UNIVERSITY of HOUSTON | ENGINEERING

PARAMETERS

Cullen College of Engineering Magazine • Fall 2021

DIVERSITY
PROGRESS
ACADEMICS
INNOVATION
SUCCESS

CELEBRATING

80 YEARS OF ENGINEERING

PRESTIGE
VISION
RESEARCH


CELEBRATING
80
YEARS
LEADERSHIP
STRATEGY
SERVICE
FUTURISM
OF THE CULLEN COLLEGE
INGENUITY
PASSION
INCLUSIVENESS

IN EVERY ISSUE

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PARAMETERS

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UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

DEAN'S LETTER

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.

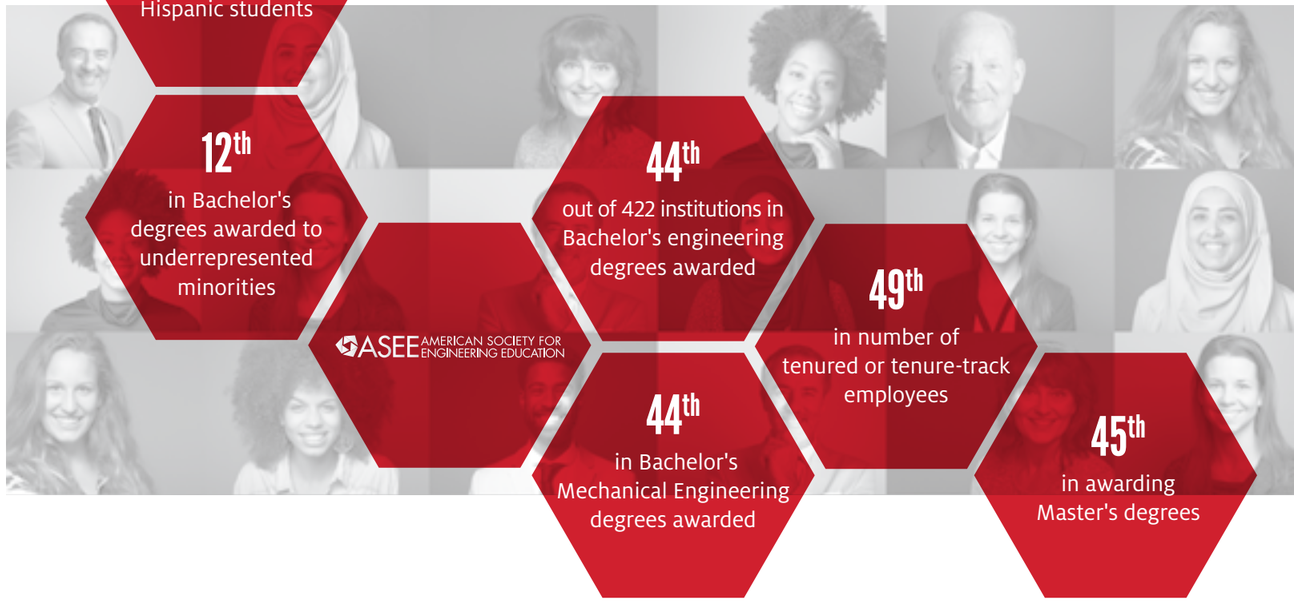
I hope you enjoy reading through these stories celebrating our past, present and future. Cheers to another 80 years and beyond of excellence in research, innovation, entrepreneurship, student success and more!

Warm regards,

Joseph W. Tedesco

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

LEADING
By Example



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.

The information comes from the latest edition of the American Society for Engineering Education's Engineering and Engineering Technology By The Numbers report. The report on data from 2019 was released in October 2020, and updated in January 2021.

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.

ENGINEERING SNAPSHOTS

CELEBRATING 80 YEARS

Cullen College Engineering Building 1
1967

American Society of Mechanical Engineers, 1968

THEN

1934

The Department of Engineering forms in **1934.**

1939

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

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

1941

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

Over the next several years, engineering students account for **1/7** of University enrollment numbers.

1947

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

1967

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.

1968

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.

120+
ACTIVE LABORATORIES

23
NATIONAL SCIENCE FOUNDATION (NSF) CAREER AWARDS
received since 2010
(4 New in 2021)

NOW

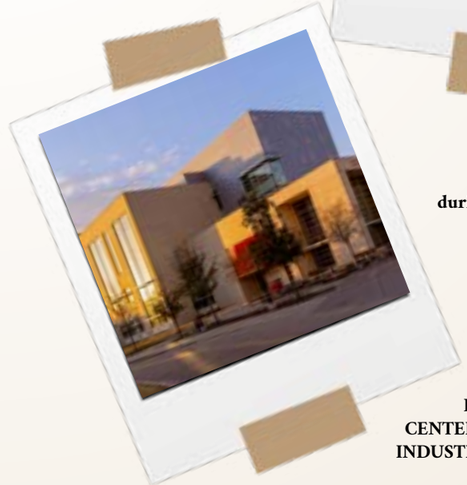
2021

4,265
STUDENTS
in FY2020

15
NAE MEMBERS

958
DEGREES AWARDED during Fall 2020 and Spring 2021:
618 *bachelors*
226 *masters*
81 *doctoral*

$35M+
IN RESEARCH EXPENDITURES



29
RESEARCH CENTERS, INSTITUTES & INDUSTRY CONSORTIUMS

141
FACULTY

CELEBRATING 80 YEARS

CAMPUS
THEN & NOW

Cullen College of Engineering Building

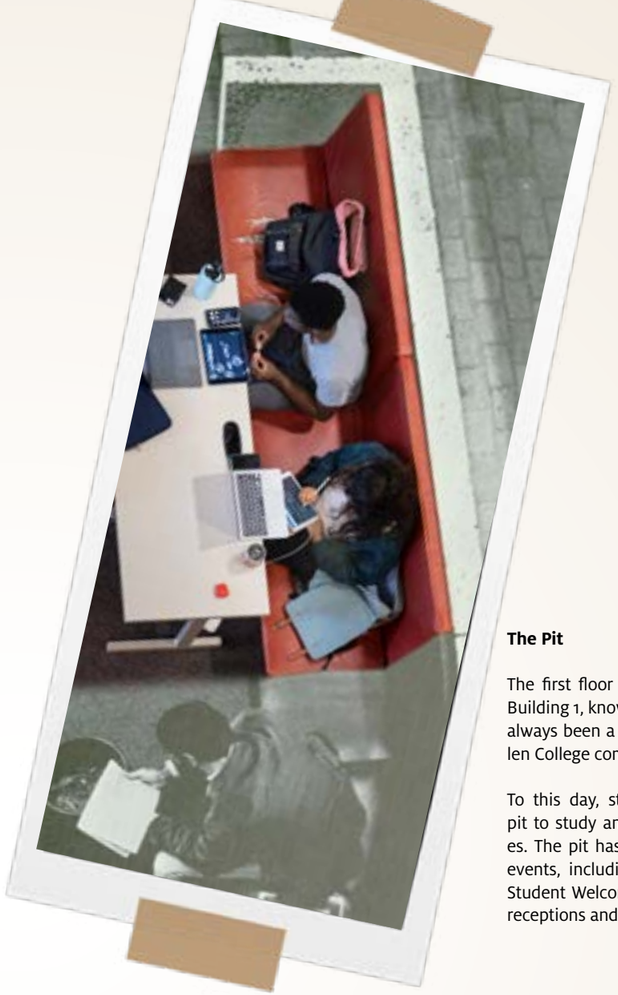
The Cullen College of Engineering Building was built and dedicated in 1968, named for Hugh Roy and Lillie Cranz Cullen, principal benefactors of the University of Houston. Now known as Engineering Building 1 to most, many of the original labs and teaching spaces are still in use today.

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 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.

