has been an instructional professor at UH and served the college in other roles, before being hired for this tenure-track position following a national search.

Gül Zerze, assistant professor. Zerze was previously a postdoctoral research associate at the University of Texas at Austin. Her research primarily covers the fundamental understanding of molecules of life via molecular simulation methods and theory.

Civil and Environmental Engineering: Behrooz Ferdowsi, assistant professor. Ferdowsi previously worked as an associate research scholar in the Department of Geosciences at Princeton, following a position as the Harry H. Hess Postdoctoral Fellow from 2017-2019. His area of study is constitutive laws for rock friction, and revisiting the physical basis for an existing empirical constitutive modeling framework for frictional behavior of rocks and other Earth materials, known as the “rate and state-dependent friction” framework.

Pietro Milillo, assistant professor. Milillo worked as a scientist and postdoctoral fellow for the Wennovation Hub, a tech incubator and non-profit that provides consulting services for businesses wanting to do work in the science and technology of processing polymers and polymeric products.

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The artistic work of a scientist at the Cullen College of Engineering was recognized with a third-place finish in the British Association for Crystal Growth’s 2020 Crystal in Art competition.

Rajshree Chakrabarti, a graduate student in the William A. Brookshire Department of Chemical and Biocatalytic Engineering, was honored for her submission, “Colours of Life,” which showcases Protoporphyrin IX. Her adviser is Peter Vekilov, the John and Rebecca Moores Professor of Chemical and Biomolecular Engineering and Chemistry.

“I saw these crystals of Protoporphyrin IX using a scanning electron microscope,” she said, describing how she created the image. “Usually, a crystal should have well-defined faces and shape, but since I did very fast crystallization, these defective crystals of Protoporphyrin IX formed. I was amazed to see these defective but unique crystals. Usually, we see black and white images in the scanning electron microscope. For the competition, Dr. Vekilov suggested me to render out crystals, and I thought of using the cougar red color of the University of Houston.”

Chakrabarti said that she keeps up with developments in her field, and as a result, she follows the BACG and the Cambridge Crystallographic Database on Twitter.

“Apart from research, I am interested in art, and crystallography is an art form,” she said. “Crystals of different shapes and sizes result from the way they are crystallized. So, when I saw this competition on Twitter from the BACG, I submitted my entry.”

Chakrabarti noted that competitions like these can help to deepen the connections between art and science, and encourage development in both fields.

“I have always been interested in art and I like to take part in competitions,” she said. “Overall, I realized during my PhD that crystallization is a form of art. The University of Houston is a top tier research university, and the research we do in Dr. Vekilov’s lab has a broader impact on society. We want to understand the fundamentals of crystallization. "Crystalization techniques are used extensively in the separation and purification of specialty chemicals like active pharmaceutical ingredients, catalysts and molecules, which in crystalline form are used in electronic and optical devices.""
**STUDENTS**

- **PROMES Event (July 2019):** Program for Mastery in Engineering Studies (PROMES) is a service of the University of Houston Cullen College of Engineering that provides engineering students with recruitment, academic advising, workshops, scholarships and professional and personal development opportunities, such as volunteer events in the local community. It places a specific emphasis on reaching out to minority groups in UH engineering and helps them develop a foundation for success in their future. The group's secretary communicated with the PROMES staff and scheduled a three-hour activity for a group of high school students as part of their STEM summer camp.

- **Tenaris Field Visit (October 2019):** In a plant tour, the chapter went to Tenaris Bay City, one of the most prominent pipe manufacturers in North America at their most advanced plant. They had a complete plant tour of the 1.2 million square feet facility and were taught about their day to day operations, which coincided with a lot of the operations research and manufacturing learned in classes.

- **Internship Experience Panel (November 2019):** In this event, the group hosted five students who had internship experiences in OR and Data Science positions at IBM, BNFS Railway, Schweitzer Engineering Laboratories, Powell Electronics and Carnegie of Engineering. The guests shared their experience and tips and tricks for job searches and interviews. The event was followed by a Q&A and networking session for the audience and the guests.

- **Ronald Reagan High School (November 2019):** The IE Department at UH was offered an opportunity to attend a major career fair in San Antonio, Texas at the Ronald Reagan High School, which is one of the oldest of Caleb, Alanna, Laila, Cameron, Sara, Joshua, Micah, Jessica and Julia. However, his mindset changed when he saw his father, Warrick, addressing a room full of his fellow engineers. To that point, Combs hadn’t really considered that field, even though his father worked in it, because he didn’t see many other African-Americans involved in it. Seeing his dad give a riveting speech to his peers was like a lightbulb moment for him, though.

**BY STEPHEN GREENWELL**

When Wesley Combs was attending Houston Community College in his 10th grade year, he was primarily interested in the liberal arts. Even before graduating, he had written novels, and he thought that would be his career. However, his mindset changed when he saw his father, Warrick, addressing a room full of his fellow engineers. To that point, Combs hadn’t really considered that field, even though his father worked in it, because he didn’t see many other African-Americans involved in it. Seeing his dad give a riveting speech to his peers was like a lightbulb moment for him, though.

“I attended my father’s presentation, and it all became clear to me;” he said. “Seeing my dad on stage, working as an engineer, gave me a picture to see myself in. I could actually envision myself giving that same speech, walking across that same stage and embracing my own family. For once, I didn’t feel alone. I was not alone.”

That speech started a whirlwind of activity on Combs’ part, starting with a first place finish in a high school in downtown Houston’s Energy Day Festival, extending to his pursuit of a Mechanical Engineering degree at the University of Houston, and culminating – for now – with his second award from the Black Engineer of the Year Awards (BEYA) STEMC Conference.

For 2021, Combs won the award for Student Leadership at the Undergraduate Level. In 2020, he received an award for winning the Student Research Competition Research. Beyond the awards, he has maintained a 3.93 GPA even as his courses have gotten more difficult, and he has been actively tutoring and mentoring other students via his involvement with the Scholars Enrichment Program (SEP) and the Program for Mastery in Engineering Studies (PROMES).

Combs said his father, Warrick, ended up working for BP for more than 20 years, before starting his own real estate investment business five years ago. In the speech that Combs saw, his father stressed the importance of providing for his wife Jane and his family, which is underpinning the importance of developing the skills of his siblings, the eldest of Caleb, Alanna, Laila, Cameron, Sara, Joshua, Micah, Jessica and Julia. A generous scholarship offer and UH’s standing as a Tier One research faculty attracted Combs to campus, after finishing his high school and HCC coursework.

“I had also been interested in transferring to UH for a while, so I figured I could get to know the campus, faculty and students while I was doing my research,” he said. “Many faculty members have had a positive influence on me since I enrolled at UH. Jakob Brgosh gave me my first research opportunity in my senior year while Holley Love and Farah Hammami have been my favorite mechanical engineering professors. It’s been very helpful for helping students succeed in difficult classes. Jerrod Henderson and Eduardo Cerna have given me opportunities to tutor, advice and support fellow STEM students as well as receive academic and professional guidance for myself.”

Combs is a member of the National Action Council for Minorities in Engineering, the National Society of Black Engineers, the American Society of Mechanical Engineers. Combs has also completed three professional internships with Boeing, the National Science Foundation and Verizon. The latter held a STEM fair for middle school students, and it was a sort of “full circle” moment for Combs, which he described in a personal essay.

“As the kids left and the interns prepared to go to the next school, one of the children, a young Hispanic girl, asked the young man if he really thought kids like her were smart enough to be engineers,” he wrote. “He smiled and said that if he could do it, anyone could. The girl smiled back and left the booth. That was the first time I had the chance to publicly present my STEM experiences. It was also the moment I realized how much I could improve the lives of other people.”

Combs hopes to keep inspiring others as he continues his educational pursuit at graduate school in Fall 2021.

**BY STEPHEN GREENWELL**

**Combs Ears BEYA STEM Award for Student Leadership**

Arturo Velazquez, a senior at the University of Houston’s Cullen College of Engineering, knows about the anxiety a medical issue can cause, and as a result, he’s attempting to make a difference by studying the field of Biomedical Engineering.

“My main motivation has always been helping people improve their health and giving them hope for a better life,” he said. “I try using medicine-implementing engineering to find solutions to diseases or improving existing ones. A few years ago, I experienced a health scare while in Taiwan. I was fortunate to only have a minor medical complication, but I could not stop thinking of the desperation people would feel hearing the own dreaded diagnosis. Having this in mind, I strive to create new technology in medicine to give people the hope that they can overcome an illness and get healthy again.”

As part of that, for his capstone project he is creating a micro-device that interacts with the brain.

“My project is capable of sending electric signals to muscles or the brain in order to create contractions or sensations,” he said. “By doing so, we help patients suffering from stroke or spinal cord injuries strengthen their nerves by making a connection between thoughts to muscle contractions and movements. The device will be connected to a computer and a program we will create, in order to make it easy for anyone to modify the type, timing and intensity of the signal sent to the nerves, based on the patient’s needs.”

Velazquez has been recognized for his efforts in and outside of the classroom and research labs. In early 2020, he received the Most Active Member award from the UH chapter of the Society of Hispanic Professional Engineers, and also became the chapter’s Mentoring Coordinator.

Velazquez was also one of six 2020 UH student recipients of scholarships from the Great Minds in STEM program. He received the Villarreal Family Scholarship, sponsored by Raul and Cecile Villarreal. He is now looking forward to a masters program in Taiwan, to have a more global perspective of engineering, while also mastering his Mandarin and Japanese skills.

He highlighted several of his professors as being strong, positive influences on his studies while at UH.

“I have been fortunate enough to receive guidance and mentoring from many figures within the College of Engineering,” he said. “Dr. Metin Akay, the founder of the Biomedical Department, shares my same passion for helping those in need and believes in the future of these technologies. Dr. Sergey Shevkoplyas was my first professor at UH and taught everyone in my class the mindset to think outside the box to find the easiest problem to solve. Prof. Hori Inoue gave me the chance to work on his research project, learning new ways to use today’s technology to solve complex problems in medicine.”

**BME Student’s Capstone Project aims to Help Stroke, Spinal Cord Injury Patients**

**BY STEVEN GREENWELL**
Her work as an undergraduate computational researcher sparked my curiosity about the different facets of Chemical Science, and also encouraged me to consider higher education in the future. This award will be of great help to me, granting me the opportunity to attend different meetings and conferences to connect with individuals from industry and academia and refine some of my skills. My research professor, Dr. [Lars] Grabow, and my research mentor [postdoc] Debtsami Mari have played a big role in this award. I am very grateful for their support.

Futy made the best of her time at UH with a variety of student organizations and opportunities outside of the classroom as well. She served as a PROMES ambassador, the public relations chair for the UH Society of Chemical Engineers, as the Community Relations Chairwoman for the Society of Women Engineers. She is involved in several student organizations. Her work as an undergraduate computational researcher sparked my curiosity about the different facets of Chemical Science, and also encouraged me to consider higher education in the future. This award will be of great help to me, granting me the opportunity to attend different meetings and conferences to connect with individuals from industry and academia and refine some of my skills. My research professor, Dr. [Lars] Grabow, and my research mentor [postdoc] Debtsami Mari have played a big role in this award. I am very grateful for their support.

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Winning an award can always be an emotional moment for a student, but for University of Houston senior Jose "Javi" Solano, being picked as a 2021 Goldwater Scholar especially resonated.

“The Goldwater Scholarship is the most prestigious undergraduate STEM scholarship in the nation, and I couldn’t have been more humbled to receive it. However, this award means much more than that to me,” he said. “It is the greatest, and sadly last, award my father was present for me to receive. He recently passed away due to complications with cancer, but I am proud to know that he was aware that I had worked in his name to receive this award.”

The Barry Goldwater Scholarship Awards are designed to foster and encourage outstanding students to pursue research careers in the fields of the natural sciences, engineering and mathematics. The Goldwater Scholarship is considered one of the preeminent undergraduate awards of its type, with only 410 students picked this year from an applicant pool of more than 5,000.

Growing up with his father Javier Sr., mother Karen and brother Gabriel, Solano graduated from the Woodlands College Park High School, and his initial interest in UH came from its proximity to home. However, after attending several open houses at the Cullen College of Engineering, he was more motivated to join what he called “a diverse community of researchers,” majoring in mechanical engineering.

He identified several members of the faculty as supporting his work, and being responsible for his success.

“I believe I excelled here because I was taken in early by two professors in the First Year Experience program, Dr. Jerrod Henderson and Dr. Dan Burleson,” he said. “In high school I had enjoyed STEM subjects, but never pushed myself to excel. When I started taking my early engineering courses, Dr. Henderson began teaching me different learning strategies, and the one that has stuck with me most is simply reading the textbook!”

Solano said Burleson was responsible for his first research opportunities at UH. “He mentored me through my first engineering research opportunity – the HERE program at the University of Houston – and has since served as my boss for a course I serve as TA for,” Solano said. “He was the mentor that introduced me to engineering research.”

Solano said he couldn’t imagine being in the position he is now without the influence of either.

“Without each of them I definitely wouldn’t be the academic I am today,” he said. “Coming into college, I had a lot on my plate, and I believe that the wrong influences would’ve instead pushed me to ignore my responsibilities. Dr. J and Dr. B taught me how to deal with these responsibilities through my studies.”

When applying for the Goldwater Scholarship, Solano noted that Ben Rayder, Ph.D., the Honors College Director of Scholarships & Major Awards, assisted him thoroughly and worked as tirelessly for him.

“We have worked together only two times, during the summer of 2017 and during my application for the Goldwater scholarship,” Solano said. “However, he has been the biggest supporter of my research career at UH. I also want to mention a few other faculty - Dr. Matthew Zelisko, Dr. Cunjiang Yu and Dr. Roberto Ballarin. My experiences with them range from working in Dr. Yu’s lab, to a simple one-time discussion about engineering literature with Dr. Ballarin. Being a previous student of all of them, their teaching styles continued to inspire me to push through the challenging courses.”

Going forward, Solano hopes to pursue his own doctorate degree, and to continue doing research this summer. He expects to graduate in December 2021.

“The last two summers, I have worked in the lab of Dr. Michael Sangid in the School of Aeronautics and Astronautics at Purdue University,” he said. “I plan to pursue my masters and PhD. under his supervision come Spring 2022.”

- JOSE SOLANO

Learn more about the Barry Goldwater Scholarship

www.goldwater.scholarsapply.org
I always had an insatiable curiosity about electronics and gadgets. We live in a modern society where you can take things apart, and you don’t necessarily know how it works.

- Caleb Broodo

As he progresses deeper into his collegiate career, University of Houston basketball walk-on and Cullen College of Engineering student Caleb Broodo only has one word to describe the experience — surreal.

Then again, few can match the at-times frantic journey that the redshirt junior has had. After not playing on his high school basketball team his freshmen and sophomore years, Broodo logged significant minutes as a junior and senior, and shot up close to his current 6’8” frame.

Broodo said he was recruited mostly by Division II schools and junior colleges for basketball, but he wanted to try playing at the Division I level while also pursuing an Electrical Engineering degree at a Tier I research school. He knew he had the chance to do both if he earned a spot as a walk-on at UH. He took a look at several Division I schools that also had high-quality engineering programs — Michigan State, Texas, Texas A&M — but his final decision came down to UH because of head coach Kelvin Sampson.

“Coach Sampson is very much a coach who is aware of talent, but values more than anything a player’s character and heart when it comes to recruiting,” Broodo said. “A player’s heart is one of those intangible things that can only be demonstrated by rebounding and defense, as well as toughness and competitiveness, something that does not show up on the stat sheet. I had a strong gut feeling from watching Houston on TV that Coach Sampson and his coaching staff has the same attitude toward player evaluation. I don’t really think I’m especially talented. I had a 6’8” frame. I was good at rebounding, and I played hard, that’s all I had going for me. I had to rely on that if I ever stood a chance to get recruited and hope that their coaching staff sees me and my heart when I try out. Coach Kellen [Kelvin Sampson’s son] saw that and gave me a chance. And now, looking back, I am more than happy I made the decision to come here. I wouldn’t want to have played for any other coach in this country.”