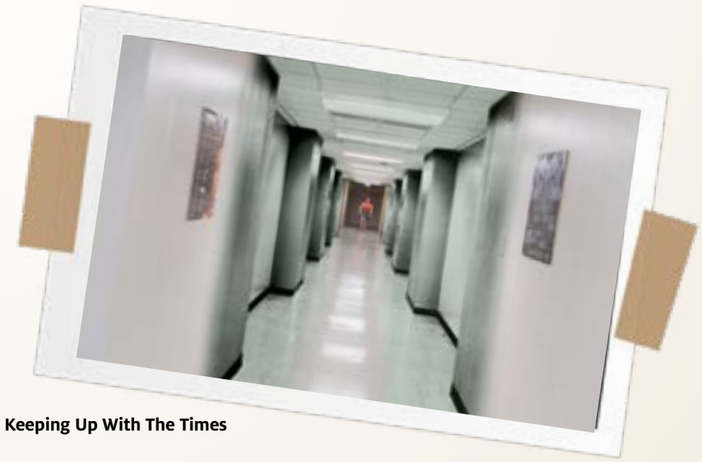
The tunnel is used to give a hands-on teaching experience, showing students first-hand how pressure distribution works. Student groups still use the tunnel today to test their prototypes and learn how their designs will hold up under wind conditions of up to 170 mph.



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.

CULLEN COLLEGE OF ENGINEERING UNIVERSITY of HOUSTON

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

BEST ENGINEERING PROGRAM

- Ranked 81 in 2010
- Ranked 78 in 2011
- Ranked 77 in 2012
- Ranked 76 in 2013
- Ranked 76 in 2014
- Ranked 76 in 2015
- Ranked 73 in 2016
- Ranked 73 in 2017
- Ranked 69 in 2018
- Ranked 69 in 2019
- Ranked 67 in 2020
- Ranked 66 in 2021

PARAMETERS

Through the Years

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 make-overs 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
(2018)

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

IN THE MEDIA **SPOTLIGHT**

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

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

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

READ ARTICLE ONLINE AT:
www.physicsworld.com

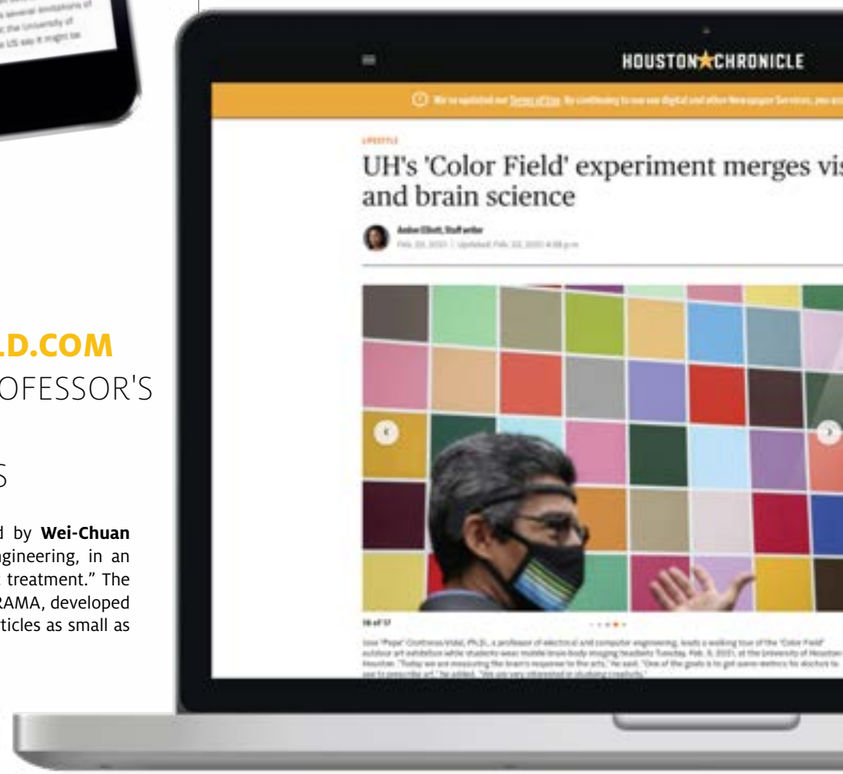
PHYSICSWORLD.COM SHOWCASES PROFESSOR'S RESEARCH ON NANOPARTICLES

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.

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



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

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 1983, 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.

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

Cullen College ***Expands***

GLOBAL REACH

with Dalian Maritime University ***Partnership***

IMAGE PHOTOGRAPHED AND DESIGNED BY XIE ZHONGQI, A STUDENT OF THE HOUSTON INTERNATIONAL INSTITUTE, DMU

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.

CULLEN COLLEGE *CLIMBS*

#66 Overall **BEST GRAD SCHOOL RANKINGS**
U.S. News and World Report

BY STEPHEN GREENWELL

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 UH 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 now Top 10 in the nation, as it improved from No. 11 to No. 9. **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. 80 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 masters' degrees and 520 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 subsea, aerospace, space architecture, materials and computer and systems engineering.

$4.5M Gift Supports Endowed Chair, & New Lecture Series on Equity and Social Justice

BY CHRIS STIPES

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 underway 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.

• $2 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.

• $500,000 supports "The Panos Family Endowed Lecture in Equity and Social Justice" in the College of Liberal Arts and Social Sciences to sustain ongoing conversations on contemporary topics that are relevant to society and bring awareness and ideas from local, national and international thought leaders.

"We are incredibly grateful for the generosity of the Thomas Michael Panos Family Estate. This significant gift will not only help fuel academic success through innovation and discovery, but will support our ability to recruit renowned faculty and expand thought leadership," said **Paula Myrick Short,** UH senior vice president for academic affairs and provost. "The additional support for an equity and social justice lecture series is an especially timely and important part of our efforts to increase visibility around these issues."

The Panos family was an integral part of this city's fabric during Houston's earliest years of expansion, according to Scott Harbers, friend and trustee of the family's estate. Though Thomas Michael Panos emigrated from Greece to Houston with only a sixth-grade education, he and his wife instilled in their children— Mike, Effie and Gus— a passion for education and the importance of giving back. Mike and Gus Panos both earned college degrees in engineering. All have since passed away.

"They were the kind of people who would help anybody," said Harbers, who lived next door to the Panos family decades ago in what is now Midtown Houston. "As a family of immigrants, I know they would appreciate the diversity of the student body at the University of Houston. They had a tremendous interest in education and equal rights. I'm hopeful that this gift will help advance the lives of students who need help to complete their studies."

$100 Million Challenge

In fall 2019, the University received a landmark $50 million gift from an anonymous donor to establish the "$100 Million Challenge" Aspire Fund, designed to inspire another $50 million in investments from additional donors to support the University's bold future in research and scholarship relevant to Houston's future in four areas that will address issues with major societal impact:

- Sustainable Energy and Energy Security
- Resilient Infrastructure and Smart Cities
- Population Health
- Global Engagement

"The '$100 Million Challenge' is a transformational initiative to propel our academic enterprise to unprecedented levels of distinction, and this first matching gift launches us," said **Eloise Brice,** vice president for university advancement. "The work and research being done at UH, and accelerated through the Challenge, will have a tremendous impact on the quality of life for all Houstonians."

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.

Larry and Gerri Snider Gift $1M for

FIRST

Industrial Engineering Endowed Chair

BY CHRIS STIPES

LARRY AND GERRI SNIDER

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 Snider 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 system performance in an array of industries including health, energy, manufacturing, human factors, logistics, and supply chains.

"We look forward to embracing a high caliber industrial engineering chair to build the program and maintain high impact academic research, while also enhancing an already exemplary student experience. The Sniders' generosity provides the program with stability and vision for many years to come," said **Paula Myrick Short,** UH senior vice president for academic affairs and provost.

Working full-time to put himself through college, in 1955 Larry earned his bachelor's degree in process engineering, a combination of industrial and chemical engineering. Gerri also worked full-time and managed their household. For decades, the Sniders have been passionate supporters of the University and steadfast proponents of hard working students, currently funding three scholarships 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 Booz 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.

Lim 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.

> *"We pray this donation significantly enhances Industrial Engineering's success in training future engineering leaders and makes a great impact on the world."*
>
> - LARRY SNIDER

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 1991-1992, 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.

UH, HCC PARTNERING ON ENGINEERING ACADEMY

AT FRAGA CAMPUS

BY STEPHEN GREENWELL

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 degrees from UH. 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.

EXTERIOR VIEW OF FELIX FRAGA CAMPUS


INTERIOR VIEW OF LAB CLASSROOM

CULLEN COLLEGE OF ENGINEERING UNIVERSITY of HOUSTON

An educational partnership between University of Houston and Houston Community College

HCC HOUSTON COMMUNITY COLLEGE

FOUR ADDITIONAL FACULTY MEMBERS

AWARDED PRESTIGIOUS

2021
FACULTY EARLY
CAREER DEVELOPMENT
(CAREER) AWARDS

FROM THE NATIONAL SCIENCE FOUNDATION

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."