Broodo was born in Missouri City and had family in the Houston metro area, which was also a draw to the university. His father Jack’s work with Dow Chemical took Caleb, his mother Linda, and his older brothers Daniel and Michael to Canada and then Michigan. He graduated from Dow High School in Midland and knew he wanted to study Electrical Engineering.

“It always had an insatiable curiosity about electronics and gadget,” he said. “We live in a modern society where you can take things apart, and you don’t necessarily know how it works. Back in the day, in the 1940s, you could take apart a radio, and you would see a tuning capacitor or the crystal detector, but now you take apart radio, and you see some very small components attached to a printed circuit board. There’s no visually intuitive understanding of how things work. As a kid, I was intrigued by this. ‘How does that work?’, I would ask myself.”

Of course, Broodo was challenged in multiple ways almost immediately upon enrolling at UH. He enrolled in the Fall of 2017, but had to evacuate campus twice in August because of Hurricane Harvey. From there, he emerged from a 30-person tryout to grab a spot on Houston’s roster.

As a result, he’s been present for the resurgence of the Houston Cougars’ basketball program. After an eight-year NCAA tournament drought, Kelvin Sampson brought UH back in the 2017-18 season. The Cougars advanced to the Sweet Sixteen in the 2018-19 season, and although the pandemic forced the cancellation of the 2020 tournament, Houston made the Final Four in 2021, its first appearance since 1984.

Broodo said that when he tried to think of the experience of being involved with the NCAA basketball tournament, he kept returning to the word “surreal.”

“It’s hard to describe in words,” he said. “You know, there were 16,000 people in attendance when we played Kentucky in the 2019 Sweet Sixteen. Obviously, there couldn’t be as many people this year, but you could certainly feel the aura of all the people watching. It’s the biggest spectacle in American sports, the only thing that rivals it being the Super Bowl.”

Broodo attributes his success to his work ethic, which developed first on the court, and then off of it. For the Cougars, he functions as a practice player and reserve, a role he’s comfortable with. And as he’s progressed from high school to college courses, Broodo admits that he’s had to work hard on his organization and time management skills, especially after he failed Circuit Analysis I and Engineering Mathematics courses the first semester of his sophomore year.

A year later, Broodo said he connected with David P. Shattuck, Ph.D., an Associate Professor of Electrical and Computer Engineering. Shattuck was the professor he would take the subsequent Circuit Analysis II course with.

“He’s one of the few professors that I looked forward to going into his class, not necessarily because of the subject matter, but because of the way he would lecture, his humor, and his personality. You could tell he loved what he did, and he had been doing it for a long time,” Broodo said. “I would look forward to going to
Leonard P. Trombetta, Ph.D., the Associate Department Chair. However, Trombetta has had a positive influence on him was the one that gave him a failing grade the first time he had a 4.0 GPA.

Unfortunately, Kouri passed away from complications related to his heart in February 2021. He's my hero, and he makes me proud to be Jewish. Einstein was someone I revered my entire life. He's my hero, and he makes me proud to be Jewish. Einstein was someone I revered my entire life. He's my hero, and he makes me proud to be Jewish.

However, Broodo said that Kouri was still in the middle of last year that he was going through all of these things related to his health while I was doing research with him. Despite dealing with that, he still found a way for me to come over his house, and to give lectures to me. That's the highest level of commitment an instructor could give, and it is something I can only wish to give to a student of mine someday.

Broodo added, “I hadn’t realized until November of last year that he was going through all of these things related to his health while I was doing research with him. Despite dealing with that, he still found a way for me to come over his house, and to give lectures to me. That’s the highest level of commitment an instructor could give, and it is something I can only wish to give to a student of mine someday.”

Broodo is completing the research he and Kou- ri started with Gemunu Gunaratne, Ph.D., Moores Professor of Physics. “Dr. Gunaratne is an excellent instructor,” Broodo said. “I am incredibly grateful he was willing to do something related to Einstein’s predic- tions. Einstein was someone I revered my entire life. He’s my hero, and he makes me proud to be Jewish.”

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with Broodo in their own time to help him stay on track during March Madness.

In addition to his engineering studies, Broodo is also attracted to unraveling the mysteries of physics. In particular, he was studying quantum mechanics, signal processing and analysis of chimp signals with Donald J. Kouri, Ph.D.

Unfortunately, Kouri passed away from complications related to his heart in February 2021. However, Broodo said that Kouri was still inspiring his current studies and mindset.

“This weekend I am going to visit his lovely wife, Shirley, who says that Dr. Kouri had wanted me to pick up textbooks from his extensive library at home,” Broodo said. “I find comfort in thinking he is still assigning homework. I am reading and learning about what he did, the people across the world whose scientific careers were propelled by him and the scientific contributions he made, of which fascinates me.”

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Broodo also got a wake-up call about the kind of effort and energy he needed to put into his studies after completing an internship at Saber Power Services, an engineering and construction firm.

“I realized the reason I failed classes is because I didn’t give them the attention they deserved,” he said. “With a lot of these engineering classes, it’s not necessarily that you have to be super smart. But you have to give these classes your full attention. I had to fail in order to learn that, and I am grateful that I did fail, or else my life would not have changed.”

Broodo stays organized with a physical calendar on his desk, and by writing everything due dates written down. I need that visual aid. Without it, I live in blissful ignorance of my classes until the assignment is past due, and then my life isn’t so bliss anymore.”

He’s appreciative for the professors he has had this semester – Gulin Akso, Ph.D., Stuart Long, Ph.D., and Ji Chen, Ph.D. Each professor met with Broodo in their own time to help him stay on track during March Madness.

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“It’s pretty obvious how much I enjoy talking about physics, isn’t it?” he said.

“I don’t know how good of a teacher I would be, but I certainly would be interested in giving to others what Dr. Kouri and other instructors had given to me,” he said. “I think my principal interest right now is to do research related to gravity. I’ve always found gravity peculiar. It, like electricity, is an overwhelming force that somehow acts at a distance, a difficult prop- osition for some to accept. The contributions Newton made, somehow realizing that the force that made an apple fall to the ground was the same force that governed the motion of the planets, was brilliant. Einstein, who was a ge- nius, took that a step forward by introducing general relativity, which incorporates the idea of the spacetime geometry. The more I learn about general relativitIty, such as how it demon- strates that gravity is illusionary, the more I get foaming at the mouth. Due to modern technol- ogy, we have a chance to live the implications and discoveries. Einstein predicted a century ago, such as observing gravitational waves. It’s mind-boggling how Newton and Einstein and several other scientists came up with their ideas. It makes you feel that the possibilities and imagination of the mind is absolutely un- bounded. The human brain is pretty amazing.”

Broodo spent the summer at a research oppor- tunity. Prior, he was very much looking forward to it. “I am planning on conducting functional analysis of gravitational wave observations made at LIGO [Large Interferometer Gravitational- Wave Observer] Laboratory this summer,” he said. “This is a special opportunity for me be- cause I get to continue Dr. Kouri’s work, and I get to do something related to Einstein’s predic- tions. Einstein was someone I revered my entire life. He’s my hero, and he makes me proud to be Jewish.”

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For University of Houston master’s student Leila Zeinali, her interest in learning has never really abated, and it has persisted from her native Iran, through a stint as a high quality teacher herself, to the Petroleum Engineering classrooms she is now a student in.

Her father’s work with Iran’s national oil company was what first stoked Zeinali’s love of mathematics.

“As a child, I was fascinated with my dad’s work as an oilfield technician,” she said. “His job was to measure the volume of oil in oil tanks received from the pipeline for distribution through Louisiana. For this purpose, he was using statistics – and later, I found out, geometry and trigonometry – for measurements and purposes. The process was intriguing to me, and naturally, I developed a deep interest in all things mathematical, especially geometry and calculus.”

Before attending college, though, Zeinali had to pass a rigorous national exam called “Kokoor.”

“To pursue my interest, I had to compete in the national exam in Iran for the few available seats in top universities,” she said. “The national exam in Iran was a beast.”

“More than a million students competed for about 100,000 seats. My hard work was paid off, and I ranked in the top 3,000 among more than 100,000 in the math and physics selection exam. As a result, I entered a good university in our city, and my rank earned me free tuition and a four-year scholarship.”

After graduation, Zeinali taught for seven years, two of which were in underprivileged schools. She won several awards, including one for the highest graduation rate in the district. However, when her husband Mojtaba Ghoraishy entered a doctorate program at the University of Kansas in 2002, she moved to the United States with him.

While he focused on finishing his program, Zeinali was the primary caregiver for their son Mohammad and daughter Minoo, but that itch to continue learning still gnawed at her. She audited several math courses at Kansas, and when the family settled in Houston after he completed his doctorate, Zeinali enrolled at the University of Houston.

“She is a great student. She never stopped learning,” said Dr. Christine Ehlig-Economides, Zeinali’s advisor. “To me, it appears to be a natural progression for her to go into engineering, and that will benefit the country.”

Her dad’s work in the oil business has instilled in her respect for the industry. The same goes for my native country in Iran, in which oil plays a prominent part daily.

“My experience as an intern, my engagement with professionals from the oil industry, and that will benefit the country. The engineering profession empowers me to step out of the typical boundary of the perceived women’s role in society. UH and its environment was vital for me to achieve this perspective.”

Zeinali encouraged other students to take advantage of Houston’s proximity to the established energy industry.

“Through participation in technical associations like the Society of Petroleum Engineers, the American Association of Drilling Engineers, and the Society of Women Engineers, I have become familiar with the various inner workings of the energy industry,” she said. “SWE holds a special place for me. I share the same vision of SWE leadership in encouraging more women to come to engineering, and that will benefit the country.”

As someone with a mathematics background, I saw how Petroleum Engineering related to math. However, it was more intriguing how different parts of the industry, from exploration to refinery, work hand-in-hand to deliver energy to the consumer.

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"Here in this city, I had the opportunity to pick up where I left off, and I decided to go back to school to follow the path of math and science," she said. "Among multiple engineering paths, Petroleum Engineering had become my favorite for various reasons. My dad's work in the oil business has instilled in me respect for the industry. The same goes for my native country in Iran, in which oil plays a prominent part daily. And the third reason for my native country in Iran, in which oil production, and completion classes, and other fundamentals of the field and felt so excited. "My experience at UH has been no less than fantastic," she said. "As someone with a mathematics background, I saw how Petroleum Engineering relates to math. However, it was more intriguing how different parts of the industry, from exploration to refinery, work hand-in-hand to deliver energy to the consumer. Among my options, UH was the most promising place to continue."
Everyone knows what it feels like to have a hunch— an inclination of what might come to pass beyond facts. It could apply to anticipating the end of a movie, for example, or in The Hobbit by J.R.R. Tolkien, Bilbo Baggins has a hunch that going on an adventure with Gandalf beyond the safety of his town would mean change, but—eventually—he embraces it. 

That is how Jacklyn N. Hall, graduate student and research assistant at the Cullen College of Engineering at the University of Houston, approaches her work. Like Bilbo Baggins in her favorite book, despite her subtle demeanor she invites adventure. Each hunch is a hypothesis and each experiment in the lab a new creative adventure to test the bounds of conjecture and make sense of the unknown. And there is change at the end of it all too, chemical change.

Hall’s research in catalysis— or expediting a chemical reaction using a catalyst— recently garnered her the recognition of the Department of Energy (DoE) Office of Science, for participation in the highly exclusive Science Graduate Student Research (SCGSR) program. Hall is one of 78 students selected nationwide to participate in the program, with an opportunity to work with the Argonne National Laboratory outside of Chicago, Illinois.

“I get to be creative on a daily basis, come up with different experiments and test my hypotheses. It motivates me and makes me passionate about learning,” she said. “I admire the work done at national labs so this is a great opportunity for me. I would love to work at a national lab in the future.”

“The DOE SCGSR award program identifies outstanding graduate students to tackle mission-critical research at national labs, and is highly competitive,” Praveen Bollini, assistant professor at the department of chemical and biomolecular engineering at the University of Houston and Hall’s advisor, said. “The award is a testament to the outstanding research Jacklyn has been conducting for the past three years as a graduate student and will help amplify the impact of her work even further.”

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The mission-critical research

Hall’s research specifically involves the conversion of the greenhouse gas methane to methanol, a useful petrochemical. When oil rigs in the Permian Basin in West Texas flare or vent natural gas that comes out when drilling and producing, over 90 percent of that gas is methane. Initially, when well counts increased sharply following the shale revolution as fracking techniques gave access to far greater oil reserves previously inaccessible, that excess natural gas found with it was burned off. In recent years, interest has grown to find a process for oxidizing – or gaining of oxygen – methane (CH₄) to alcohols such as methanol (CH₃OH) that can be carried out at remote drilling locations.

Unlike methane’s use to generate power, methanol is a useful chemical to make, among many derivatives, formaldehyde—used in the construction, coatings and adhesives industries—as well as acetic acid for photographic film, synthetic fibers and even a main component in vinegar. Beyond the chemical industry, efforts to make methanol an essential part of road transportation via gasoline blends and marine fuel efforts to reach lower carbon dioxide (CO₂) specifications is also underway, per the Methanol Institute.

“The difficulty with oxidizing methane to a more useful chemical is the need for high temperatures or high pressures. A lot of scientists are focused on facilitating this reaction in more mild conditions to make it more energy efficient and more economically viable,” Hall said.

The process of oxidizing methane to methanol is a key process in the energy transition for contributing to a carbon net zero future, a mission that is central to the mission of UH Energy—the University’s collective effort to produce a trained workforce, needed innovations and new technologies for the energy industry.

“Mitigating natural gas flaring and venting from stranded assets in the Permian and other remote predominantly oil plays requires a cost-effective and environmentally friendly method to convert the natural gas to liquids that can be trucked or piped,” Ramanan Krishnamoorti, chief energy officer for UH Energy at the University of Houston said.

“This has been one of the key goals of the hydrocarbon industry to lower its environmental footprint. The research that Jacklyn will be advancing with researchers at the DOE labs will provide scalable and affordable technology innovations that are going to be transformative.”

The next step

The opportunity for Hall to work with scientists at Argonne National Laboratory outside of Chicago will allow her improved access to X-ray spectroscopy technology that can be used to examine similarities between the synthetic catalysts described in her research and bacteria in nature that perform similar methane to methanol oxidation functions. The advantage of the synthetic catalyst is the capacity to increase the scale of the reaction to work in industry by increasing targeted reactive sites that improve selectivity in chemical reactions. But X-ray spectroscopy is needed to better understand the process of synthetic catalysts.

“Jacklyn has discovered and reported, for the first time, a catalyst in which every available site catalyzes methane to methanol conversion,” Bollini said. “This could lead to a paradigm shift in the way we think about converting shale gas resources to value-added chemicals. Advanced X-ray based techniques available at Argonne National Lab will allow her to better understand the nature of active sites involved in methane conversion to methanol.”

The niche field of catalysis and spectroscopy is not one that Hall knew she wanted to study as a child. She wanted to be an astronaut. And while perhaps her specialization in chemical engineering is not as easy to explain at a cocktail party – and to her parents – her interest in the field comes from a place of altruism and wonder.

“I do not know if I will ever see the broader implications of my work,” Hall said, “but it is nice to think that it could have relevance in the future by making processes more energy efficient or by helping reduce emissions.”

Sometimes solutions are as simple as a chemical reaction."
A look back through the Cullen College’s history would be incomplete without the stories of its alumni. Students impact our history during their time at the college and beyond, going on to start revolutionary businesses and lead trailblazing careers, becoming astronauts, company CEOs, world class researchers and more.