MEHMET ORMAN

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.

"Persister 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

Examing 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 »


KYUNG JAE LEE


SHAILENDRA JOSHI

a new source of lithium-rich brines in petroleum source rocks for sustainable energy storage.

"While water produced from organic-rich petroleum 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 geochemical cycle," said Lee. "We will develop a transformative framework for characterizing lithium in source rock brines, 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 essential element in preferred energy storage technology for energy transition, the U.S. has limited domestic production of lithium in the upstream supply chain.

Lee's project will determine the reaction mechanism of kerogen conversion-releasing lithium and enhance modeling capability for characterizing the transport of it. As part of the project, Lee will also develop educational programs to enlighten present and future energy professionals' understanding of subsurface processes related to the origin, fate, and transport of sustainable resources in the subsurface energy systems.

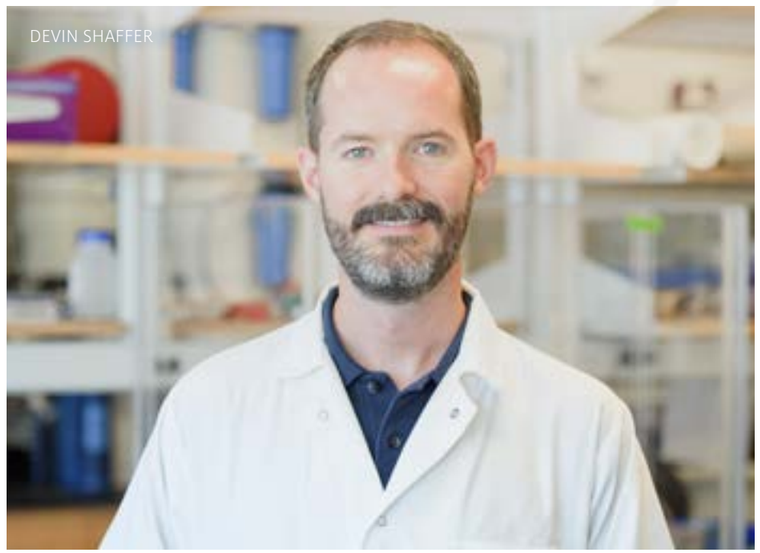
SHAILENDRA JOSHI

Recyclable Thermoset Polymers Research

BY STEPHEN GREENWELL

For **Shailendra P. Joshi**, the Bill D. Cook Assistant Professor of Mechanical Engineering at the University of Houston's Cullen College of Engineering, as the technological advances in the world of plastics as structural materials have occurred, there has been the negative side effect of the environmental impact of those materials.

"The ubiquity of plastics, both thermoplastics and thermosets, in our daily lives presents challenges due to their potential threats to the environment and natural habitats arising from their low recyclability," he said. "Conventional thermoset polymers, whose attractive mechanical properties make them important structural materials, are particularly insidious. The irreversible crosslinking at the molecular level seriously impedes their reprocessing and recycling ability. Novel polymer chemistries offer exciting avenues to develop recyclable thermosets, which are also known as vitrimers."


DEVIN SHAFFER

However, understanding the mechanical behaviors of reprocessed vitrimers is challenging. Joshi hopes to change that by examining these materials at multiple length-scales, starting at a granular level. "Each recycling and reprocessing cycle of a preceding vitrimer part, via pulverization and compaction, generates defects in the recycled part, which redefines its microstructure and hence, the mechanical properties. We aim to fundamentally understand the microstructure-property linkages of such vitrimers using novel theoretical approaches and computational tools." He is the latest recipient of a National Science Foundation CAREER award, one of the most prestigious grants in support of early-career faculty.

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 Chairman, who made my transition to the U.S. three years ago comfortable, and my department colleagues, for a stimulating and collegial environment. My family has been a strong positive force all along, but most critically during the past three years here in Houston, as I pretty much reset my academic career."

Joshi said that receiving the CAREER award, which comes with $516,654 in funding, will allow him to pursue granular mechanics. In addition to the NSF, he has also received funding from the U.S. Army Research Lab through the Materials in Extreme Dynamic Environments (MEDE) Program.

"I am broadly interested in failure of materials," 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 aluminum for the same material volume, using computational approaches."

Joshi described the research that the CAREER award would enable the design and development of recyclable structural plastics, which could help mitigate better the harmful environmental effects of conventional plastics.

He noted, "The research program is integrated into a broader educational goal of creating an immersive learning experience for underrepresented 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-sensitive 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 Department, 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 Platform 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 eager to pursue this research in covalent organic framework membranes, which are new materials that can efficiently separate complex liquids. I'm also looking forward to partnering with the teachHOUSTON program at UH to engage undergraduate pre-service STEM teachers in the research."

Shaffer earned his doctorate from Yale in 2016. He was hired by the Cullen College of Engineering in 2018, after his work as a postdoctoral fellow in 2016 and 2017 in the Materials Science and Engineering Division at the National Institute of Standards and Technology in Gaithersburg, Maryland.

Before beginning at Yale, he worked as a professional engineer for Carollo Engineers, Inc., in Phoenix. He earned his Master's in Environmental 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 separations for liquids," he said. "In the lab, we design new membrane materials and test membrane separation processes for applications like purifying drinking water, recycling wastewater from oil and gas production, and filtering impurities from organic liquids. This CAREER project will engineer membranes from covalent organic frameworks (COFs), which are polymers with ordered porous structures. We will fabricate ultrathin COF membranes with tunable pore properties and apply these membranes to different liquid separation challenges in the energy, environmental and health fields."

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 encouragement of my colleagues in the Civil and Environmental Engineering Department and the Cullen College of Engineering in my research and in pursuit of this CAREER award," he added.

SINCE 2010, THE CULLEN COLLEGE HAS RECEIVED

23

NSF CAREER AWARDS

MEGAN ROBERTSON (CHBE)

JIMING BAO (ECE)

JACINTA CONRAD (CHBE)

JEFFREY RIMER (CHBE)

DEBORA RODRIGUES (CEE)

LARS GRABOW (CHBE)

WEI-CHUAN SHIH (ECE)

GILA STEIN (CHBE)

HALEH ARDEBILI (ME)

ZHU HAN (ECE)

STANKO BRANKOVIC (ECE)

BORA GENCTURK (CEE)

CUNJIANG YU (ME)

AARON BECKER (ECE)

ZHENG CHEN (ME)

JEREMY PALMER (CHBE)

SHEEREEN MAJD (BME)

ROSE FAGHIH (ECE)

DAVID MAYERICH (ECE)

MEHMET ORMAN (CHBE)

KYUNG JAE LEE (PE)

SHAILENDRA JOSHI (ME)

DEVIN SHAFFER (CEE)

JOSE LUIS CONTRERAS-VIDAL

MAKING WAVES

in Art and Engineering

BY SARA TUBBS

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.

"We wanted to do this in a real setting and 'Color Field' offered us the perfect opportunity," said Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen Distinguished Professor in the UH Department of Electrical and Computer Engineering. "This exercise is all about communicating with other disciplines and exploring technology in new ways as well as identifying opportunities to develop new technology that doesn't exist."

Presented by Public Art UHS, "Color Field" is the first curated exhibition of outdoor sculpture presented at UH and the second project in Public Art UHS's Temporary Public Art Program. There are 13 works from seven contemporary artists which include: TYPOE, Sam Falls, Spencer Finch, Sarah Braman, Jeffie Brewer, Odili Donald Odita and soundscape artist Amos Cochran. The exhibition was organized by Crystal Bridges Museum of American Art in Bentonville, Arkansas.

"'Color Field' enables viewers to question their perceptions while thinking about the impact color has on our lives," said María C. Gaztambide, Public Art UHS director and chief curator. "Our goal is for students – of all disciplines – and the greater UH community to respond to these works intuitively and experience them freely."

Precision Art Therapy

As director of the BRAIN Center (Building Reliable Advances and Innovations in Neurotechnology), Contreras-Vidal is a pioneer of neural and rehabilitation engineering research focusing on non-invasive brain-machine interface systems and neuroprosthetics, the study of the brain's response to the arts and the impact of neurotechnology in medicine, neuroscience and medical device design.