While it may seem natural to look back and credit your alma mater for your career, others have even more to be thankful for. For some it’s the lifelong friendships and connections made, and for others, it’s the discovery of a soul mate.

Unbeknownst to him, Jagannatha Rao – Associate Professor and Associate Chairman of the Mechanical Engineering Department, on a fall day in 2014, teaching an honors Intro to Engineering class – gave Andres Marroquin the perfect opportunity he had been waiting for when it came to approaching Diana Marin.

“Dr. Rao said, ‘Okay, guys, get into teams. We’re going to do a little class project. It was a friction car project,’” Diana said.

Andres said, “By this point in the semester, I had already noticed her, so I decided to sit right by her. And that was the day that we popped into teams. ‘Oh, this is my chance,’ I thought. And I’m pretty timid, so I didn’t talk to her right away. I was in the corner. But I asked her before anyone else got a chance, ‘Hey, hey, do you have a project partner?’ Like I was trying to call dibs basically.”

Of course, Diana didn’t notice his initial effort.

“I tried to ask the guy next to me, but he had already turned around and looked at the guy next to him,” she said, laughing. “So Andres and I became partners. And, well, we bombed that project. But we had a lot of fun. And we got to know each other, and found out we had the same sense of humor, and we realized we liked one another, and it just went from there.”

On February 22, 2020 – chosen for those numbers – Diana Marin became Diana Marroquin, after marrying Andres at Annunciation Catholic Church. The couple still lives in Houston, along with their dog, Croissant, a mini-poodle mix.

After two and a half years of high school at Lamar, Diana earned her diploma at the Incarnate Ward Academy. From there, she enrolled at University of Houston Cullen College of Engineering.
the Cullen College of Engineering and earned her degree in Mechanical Engineering.

"To me, UH is super underrated," Diana said. "It’s very affordable, and while it might not have the glamour of some other schools, it’s a fraction of the cost. Both of my parents went to UH, so they also pushed it a lot." There are connections to the University of Houston throughout Diana’s family tree. Her mother, Carmen, earned her degree in Purchasing Materials and Management, and her father, Antonio, received his degree in Computer Science. They even had their wedding reception at the Hilton on campus.

Diana’s uncle, John, also got his Art degree from UH. Her older brother, Michael, got his degree in Hotel Restaurant Management from UH in 2019, and her younger sister, Gabriela, earned her Computer Science degree in 2020.

Diana didn’t initially know what she wanted to study at UH, but she received some helpful advice from her father based on her interests.

"In high school, I didn’t even know what I wanted to study," she said. "I knew I liked math, and that was about it. My dad said, ‘Well, you could always look into engineering.’ Initially, I was in the petroleum engineering program, because it’s Houston and there are plenty of jobs in that field. But as the oil industry had a downturn, I thought, maybe I can work in the oil field and work for a petroleum company without being a petroleum engineer. Mechanical was the next engineering field that was math-based, and I just went with it, and I liked it.”

Diana identified Christiana Chang, Ph.D., an Instructional Associate Professor of Mechanical Engineering, as one faculty member that supported her development.

"Dr. Chang was always so available for me," Diana said. "She was very critical, but it was very constructive. You know, it wasn’t like she was being harsh. It’s like, okay, here’s where you can improve, you know, and I see what you’re trying to do. But let’s try to make it a little better.”

Andres also identified Chang as one of the professors that influenced him, although for a much more direct reason.

“She failed me,” he said, laughing. “But the thing is, not only did she fail me, but whenever I went to her office hours, she was tremendously helpful. Going to her office hours kind of changed my whole approach to studying. After that, I was much more willing to see a professor after class, for any questions I ever had.”

Diana noted that because of the pandemic, she’s been forced to bounce around in different jobs after her graduation. However, she is now training as an operations support officer at NASA.

In contrast to Diana, Andres didn’t really have a family connection to UH before attending. He grew up in Pasadena and graduated from East Early College High School in Houston with an Associates degree in Science. Initially though, he wasn’t interested in UH because of engineering.

“I was actually not trying to be an engineer,” he said, laughing. “In the beginning, I went to an engineering camp and I realized this isn’t what I expected. I knew I liked engineering, but I thought that I actually wanted to design cars. You know, I’m super into cars. I wanted to draw them and design them.”

Andres said that as he explored the industrial design program, he realized that it wasn’t something he wanted to make a career of. At that point, he realized he was less interested in the design aspect, and more interested in the mechanics.

“I want to be able to utilize the science and math skills I have, and I want to be able to build a car and actually make it a reality in that sense more than just kind of design what it looks like,” he said. “So, I went to mechanical engineering route, and I’m happy I did.”

Since graduation, Andres has worked for JET Rubber, Inc., as a mechanical engineer. The company makes rubber products mostly for the oil industry, but he noted that they’re diversifying into other industries as well. The company has established an internship program, and Andres oversees two other employees as a result.

“We have so much work we don’t even know how to handle it right now,” he said, laughing. “It’s a good problem to have though.”

When it came to their engagement, Andres proposed at the Blaffer Art Museum. Andres picked the location because it was a common date activity for the pair — they had visited four or five times while undergrads to see the new exhibits as they rotated through.

Andres heightened the drama in a way, too, by taking Diana out the previous week with visits to the Japanese gardens and other date nights, and then, not proposing. By the time Friday of that week rolled around, she didn’t have expectations for what Andres described as a mellow night of visiting Blaffer and then going to Eighth Wonder for a few beers, unaware that Andres’ brothers had staged an area of the art museum for the proposal.

At the time, there was a video exhibit at the museum, which exited into a hallway. A security guard in the room gave Andres the signal that his brothers had finished by coughing, and insisting that he and Diana keep moving, because the museum was going to close soon. But as they moved into the hallway, there were rose petals on the ground, and pictures of Diana and Andres hanging on the walls.

“She said, ‘What’s going on?’” Andres said, laughing. “And I just said, ‘Yeah, this is happening. That’s us.’ And I kept walking, and she didn’t realize what was happening until I got on one knee.”

“Yeah, I was just like, okay, there are photos of us on the wall,” Diana said. “Right. Cool. And then here and his younger brothers playing music. And I’m thinking, I don’t remember them playing Canon in D this whole time. But I think I think that’s a product of us having dated for so long. Getting engaged just seemed so natural.”

“I got down on one knee, and I told her, ‘You know, we’ve been on a lot of adventures and I want to do that for the rest of my life. How about you?’” Andres said. “She said yes, and I said in that case, will you marry me? And she said yes.”

"We have so much work we don’t even know how to handle it right now," he said, laughing. "It’s a good problem to have though."
It was thanks to PROMES that Michael and Mackrena Ramos met on the very first day of college, in their English class in August of 1994, at 8 a.m., and then saw one another throughout their first week of college. Michael was new to Houston, and he didn’t know the campus or anyone on it yet.

"Having finally found my classroom, I was just looking to find a seat, but not in the front row," he said. "I noticed Mackrena almost right away. She was – and still is! – beautiful. As the English class time ended, I navigated to my next class, which was a recitation session for Chemistry I, and who do I see there again… Mackrena!"

For her part, Mackrena said she was initially just looking for peers for a study group.

"I recall looking at all the students on that first day and wondering who I would study with, since my high school counselors all advised me to find a study group," she said. "I remember that he had a friendly face and made eye contact easily. He sat in the back of the class and I was typically in the front, but once we became friends, we always sat in the same group together."

Michael noted that he had to work to get Mackrena’s attention.

"I quickly figured out that we were in a lot of the same courses due to us both being in PROMES," he said. "This made for a very awkward stage of just trying to get her to notice me, which for me was a series of sometimes successful attempts to make her laugh. This kind of went on for about a year and a half, and through that time I found out that scholastically, she was on a very different level than I was – she was very smart!"

However, Michael said that thanks to their similar class schedule and the fact that they were both staying in the Towers meant that they became friends first, with the relationship blossoming over time.

“We fell into a routine around campus with classes and studying, but the best thing that happened during that time was that we became best friends. This really helped lay the foundation of our relationship – understanding each other’s families, our goals, and our dreams for building our life. Things come much easier when your goals align, for both near and long term."