"Just imagine if medical experts could move from general art therapy to precision art therapy that's personalized and prescribed specifically for you and me," he said.

Akshay Sujatha Ravindran, an electrical and computer engineering graduate assistant, is eager to understand how the arts can be integrated into his research at the BRAIN Center.

He's been analyzing preliminary data from his headset, which looks at a measurement of creative engagement from the brain signals. Once the "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.

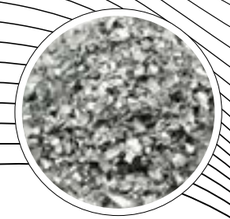
For now, he and his fellow classmates will continue to interpret various frequencies from their headset data to better understand how they match to specific experiences and art exhibits.

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

JOSE LUIS CONTRERAS-VIDAL AND STUDENTS FROM HIS SPRING 2021 NEUROHUMANITIES CLASS.

Discoveries Highlight

New Possibilities for Magnesium Batteries



BY JEANNIE KEVER

Magnesium batteries have long been considered a potentially safer and less expensive alternative to lithium-ion batteries, but previous versions have been severely limited in the power they delivered.

Researchers from the University of Houston 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 magnesium battery – to demonstrate a magnesium battery capable of operating at room temperature and delivering a power density comparable to that offered by lithium-ion batteries.

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

Magnesium ions hold twice the charge of lithium, while having a similar ionic radius. As a result, magnesium dissociation from electrolytes and its diffusion in the electrode, two essential processes that take place in classical intercalation 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 difficulties by storing magnesium cation in its complex forms. Neither approach is practical.

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

"We demonstrated a heterogeneous enolization redox chemistry to create a cathode which is not hampered by the ionic dissociation and solid-state diffusion challenges that have prevented 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, creating a new paradigm in magnesium battery electrode design."

Yao, who is also a principal investigator with the Texas Center for Superconductivity at UH (TcSUH), is a leader in the development of multivalent 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 advancements in the magnesium battery field, including developing highly recognized, efficient electrolytes based on boron cluster anions. However, these electrolytes had limitations in supporting high battery cycling rates.

"We had hints that electrolytes based on these weakly coordinating anions in principle could have the potential to support very high cycling rates, so we worked on tweaking their properties," said Rana Mohtadi, a Principal Scientist in the materials research department at TRINA and co-corresponding author. "We tackled this by turning our attention to the solvent in order to reduce its binding to the magnesium ions and improve the bulk transport kinetics."

"We were fascinated that the magnesium plated from the modified electrolyte remained smooth even under ultrahigh cycling rates. We believe this unveils a new facet in magnesium battery electrochemistry."

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. Lebens-Higgins also is affiliated with the Binghamton University.

"The new battery is nearly two orders of magnitude 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 trapping capability."

Tutusaus said the work suggests the next steps toward high-performance magnesium batteries.

"Our results set the direction for developing high-performance cathode materials and electrolyte solutions for magnesium batteries and unearth new possibilities for using energy-dense metals for fast energy storage," he said.

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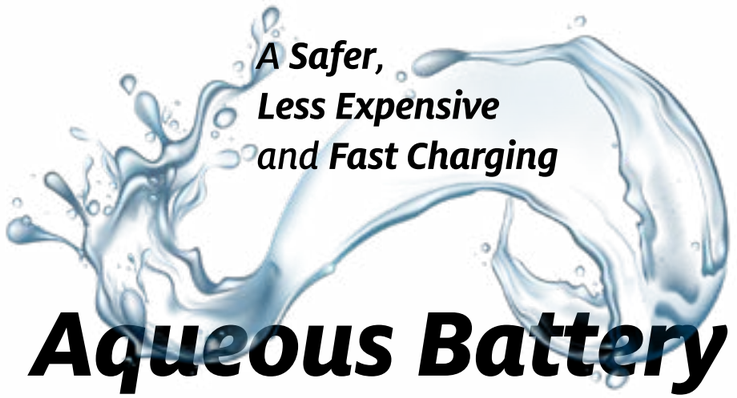
Read Review Article:
Current status and future directions of multivalent metal-ion batteries

NATURE ENERGY:
www.nature.com/articles



A Safer, Less Expensive and Fast Charging

Aqueous Battery

BY JEANNIE 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.

Xiaonan 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."

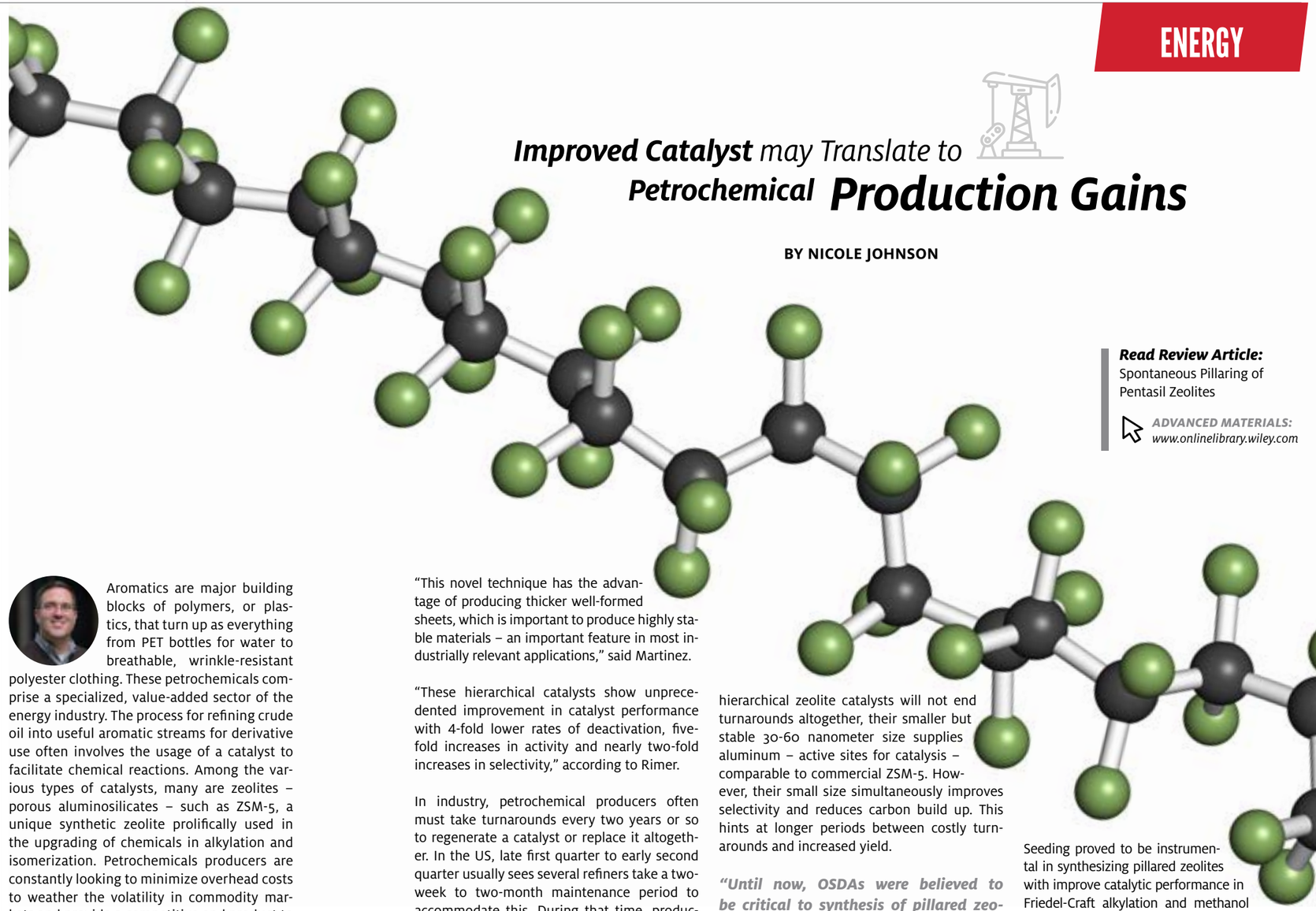
Testing determined that the novel 3D zinc-manganese nano alloy anode remained stable without degrading throughout 1,000 hours of charge/discharge cycling under high current density (80 mA/cm2).

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 Huajun Tian, Zhao Li, David Fox, Lei Zhai, Akihiro Kushima and co-corresponding author Yang Yang, all with the University of Central Florida; Zhenzhong Yang and Yingge Du, both with Pacific Northwest National Laboratory; Maoyu Wang and co-corresponding author Zhenxing Feng, both with Oregon State University; and Hua Zhou with Argonne National Laboratory.



Improved Catalyst may Translate to Petrochemical Production Gains

BY NICOLE JOHNSON

Aromatics are major building blocks of polymers, or plastics, that turn up as everything from PET bottles for water to breathable, wrinkle-resistant polyester clothing. These petrochemicals comprise a specialized, value-added sector of the energy industry. The process for refining crude oil into useful aromatic streams for derivative use often involves the usage of a catalyst to facilitate chemical reactions. Among the various types of catalysts, many are zeolites – porous aluminosilicates – such as ZSM-5, a unique synthetic zeolite prolifically used in the upgrading of chemicals in alkylation and isomerization. Petrochemicals producers are constantly looking to minimize overhead costs to weather the volatility in commodity markets and provide a competitive end product to the average person.

Jeffrey Rimer, Abraham E. Dukler Professor at the University of Houston Cullen College of Engineering and Javier Garcia-Martinez, professor of inorganic chemistry at the University of Alicante, have uncovered a seeding method that simplifies the synthesis process and results in spontaneous pillaring of zeolites. The work is published in *Advanced Materials*. The process results in more aluminum concentrate in the zeolite and a unique crystal structure to facilitate chemical reactions with reduced carbon build up.

"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.

"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. In the US, late first quarter to early second quarter usually sees several refiners 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 aluminum – active sites for catalysis – 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.

"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.

Seeding proved to be instrumental in synthesizing pillared zeolites with improve catalytic performance in Friedel-Craft alkylation and methanol to hydrocarbon reactions. This synthesis approach bypasses the typical energy intensive process of utilizing OSDAs. Organics previously thought essential for creating zeolites that can be utilized commercially are ultimately no longer necessary.

Next steps for this project include scaling up the process to show whether this improved zeolite catalyst can replicate its performance on industry scale. This research also functions as a springboard for further exploring the implications of seeding to produce other zeolites with unique structures and exceptional performance in commercial applications.

Read Review Article:
Spontaneous Pillaring of Pentasil Zeolites

ADVANCED MATERIALS:
www.onlinelibrary.wiley.com

Attitudes about **Climate Change** *are Shifting,* **Even in Texas**

BY JEANNIE KEVER

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. Brookshire Department of Chemical and Biomolecular 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 58 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.

"With so much potential for change ahead, we wanted to assess public attitudes about climate change and support for specific policies aimed at curbing emissions," said Pablo Pinto, director of the Center for Public Policy at the Hobby School. "We found people are worried about climate change and want it to be addressed, but many people, especially older residents, don't understand the strategies being considered."

Among the findings:

2 OUT OF 3 nationally **are *worried*** about climate change.

55% agree **"the oil & gas industries have *deliberately misled* people on climate change,"** while **49%** of Texans agree.

More than **60%** of **Texans *agree***.

About **2/3** say oil and gas companies ***should adopt* carbon management technologies**.

56% say government should promote, incentivize and ***subsidize carbon management technologies***, while **53%** of **Texans *agree***.

64% of people nationally, and **61%** of **Texans,** say hydraulic fracturing has a negative effect on the environment.

MITIGATION STRATEGIES

aren't well understood, as

61% have heard of carbon taxes, while

LESS THAN 1/2 are familiar with carbon management and just

1/3 have heard of carbon pricing.

Younger people and those with more education had higher levels of awareness.

The full report
is available on the UH Energy and Hobby School websites

FOR MORE INFO, VISIT:
www.uh.edu/uh-energy/

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. Still, among people who were better informed on the topic, about 76 percent said individual choices were partly to blame.

"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.

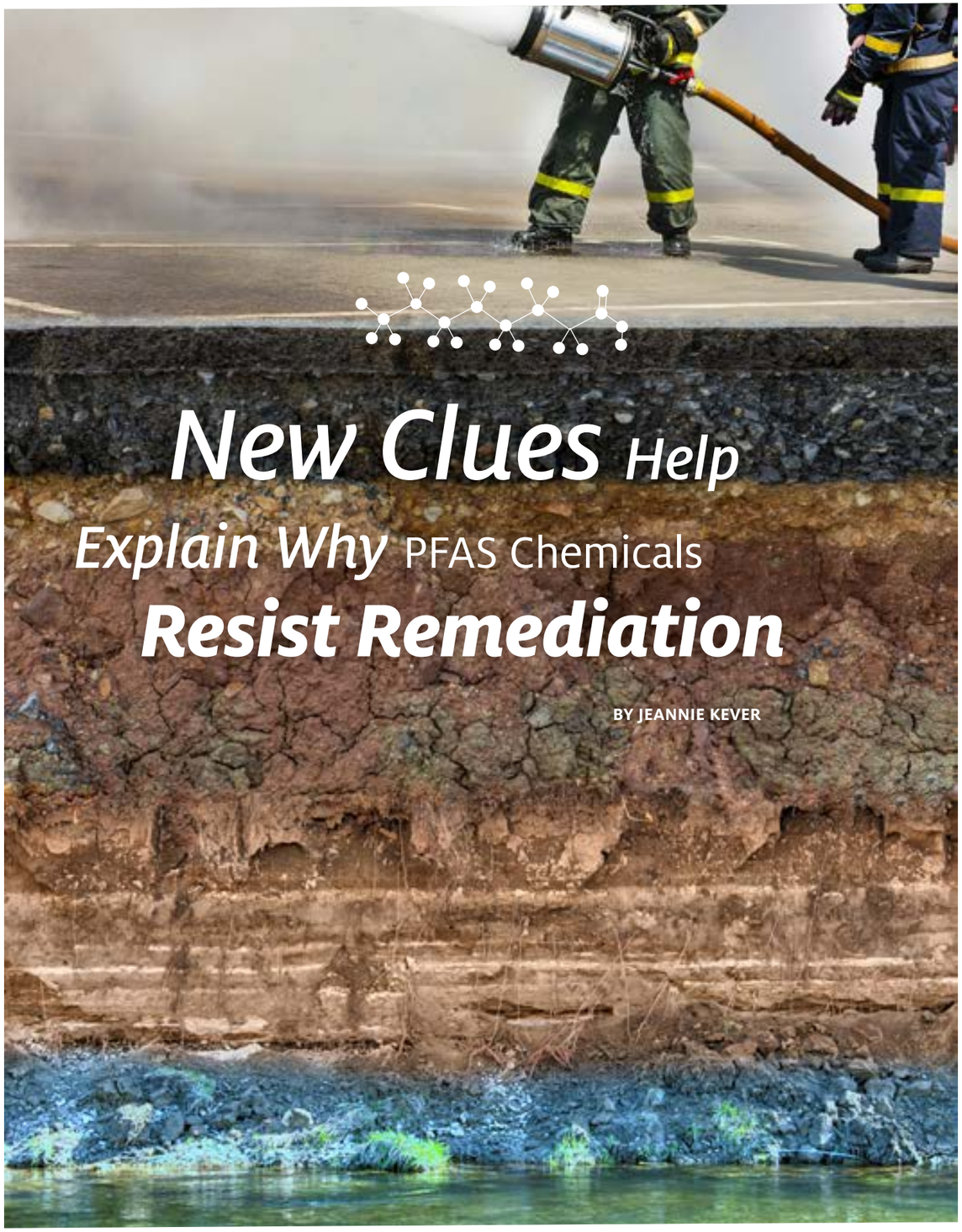
The researchers found generational differences in support for paying higher prices in exchange for carbon-neutral energy, with younger people generally more willing to pay a higher premium.

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.



New Clues Help Explain Why PFAS Chemicals *Resist Remediation*

BY JEANNIE KEVER

"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.**"

- KONSTANTINOS KOSTARELOS

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, he said. "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.

Before the *Flood*: Forecasting Inundation Extents

BY STEPHEN GREENWELL

For University of Houston professor **Hyongki Lee**, living firsthand through the calamity and destruction caused by Hurricane Harvey in 2017 has shaped his research interests, and brought to the forefront how important the need for a forecast flood extent can be.