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I didn’t pursue being anything more than friends until the end of 1995. I took a leap and laid all of my feelings for her on the line.”

On campus, they spent time together at the Towers, the engineering buildings and the Y-Building.

“When the Y-Building, she would study at the ASCE area and I would be at the ASME area, and we would meet up for meals or for breaks when we needed them,” Michael said. “Some of the places off campus that we liked were Mall’s, Taquita La Jaiscience, the IHOP off Kirby and 59, and Empire Cafe. In my freshman and sophomore years, I spent a lot of time in the UC Satellite during the day having my pool and air hockey skills and then the UC during the weekend playing in the arcade.”

For Mackrena, “Anything with late hours was a hit with our group of friends.” She added, “PROMES was a lifeline to success and graduation for us; it provided a like-minded group of determined students, a proven path to graduation mixed with great lectures and study sessions. It really provided the foundation for us to thrive as first generation university students.”

The couple continued to date as they finished college – Mackrena in the Spring of 1999, and Michael in 2000. Because they had talked about their goals, they said they wanted to have their degrees and their initial jobs before getting married. Mackrena landed a full-time position with the Civil Engineering firm – Lockwood, Andrews & Newnam – out of college.

“This added a new dynamic to our relationship, because she had a real income now,” Michael said, laughing. “So, our dinner dates got significantly upgraded. But it was great to have a partner that understood the workload and time that finishing a degree needed.”

After his graduation, Michael was hired by Schlumberger. After paying off some of his loans and cred- it card balances he had “earned” in college, he bought a ring for Mackrena and proposed in November 2001. The couple married a year later.

“I started as an intern during my last semester of study and now, with a 22 year career with them, I am the Vice President of our Water Conveyance group at Lockwood, Andrews & Newnam,” she said. “I’m also the Program Manager for the City of Houston’s Surface Water Transmission Program. LAN has been the program manager and technical advisor since 1983.”

Michael worked in the oil and gas industry for 20 years at Schlumberger. After an economic downturn combined with the pandemic, he has transitioned into using his analysis skills on the stock market.

“A lot of the lessons I was given during my time at UH have served me well over the years, and continuing that learning was something that I was excited to do at Schlumberger,” he said. “For me, UH gave me an opportunity to pursue a Mechanical Engineering degree, and while in pursuit of that I was able to meet Mackrena. Having achieved the goal of obtaining my degree, that gave me an opportunity to prove myself in industry. One begets another, begets another. If opportunity is there, I am not one to waste it. All of those choices, including meeting and pursuing Mackrena, have all led me to where I am today – a happy husband, an active father and a proud University of Houston Alum.”

Michael adds, “As of today, we still reside in the Houston area and visit the campus fairly regularly. We bring our fourteen year old son, Miguel, to as many events on campus as we can to help instill in him just how important the campus and the University is to our story. And as a family, we will continue to support the University of Houston as it has given us so much and we are forever grateful.”

“I currently serve as a committee chair for the EAA Tailgate committee and as the committee chair for the EAA Gala Awards, which is our most prestigious event. We would love to have as many Alumni in attendance as possible!”

Professionally, Mackrena continues to practice as a civil engineer.

Both have given back to the Cullen College of Engineering at various points. Both have been board members of the Engineering Alumni Association, and they have season tickets for football, in addition to attending basketball and baseball games regularly. Michael is still active on several boards, and volunteers with the Engineering Career Center to review resumes and conduct mock interviews.

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I didn’t pursue being anything more than friends until the end of 1995. I took a leap and laid all of my feelings for her on the line.”

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Laura Hood experienced firsthand how important it was to feel like she belonged, or that she could fit in, when it came to a workplace, although when most people are shadowing their parents at work, it isn’t necessarily at NASA.

That’s where her father Ben, a Cullen College of Engineering graduate, worked from 1963 to 1986. He started on communications systems for Apollo, before moving on to avionics systems for the Space Shuttle as the years passed and the technology changed.

“It was February 1981 during my senior year of high school, and the second to last simulation before the Space Shuttle’s first launch in April 1981,” she said. “This was way before Take Your Daughter To Work, but it was the first time I shadowed him for a whole day seeing what he did. He was the Avionics manager in the Mission Evaluation Room (MER). The Mission Control Center handles all of the real time decisions when issues come up during a mission.”

“My father gave me a headset to listen to the voice loops and I was sitting at the Avionics console. The headsets have very long cords, and he went to the console behind us so I was by myself at the desk. Someone came up to me and started asking me an Avionics question. My father saw and came to my rescue, but it was cool to me that someone had asked me a question thinking I looked someone that could answer their question. I knew then that I could be an engineer.”

Laura went on to study engineering at UH, just like her father had. He was a founding member of the Theta Tau engineering fraternity chapter, a member of the IEEE and graduated with honors in 1961. After graduation, he worked with Bell Labs, before moving back to Houston and taking a job with NASA.

“He and my mother, Kathleen, wanted my sister Leslie and I to be strong and independent women, and they wanted to make sure that we got degrees that would allow us to support ourselves,” Laura said. “He encouraged Cougar spirit by taking us to UH football and basketball games when we were young. We were too young, but he and his father attended the Game of the Century in the Astrodome. We saw some great teams growing up, but we were also fortunate to be at UH during the Phi Slamma Jamma days, and I can’t remember missing any basketball games during that time.”

Laura initially wanted to get into a different field from her father, but advances in technology caused her interests to merge in some ways.

“It was interesting that sometimes I did some of the same things that he did, because he was advising me, but sometimes I would purposely try to do different things,” she said. “I originally wanted to be a computer programmer, but he saw how much I liked math and encouraged me to try for Electrical Engineering, and I could do as much as I wanted with computers from that field. UH started a computer engineering option in its Electrical Engineering degree some time before I started in 1981, so I thought that was perfect. My father’s specialization was communications systems so I felt like it was different.”

She completed the computer engineering option of her degree, but the technology was changing so quickly that she realized her knowledge was becoming outdated. As a result, she looked to expand her knowledge base.

“I took an elective class in Control Systems with Dr. Leang-San Shieh and loved the math that was in that class,” she said. “I ended up taking all of my EE electives in Control Systems with Dr. Shieh and Dr. Gene Denman, except for one class in communication systems with Dr. Wallace Anderson. I had Dr. Anderson for both of the Engineering Math classes also.”

Her father also stressed that she should meet with two other professors—William Leach, a drafting professor in the Civil Engineering Department, and Thomas Whitaker of Electrical and Computer Engineering.

“Professor Leach was very gracious in meeting with me, and he remembered my father even though it was 20 years later. He recommended to me that I join the IEEE, and I did that soon afterwards. It was great advice and I met a lot of people through the IEEE.”

Laura managed to take a course with Whitaker, which she enjoyed. He had also taught her father.

“My father really respected Dr. Whitaker,” she said. “Dr. Whitaker was the one that encouraged him to take a job with Bell Labs. My father was a home body and I know that he didn’t want to leave Texas, but Dr. Whitaker told him that he shouldn’t pass up that opportunity. It was a great experience for him and he learned a lot in the short time he was there. I remember him telling me that he couldn’t believe that Dr. Bode was walking the halls of the Bell Labs at the same time as him. I was learning about Bode plots at the time, and I was a little star struck at that news.”

After graduation, Laura started working at McDonnell Douglas doing Space Shuttle ascent flight control system analysis. When the company lost their NASA contract in that area two years later, she tried getting a job with NASA, but the organization wasn’t hiring in her field at the time. She instead worked at Lockheed Martin for a year, while working on a Master’s degree. When there was an opening at NASA, it was in a division known to the Hood family.

“I ended up taking the offer from the division where my father had started in NASA, which was Tracking and Communications,” she said. “It was kind of weird that about half of the people in the division had worked with my father in the past, but the other half were young like me at the time and had no idea about my connection. The change in job caused me to change my master’s specialization from Control Systems to Communications Systems, but I had liked taking the communication classes as an undergrad so I was ready for the change.”

Laura didn’t think it was the family connection that got her the job, though—“It was the hard work she was doing at UH, in pursuit of her master’s degree.”

“There was a NASA person from the Tracking and Communication Division taking that communications class at the start of his pursuit of a graduate degree,” she said. “He knew my father but he saw me in that class, so I think that helped me get the job at the NASA. I wasn’t just a NASA person’s kid. I was someone that did well in a class related to what he was doing.”

Laura’s sister Leslie also graduated from UH, with a Bachelor’s degree in Business Administration in 1985. However, she was also drawn into NASA, thanks to the expansion of the organization in the 1980s. Leslie worked for NASA contractor Bendix from 1986 to 1997. She started in payroll,
but moved into a computer programming related job for their business department. From there, she was hired by Compaq – and later Hewlett Packard – from 1997 to 2009 in the database programming for business department.

“I know my father would have been surprised that Leslie ended up in a more technical field than the degree that she got at U of H,” Laura said. “I remember my father and I trying to help her learn Cobol at U of H, and being so thankful that I was learning Fortran. She did much better with other computer languages after graduation.”

Laura now lives in Pearland with her husband Gary Lovstuen. Laura’s sons also went to UH schools, although they did not pursue engineering like their mother and grandfather did. Sean Benjamin Lovstuen graduated from Clear Lake in December 2020 with his B.S. in Information Technology, with a minor in Cybersecurity. Kyle Alton Lovstuen is scheduled to graduate from the UH College of Technology in December 2021 with a B.S. in Supply Chain and Logistics Technology.

Now, Laura serves as a mentor for high school students in FIRST Robotics Competitions. She uses her own experiences as an engineering, and before, when talking to and guiding students.

“I know how important it is for young women to see women engineers, so they know that it really is a field that they can go into,” she said. “Just a couple of years ago, one of our brightest young women was at an engineering conference and a man at a conference table gave her a hard time about picking up a packet on his table. He thought it was funny to tell her that there was no makeup in the packet, like she had no business picking up engineering information. Fortunately, she ignored him and she’s doing very well majoring in engineering at Rice. But that is a reminder to make sure that young women know that engineers look like them, and it is a career that is possible for them. I was very fortunate that my experience as a high school senior was different from hers, especially at a time when there were very few women engineers."

Tiffany Little (BSME ’00) & Meagan Weathersby (BSME ’21)
(Aunt & Niece)

According to Tiffany Little, “I enjoyed my time at UH; met many great people and learned a lot. My degree has enhanced my job experience over the years by applying the technical knowledge acquired at the university. I’m honored that my niece chose to follow in my footsteps to also accomplish becoming a Mechanical Engineer at the Cullen college of engineering. Go Coogs!”

Her niece, Meagan Weathersby had an equally positive experience: “I enjoyed my time at The Cullen College of Engineering. I made life long friends while preparing for my future career. After graduation, I accepted an offer with M&S Engineering in The Woodlands Texas as an Electric Distribution Engineer. I am enjoying it so far and cannot wait to see how much I grow in the company!”

Badri & Tejas Roysam (MSEE ’18)
(Father & Son)

While Badri Roysam may only be an honorary Cougar, serving as the Hugh Roy and Lillie Cranz Cullen University Professor and Chair of Electrical and Computer Engineering, his pride for the University of Houston runs deep. His son, Tejas Roysam, received his master’s in Electrical Engineering, with a focus on computer engineering, machine learning, cybersecurity, and embedded computing. His primary interests are in data science and machine learning methods applied to security, and embedded wireless communication systems.

Today, Tejas is a member of the Human Interface branch (EV3) in NASA’s engineering directorate, working as the component owner for the xEMU helmet camera system, which is the high-definition camera that will sit on each crewmember’s shoulder in the new exploration space suits to be used on ISS, Lunar Gateway, and lunar Lander missions. Tejas also contributes to other life support and data handling systems onboard the suit, mostly contributing to audio and video processing, embedded control software, and electronic design and analysis. His other experience involves working in the Flight Operations Directorate and the Software, Simulations and Robotics branch.
BY STEPHEN GREENWELL

When Rex Walheim first enrolled at the University of Houston’s Cullen College of Engineering’s master’s program in Industrial Engineering in the 1980s, his goals were literally sky high. At the time, he was a flight controller at the Johnson Space Center and a lieutenant in the United States Air Force, and he hadn’t yet flown a vessel himself.

“I knew that an advanced degree was important for a career in the Air Force,” he said. “I was interested in becoming an Air Force Flight Test Engineer, which required an Engineering master’s degree. A friend of mine told me about the UH Industrial Engineering program and it sounded interesting. I decided to try it out, and ended up enjoying it. I found that it was a good mix of engineering and management.”

After completing his master’s at UH in 1989, he managed a program to upgrade missile warning radars, followed by the Flight Test Engineer course at the Air Force Test Pilot School in 1992. Following his graduation, he was assigned to the F-16 Combined Test Force at Edwards Air Force Base, where he was a project manager and then commandant of the avionics and armament flight. In January 1996, Walheim became an instructor at the Air Force Test Pilot School, where he served until he commenced astronaut training.

“Completing my Industrial Engineering degree at UH was absolutely essential to my ability to be selected as a Flight Test Engineer, and to potentially eventually become an astronaut,” he said.

He was selected by NASA as an astronaut in March 1996, and reported to the Johnson Space Center in August 1996. After completing 2 years of training and evaluation, he qualified for flight assignment as a Mission Specialist. His first trip was from April 8 through April 19, 2002, a delivery mission to the International Space Station. He completed two spacewalks, totaling more than 14 hours.

Walheim described the process of blasting off into space in a 2002 profile in “Parameters.” “I had a little wist mirror that I had on my left arm so I could look out the overhead window behind us, and when the main engines came up I could see the smoke from the exhaust coming up,” he said. “A little later I looked up again and I could see the beach out the back window, and I could see it just fading away. It was just really amazing to see how fast we were climbing. You’re going about 100 miles per hour by the time you clear the pad so it doesn’t take long. You’re really screaming.”

Given the sometimes contentious relationships between the nations on the ground, Walheim said that the international collaboration needed for the ISS and other projects was often overlooked.

“I think people don’t appreciate what a great example of international cooperation the space program is,” he said. “There are obviously big challenges in the relations of the United States and Russia, but the cooperation in space is amazing. For more than 20 years, we have been great partners in space, working together, living together and solving problems together. The same is true with our European, Japanese and Canadian partners. It is incredible how well you can get along when you have important common goals and a shared need to survive in a very inhospitable environment.”

Looking back at his days at UH, Walheim had fond memories of several professors.

“One of my favorite professors at UH was Dr. John Hunsucker,” Walheim said. “He was a very colorful lecturer. When he wanted to clarify a point he was making, he would commonly prefix it with the phrase, ‘Now for the slow learners and graduate students.’ I also enjoyed taking classes in the business school as part of the program. One of my favorite professors there was Dr. Janelle Dozier. She taught an Organizational Behavior class that I found especially interesting.”

Walheim balanced his work at the space center with his work pursuing his degree, like many students do now.

“For about the first year and a half of the Masters program, I was working full time, and then taking classes in the evening,” he said. “Although it was busy, I enjoyed switching gears on class days and being a student again. The Air Force allowed me to take classes full time to finish my last six months of the program.”

Walheim retired from NASA as the deputy director of the Johnson Space Center’s Safety and Mission Assurance Directorate in July 2020. The agency noted that he spent almost 36 years in government service, 36 days in space, and 36 hours on spacewalks. He still works for a space company and with the ISS, although in the private sector, with Axios.

“At Axios Space, we are building commercial modules that we will add onto the International Space Station,” he said. “These modules will make up a segment of the station where governments or private individuals will be able to do research, manufacturing, marketing, educational outreach and many other activities.”

The company has also made headlines for its goal of sending private astronauts aboard the space station.

“We hope to fly our first Private Astronaut Mission late next year,” Walheim said. “I am the Director of Safety and Mission Assurance at Axios, so I help to make sure our crews fly safely and that our modules and systems are built robust enough to effectively accomplish our missions. I also ensure that our company’s employees are able to do their jobs safely here on Earth.”