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.

OFFICE OF WATER PREDICTION: MAP OF TEXAS

In the statement of need for the project, 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 effected 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.

Life Expectancy Lower for those Living Near *Superfund Sites*

BY LAURIE FICKMAN

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.

"We have ample evidence that contaminant releases from anthropogenic sources (e.g., petrochemicals or hazardous waste sites) could increase the mortality rate in fence-line communities," reports Rifai. "Results showed a significant difference in life expectancy among census tracts with at least one Superfund site and their neighboring tracts with no sites."

Nationally there are thousands of so-called Superfund, or contaminated, sites that pose a risk to human health and the environment. These sites include manufacturing facilities, processing plants, landfills and mining sites where hazardous waste was dumped, left out in the open or poorly managed.

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.

HANADI RIFAI IN THE LAB WITH GRADUATE STUDENT RESEARCHER, DANA REED

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

Rifai also examined the impact of flooding, which could cause the transport of contaminants from Superfund sites and potentially affect neighborhoods farther than the nearby fence-line communities.

"When you add in flooding, there will be ancillary or secondary impacts that can potentially be exacerbated by a changing future climate," said Rifai. "The long-term effect of the flooding and repetitive exposure has an effect that can transcend generations."

Joining Rifai on this project is Clint N. Dawson of the University of Texas at Austin, and **Amin Kiaghadi**, a postdoctoral fellow for Rifai and Dawson.

Read Article:
The presence of Superfund sites as a determinant of life expectancy in the U.S.

NATURE COMMUNICATIONS:
www.nature.com/articles

Hu Earns NASA *Funding Award*

BY STEPHEN GREENWELL

Xie Hu, a 2020 hire as an assistant professor in the Cullen College of Engineering's Civil and Environmental Engineering Department and at the National Center for Airborne Laser Mapping, received a $375,000 grant for her research proposal from NASA.

"Four-Dimensional Landslide Quantification in the Western U.S. Using Remote Sensing Big Data" was one of 38 proposals selected for funding as part of NASA's Research Opportunities in Space and Earth Science aimed at new and early career investigators. Hu's proposal was selected from a pool of 238 applicants, which had an acceptance rate of 15.9 percent.

Hu is enthusiastic about the response she's gotten regarding her proposal and research so far.

"It's fantastic news," she said of the NASA grant. "It is my first award as the principal investigator and as a junior faculty. I'm grateful for what I've learned on landslide hazards during my postdoc research with Dr. Roland Bürgmann at UC Berkeley and my Ph.D. study with Dr. Zhong Lu at SMU. I also appreciate the guidance and suggestions from my colleagues **Dr. Hyongki Lee** and **Dr. Craig L. Glennie** at NCALM, and Yuning Fu and Eric Fielding. I would also like to thank our CEE Department and the Grant Office for their assistance."

Hu's research focuses on radar and ground motion, as well as geohazards. This specific proposal concerns landslides.

"In the U.S., landslides cause tens of casualties and billions of dollars in damage every year," she said. "The western U.S. is especially vulnerable due to steep slopes, high precipitation, wildfires and logging, while the convergent plate boundaries exacerbate landslide hazards by prolonged weakening of materials and occasional dynamic shaking.

Although national and statewide landslide inventories exist, they are limited in the completeness of landslide locations and attributes due to lack of geomorphological or cartographic evidence."

Hu will be using her expertise along with radar data and observations to track landslides, even slowly occurring ones that might not be immediately apparent to the human eye.

"Scientific advancements have been achieved in every individual earth science discipline with more accurate observations and more robust models driven by remote sensing big data from ground, air and space, such as topography, precipitation and tectonic loading," she said. "The key data are from the Synthetic Aperture Radar [SAR]. It can be used to measure ground displacements and to monitor surface changes by repeatedly imaging the Earth remotely ... The main objective of my project is to use remote sensing big data to quantitatively define the role and interplay of those environmental forces in the lifespan of slow-moving landslides."

Going forward, Hu noted that having measurable observations of these slow-moving landslides would be incredibly valuable for areas affected by them, especially the western portion of the United States.

"This is a multidisciplinary research of high societal relevance as it addresses landslide hazard and resilience across population centers, transportation corridors and watersheds in the seismically active Western U.S.," she said. "A slow-moving landslide system can be recognized as an exceptional natural tectonics laboratory with accessible size and shortened timespans, which can help us understand the geological processes at different spatiotemporal scales."

Grabow Nets Another $2M for Research Projects on Small Reactors, Catalysts

BY STEPHEN GREENWELL

THE TAP REACTOR AND OTHER ASSOCIATED EQUIPMENT IN LARS GRABOW'S LAB

A Cullen College of Engineering professor will be furthering his research into developing small, modular reactor systems and tuning the properties of catalysts after receiving a pair of grants expected to total more than $2 million in funding.

Lars C. Grabow, the Dan Luss Professor in the Cullen College of Engineering's William A. Brookshire Department of Chemical and Biomolecular Engineering, is the primary investigator for "Resilient Ammoxidation of Small Hydrocarbons (R-ASH) Using Forced Dynamic Operation for Maximal Flexibility." While the exact budget is still being negotiated, roughly $1.3 million of the $3.6 million project will fund work at UH. Other team members are at the Idaho National Laboratory, the University of Virginia, the Pacific Northwest National Laboratory, and KX2 Development.

Grabow described the aim of the research in an abstract for public release.

"There is growing interest to valorize geographically distributed, low volume domestic feedstocks using flexible and modular process units," he wrote. "Smaller reactors mean faster response time, inviting transient operating strategies such as feed modulation to achieve more resilient processes with greater feedstock flexibility, enhanced product yields, and extended catalyst lifetimes."

The goal is to increase options and safety when it comes to dealing with sometimes volatile and explosive chemicals.

"We picked acrylonitrile as a target product, because its transport and storage is dangerous and it is a highly energy intensive chemical to make," Grabow said. "The distributed approach promises not only to increase the flexibility of the location and time when acrylonitrile is made, but it also contributes to process safety because the risk of explosive polymerization during transport or extended storage periods of acrylonitrile can be effectively reduced."

Acrylonitrile is a commodity precursor used in the chemical industry for the production of ABS/SAN resins, acrylic fibers, acrylamide, nitrile rubber, adiponitrile, and carbon fibers. Its distributed manufacture is particularly interesting for carbon fiber producers, an industry sector with double-digit annualized growth rates.

R-ASH, as the project is nicknamed, shares ideas with another project Grabow is working on with collaborators from UVA. **Mike Harold** of UH is also a collaborator for both projects. Grabow noted that new chairman of the William A. Brookshire Department of Chemical and Biomolecular Engineering, **Triantafillos "Lakis" Mountziaris,** spearheaded the idea of distributed manufacturing when he was a Program Director at the National Science Foundation.

"Distributed Chemical Manufacturing or 'DCheM' is a concept that aims to revolutionize and 'democratize' the process industries sector by deploying modular process plants close to the feedstock or to the customer," Mountziaris said. "This approach can take advantage of geographically scattered feedstocks and provide opportunities for economic development to rural and remote areas. It can also enable on-site production of dangerous chemicals to avoid their transportation and storage. The project that Dr. Grabow and Dr. Harold will pursue with their collaborators is very timely and addresses this need with potential economic and environmental sustainability benefits."

Grabow is a co-PI for the second grant, "Catalyst Evaluation for Deactivation and Remediation (CEDAR): Development of Robust Materials and Resilient Processes via Transient Measurement and Data-driven Multiscale Models," which is led by the INL. About $690,000 of the roughly $6.5 million project is earmarked for research at UH.

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 Rebecca Fushimi of INL organized a workshop on Dynamic Catalysis 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 Fushimi at INL, because she is the leading U.S. expert in the use of temporal analysis of products [TAP] reactors for studying heterogeneous catalysis. 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 10 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 CEDAR project would hopefully enable us to make this prediction in just one day! Yes, that's wishful thinking, but we aim high."

Brankovic Leads Multi-Department Research *Into Synthesis Via SLRR Reaction*

BY STEPHEN GREENWELL

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 paper, "Electroless Pb Monolayer Deposition – Prelude for Further Advances in Catalyst Monolayer Synthesis via Surface Limited Redox Replacement Reaction," was published in April 2021 in *ACS Catalysis*, a journal with an impact factor of 14.