BY STEPHEN GREENWELL

A graduate of the University of Houston’s Cullen College of Engineering worked as a member of the team at Weiler Labeling Systems, which provided customized labels for the COVID-19 vaccine rollout.

Austin Dodge, a December 2017 graduate of the Electrical and Computer Engineering Department, said this sort of work was what he had in mind when he graduated.

“This is exactly the work I envisioned,” she said. “I wanted something hands on. If I program something, I want to see something move in the real world, and I get to work right next to the machine. There are a lot of engineering jobs where you sit in a cubicle and you don’t even get to see the product you’re working on, but I actually get to do hands on diagnostics. I get to test my code as soon as I make a change and get instant feedback, which is really satisfying.”

Weiler announced in August 2020 that the VR-72 labeler would be used for the vaccine when it was finished. According to information provided by Weiler, the labeler can handle speeds of more than 600 vials per minute.

Adat Building on Skills from UH Education

A graduate of Westside High School in Houston, Dodge said the work with Weiler aligns with her studies and outside the classroom she pursued in college. Dodge was part of a team of four undergraduates who earned second place
ME, Space Architecture Graduate Lopez making his Interstellar Mark

BY STEPHEN GREENWELL

For University of Houston graduate and native Houtzian Javier Lopez Jr., it was repeated visits to the Space Center Houston with his parents and twin sister Cynthia that kindled a lifelong interest in the stars.

“As a little kid, I was fascinated that people were actually travelling to space, and thinking about how when looking up at the night sky, there were people living among the stars, aboard the International Space Station,” he said.

“Once I learned more about the Apollo missions and that several astronauts had visited the Moon, my mind was blown and the passion for space exploration began growing inside of me. I decided very early on that being an astronaut would be my dream job.”

Lopez graduated with his B.S. in Mechanical Engineering from the Cullen College of Engineering in Spring 2019. He followed this up by earning a master’s in Space Architecture in Fall 2020, and now, he works full-time with Lunar Resources, Inc., a space industrial company pioneering space manufacturing and off-earth resource extraction.

However, Lopez noted that it wasn’t a completely straight path from his dream of working in the aerospace industry to immediate success. He applied for more than 20 internships at NASA while a student. He completed two with NASA’s Marshall Space Flight Center in Alabama, working on Humans Factors Engineering, before also completing two NASA Pathways internship programs in structural dynamics, design and other disciplines. Lopez has also completed an internship with Lockheed Martin, working on the Orion program.

“My experiences with working at NASA will be something that I will always remember and hold dear to my heart,” he said. “It was nice having the hard work finally pay off and work alongside accomplished people on some of the coolest projects.”

Lopez cited the support structure provided by his parents – Javier Sr. and Lourdes – as well as by organizations, friends and faculty at UH, as being vital for his success.

“During my first semesters at UH I worked hard to do well academically and I also became heavily involved with the Society of Hispanic Professional Engineers (SHPE), which opened my eyes to the many opportunities that were out there and helped me realize my fullest potential,” he said. “Learning about the success my friends and peers were able to obtain, I was motivated and encouraged to do the same.”

For his Mechanical Engineering degree, he identified professors Farah Hammami and Holley Love as significant mentors. At the Cullen College of Engineering’s Sasawaka International Center for Space Architecture, he said director Professors Kriss J. Kennedy and Larry Toups were positive influences. For his NASA internships, he had two prominent mentors – Charles Dischinger and Tanya C. Andrews.

Like many other graduates of the Class of 2020, Lopez also had to navigate a world going through the coronavirus pandemic. He encouraged current students who new graduated to continue working, but to be prepared to pursue alternative plans if needed.

“I was very lucky to have been working part-time with the company I am currently at before receiving my full-time offer, so I didn’t experience those difficulties I know many are facing,” he said. “However, I did have a backup plan, and that was to attend the virtual career fairs hosted by UH, attend Space Week’s Virtual National Convention, and continue applying to companies that I was interested in. This pandemic has changed the way we do many things and I know it has been tough for everyone, but do your best to not be discouraged and keep on applying for positions with companies that are out there and help you realize your dream company or position. You know exactly what you can be capable of and what you can bring to the table to your professional endeavors. Continue to work hard and push yourself until you’re where you want to be.”

By Stephen Greenwell
SPRING 2021 COMMENCEMENT
After a year of virtual events, the University of Houston was able to hold in-person Commencement ceremonies for the Spring 2021 graduating class. The Cullen College of Engineering joined with the Gerald D. Hines College of Architecture and Design to host a safe, socially-distanced, outdoor ceremony for its graduates at TDECU Stadium.

CULTURE & EVENTS
To learn more about events and outreach at the Cullen College, visit www.egr.uh.edu/events or follow us on social media!

WOMEN IN ENGINEERING
The Cullen College’s Women in Red Trailblazers met for another virtual event on Zoom this past spring, hosted by its leading Woman in Red, Cynthia Oliver Coleman. The annual Rising Star Award was presented to Jennifer Stewart. The Women in Engineering committee hopes to hold its next event in person – make sure to check the college’s website for details.

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Today, a lesson from an engineering campus. The University of Houston presents this series about the machines that make our civilization run, and the people whose ingenuity created them.

I’ve often talked about how technology mirrors us – and how we mirror our technology. More than we realize, we are reflections of the things we make. So how does that mirroring work in engineering schools – the places where so many people get their start in shaping our technology. Well …

We constantly tear down and rebuild. But do we trail behind or set the future as we build? The answer’s not simple. Think about steam engines – how they transformed our 19th century world.

I first studied engineering right after WWII. And steam engines were still central in my studies. That seems strange today, even though steam still provides most of our power. Nuclear energy, fossil fuel energy, even some solar energy – they all drive steam turbines. But steam power fades from our curricula, because it’s largely a settled technology.

And yet … the late ‘50s found me teaching lab courses that still had many steam experiments. Gas turbines were used widely by then. And America’s first nuclear power plant was already up and running. We taught about steam, while that university already had a top nuclear engineering program. The way the past and forefront overlapped seems puzzling.

Here I was, teaching an old settled technology, while I studied shock wave structure on re-entry rocket nose cones. I was learning how to control neutrons in a reactor. And our students? Well, here’s the thing: They knew they were learning lab technique with old machines, so they could go out and create new machines.

I came to Houston in 1980. Steam engines were finally gone by then. Now our labs filled a huge, rambling, old airplane hangar of a building. We called it, The Y-building. And, oh, the stuff inside it: Huge tensile test machines; a great tank for under-water acoustical tests. A wind tunnel. A large centrifuge buried in the concrete floor. One prof. had set up railroad tracks to do acoustical tests for cracks in rolling iron railway wheels.

The past and future met in that building. And here we learn a lesson: Any good engineer knows the past – but that same engineer cannot be chained to the past. I recently watched as my granddaughter, an engineer, designed a radically new machine. And it depended on a latch that used a 19th century mechanism.

So, as we constantly reshape old buildings on any engineering campus, the past lingers. That Y-building finally perished – replaced by a more modern one. It’s arranged for research on a smaller scale. Those massive Y-building experiments now seem to be no more than the stuff of this old man’s nostalgia.

But campuses reflect the past and future of engineering in a kind of rolling evolution. And that’s how things must be. The past eventually becomes baggage. But it never completes its purpose until it has bridged us into the next future.

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

For more on how we and our machines mirror one another, see J. H. Lienhard, “The Engines of Our Ingenuity, An Engineer Looks at Technology and Culture.” (Oxford University Press, NY, 2006): Part II, Steam and Speed.

For an example of how one important university engineering laboratory evolved throughout its entire history, see J. H. Lienhard Jr, History of the Rohsenow Kendall Laboratory, at: http://rklab.mit.edu/history.html. This episode first aired on June 7, 2021.

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

UH Cullen College of Engineering
Office of Communications
Engineering Building 2
4722 Calhoun Road, Suite E311
Houston, Texas 77204-4009

@UHEngineering