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; **Kamyar Ahmadi** from the Materials Science and Engineering Program; and **Francisco Robles Hernandez** of the College of Technology. **Taha Salavati-Fard**, formerly a postdoctoral fellow in the Chemical and Biomoleulcar Engineering Department, is now a research associate at the University of Oklahoma.

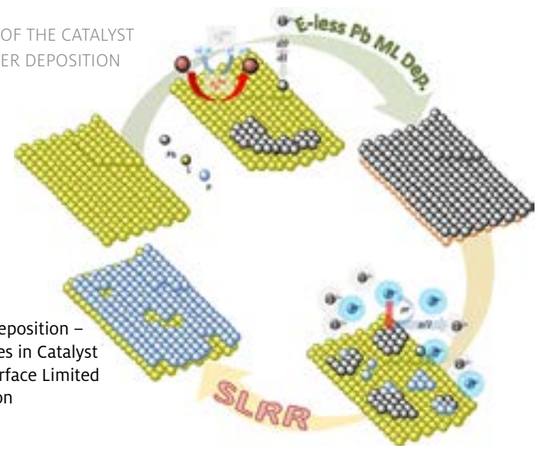
The published work is a result of multiyear effort among UH researches to perfect and understand a new phenomenon for monolayer controlled deposition and to present its practical importance to the relevant fields of catalysis and electrocatalysis.

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."

DIAGRAM OF THE CATALYST MONOLAYER DEPOSITION



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

ACS CATALYSIS:
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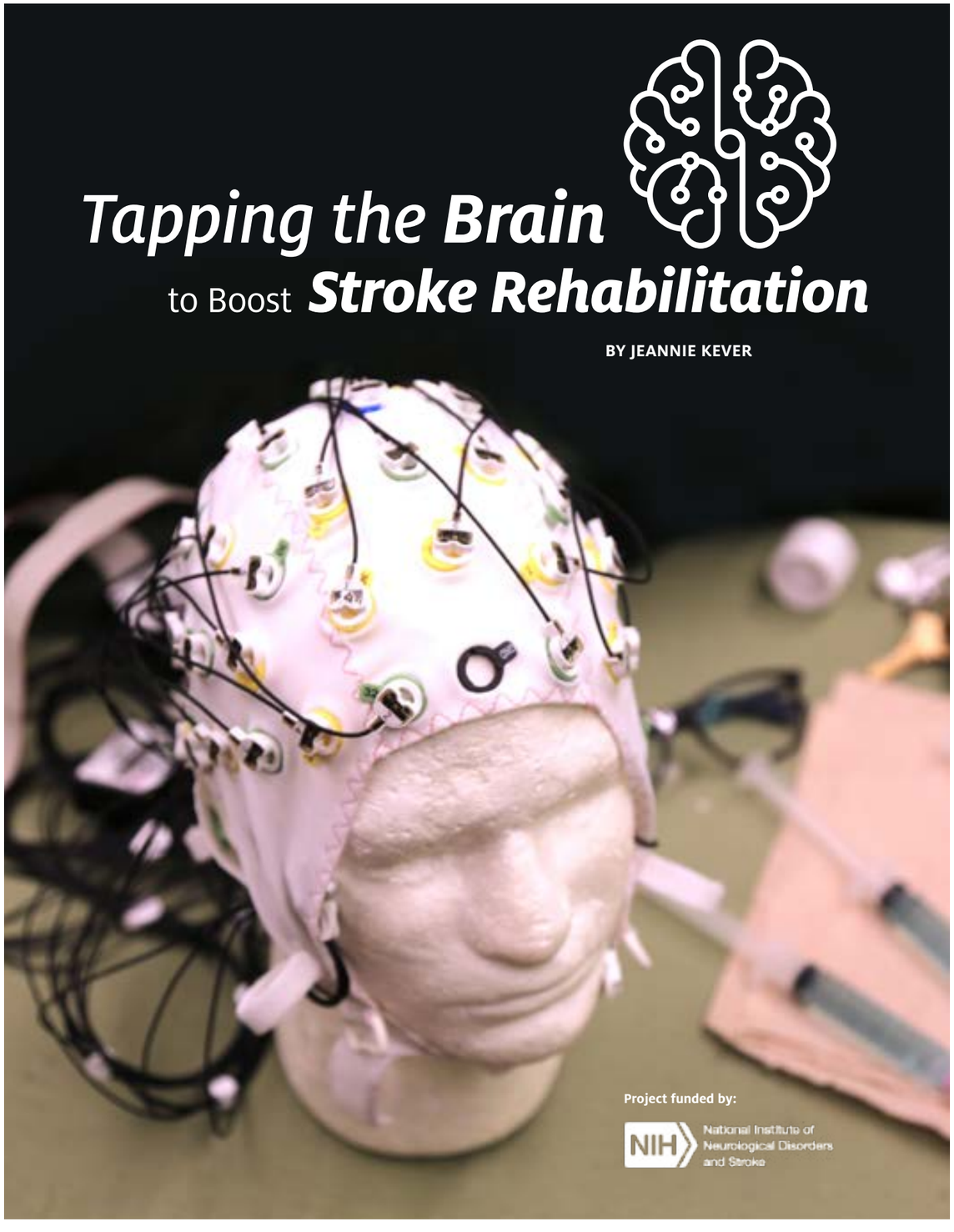
*Tapping the **Brain*** to Boost ***Stroke Rehabilitation***

BY JEANNIE KEVER



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

- JOSE LUIS CONTRERAS-VIDAL

Stroke survivors who had ceased to benefit from conventional rehabilitation 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 *NeuroImage: 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 after the therapy sessions ended, suggesting the potential for long-lasting gains. He is also Hugh Roy and Lillie Cranz Cullen Distinguished Professor 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 captures 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-principal 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, researchers 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-principal 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 Hermann, 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 Institute, researchers involved with the project include **Nikunj A. Bhagat** and **Zachary Hernandez** with UH; Nuray Yozbatiran and Rupa Paranjape with UTHealth; Zafer Keser, formerly with UTHealth; Jennifer L. Sullivan, 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 work 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 anticipated 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 participating 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 follow-up testing was conducted two months after therapy ended, and Contreras-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.

UH Researcher **Develops,** ***Tests Nano-Carrier*** *as Potential* **Treatment** *for* **Brain Tumors**

BY LAURIE FICKMAN

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 chemotherapeutics across the blood brain barrier and undesired side effects of these therapeutics on healthy tissues," said **Sheereen Majd**, assistant professor of biomedical engineering at the University of Houston. "To get enough medicine across the blood brain barrier, a high dosage of medication is required, but that introduces more toxicity into the body and can cause more problems."

In an article published and featured on the cover of a January issue of *Advanced Healthcare Materials*, Majd reports a new glioma-targeted nano-therapeutic that will only address tumor cells offering increased effectiveness and reduced side effects.

An iron chelator known as Dp44mT (Di-2-pyridylketone-4,4-dimethyl-3-thiosemicarbazone) is an effective medication known to inhibit the progression of tumors but had not been used against brain tumors prior to this study. The chelator works to pull out the overabundance 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 (Interluken) receptors. Because the IL13 receptors are abundant, she added IL13 ligands onto her FDA-approved 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 nearly impervious to common chemotherapeutics such as temozolomide or doxorubicin.

"There is, hence, an urgent need for more effective therapeutic formulations with the ability to overcome drug resistance in aggressive glioma tumors and to kill these malignant cells without damaging the healthy tissues," reports Majd.

Majd's study, which tested the nano-therapeutic both in vivo and in vitro, is the first report on targeted delivery of Dp44mT to malignant tumors.

Cancer 'Guardian' **Breaks Bad** *with One Switch*

THIS ARTICLE WAS WRITTEN JOINTLY BY RICE UNIVERSITY AND THE UNIVERSITY OF HOUSTON.

A mutation that replaces a single amino acid in a potent tumor-suppressing protein turns it from saint to sinister. A new study by a coalition of Texas institutions shows why that is more damaging than previously known.

The ubiquitous p53 protein in its natural state, sometimes called "the guardian of the genome," is a front-line protector against cancer. But the mutant form appears in 50 percent or more of human cancers and actively blocks cancer suppressors.

Researchers led by **Peter Vekilov,** and his group at the University of Houston, and Anatoly Kolomeisky at Rice University have discovered the same mutant protein can aggregate into clusters. These in turn nucleate the formation of amyloid fibrils, a prime suspect in cancers as well as neurological diseases like Alzheimer's. An abstract for their paper can be found online.

The condensation of p53 into clusters is driven by the destabilization of the protein's DNA-binding pocket when a single arginine amino acid is replaced with glutamine, they reported.

"It's known that a mutation in this protein is a main source of cancer, but the mechanism is still unknown," said Kolomeisky, a professor and chair of Rice's Department of Chemistry and a professor of chemical and biomolecular engineering.

"This knowledge gap has significantly constrained attempts to control aggregation and suggest novel cancer treatments," said Vekilov, the John and Rebecca Moores Professor of Chemical and Biomolecular Engineering and Chemistry at UH.

The mutant p53 clusters, which resemble those discovered by Vekilov in solutions of other proteins 15 years ago, and the amyloid fibrils they nucleate prompt the aggregation of other proteins the body uses to suppress cancer.

"This is similar to what happens in the brain in neurological disorders, though those are very different diseases," Kolomeisky said.

The p53 mechanism described in the *Proceedings of the National Academy of Sciences* may be similar to those that form functional and pathological solids like tubules, filaments, sickle cell polymers, amyloids and crystals, Vekilov said.

Researchers at UH combined 3D confocal images of breast cancer cells taken in the lab of chemical and biomolecular engineer **Navin Varadarajan** with light scattering and optical microscopy of solutions of the purified protein carried out in the Vekilov lab.

Transmission electron microscopy micrographs of cluster and fibril formation contributed by Michael Sherman at the University of Texas Medical Branch at Galveston (UTMB) supported the main result of the study, as did molecular simulations by Kolomeisky's group

All confirmed the p53 mutant known as R248Q goes through a two-step process to form mesoscopic condensates. Understanding the mechanism could provide insight into treating various cancers that manipulate either p53 or its associated signaling pathways, Vekilov said.

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 Klindziuk 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. Varadarajan 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.

BY STEPHEN GREENWELL

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 $25,000 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 graduate student lead for the project is **David Eguren**. Other team members include **Alexander Steele**, **Yang Hu**, **Krishna Sarvani Desabhotla**, **Swagat Bhandari**, **Lujayna Taha**, **Nivriti Sabhnani** and **Allen Shen**.

"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 TIRR 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.

New Discoveries of Deep Brain Stimulation put it on Par with Therapeutics

BY LAURIE FICKMAN

Despite having remarkable utility in treating movement disorders such as Parkinson's disease, deep brain stimulation (DBS) has confounded 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 higher frequencies (>100Hz) 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 (130–180 Hz) induces high-frequency oscillations (~300 Hz, HFO) similar to those observed with pharmacological treatment," reports **Nuri Ince**, associate professor of Biomedical Engineering.

NURI INCE AND STUDENTS

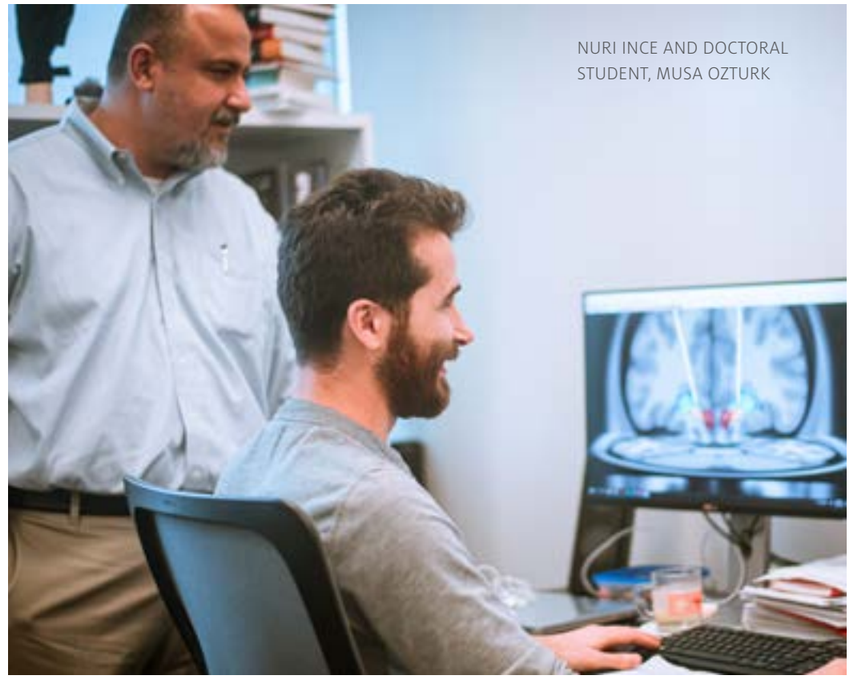
For the past couple of decades, deep brain stimulation (DBS) has been the most important therapeutic advancement in the treatment of Parkinson's disease, a progressive nervous system disorder that affects movement in 10 million people worldwide. In DBS, electrodes are surgically implanted in the deep 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.

"For 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 methods, 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.



NURI INCE AND DOCTORAL STUDENT, MUSA OZTURK

BY LAURIE FICKMAN

The founding chair of the Biomedical Engineering Department at the University of Houston is reporting a new deep neural network architecture that provides early diagnosis of systemic sclerosis (SSc), a rare autoimmune disease marked by hardened or fibrous skin and internal organs. The proposed network, implemented using a standard laptop computer (2.5 GHz Intel Core i7), can immediately differentiate between images of healthy skin and skin with systemic sclerosis.

"Our preliminary study, intended to show the efficacy of the proposed network architecture, holds promise in the characterization of SSc," reports **Metin Akay**, John S. Dunn Endowed Chair Professor of biomedical engineering. The work is published in the *IEEE Open Journal of Engineering in Medicine and Biology*.

"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 often elusive. Several studies have shown that organ involvement could occur far earlier than expected in the early phase of the disease, but early diagnosis and determining the extent of disease progression pose significant challenge for physicians, even at expert centers, resulting in delays in therapy and management.

In artificial intelligence, deep learning organizes algorithms into layers (the artificial neural network) that can make its own intelligent decisions. To speed up the learning process, the new network was trained using the parameters of MobileNetV2, a mobile vision application, pre-trained on the ImageNet dataset with 1.4M images.

"By scanning the images, the network learns from the existing images and decides which new image is normal or in an early or late stage of disease," said Akay.

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 Yasmin 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 Shersen**, **Ting Chen** and **Chandra Mohan**, all of University of Houston; and Minghua Wu and Shervin Assassi of the University of Texas Health Science Center (UT Health).

Focusing on the Unhealthy Brain to Speed Drug Discovery

BADRI ROYSAM AND STUDENTS, ADITI SINGH, JAHANDAR JAHANIPOUR AND REBECCA LI, REVIEW A VISUALIZATION OF BRAIN TISSUE CELLS PROJECTED IN THE RESEARCH COMPUTING DATA CORE VISUALIZATION THEATER AT THE UNIVERSITY OF HOUSTON'S HEWLETT PACKARD ENTERPRISE DATA SCIENCE INSTITUTE

BY LAURIE FICKMAN

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 about his latest paper published in *Nature Communications*. "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 10 – 100 different biomarkers of interest at the same time using direct or indirect IHC immunostaining protocols," reports Roysam. The new toolkit uses repeated cycles of optimized 10-plex immunostaining with 10-color epifluorescence imaging to accumulate highly enriched image datasets from individual whole-brain slices, from which seamless signal-corrected mosaics are reconstructed and analyzed.

This makes way for more rapid drug development. "We present a direct method that generates readouts for a comprehensive panel of biomarkers from serial whole-brain slices, characterizing all major brain cell types, at scales ranging from subcellular compartments, individual cells, local multi-cellular niches, to whole-brain regions from each slice," said 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 system-level 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.

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

BY LAURIE FICKMAN

When a mosquito begins 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 P. Falciparum parasite, is artemisinin-based combination therapy, which provides a one-two punch. The drug artemisinin (derived from the Asian Artemisia annua or sweet wormwood) is combined with a quinoline-based compound. Artemisinin weakens the parasite by oxidizing it; the quinoline drug kills it.

"But the two drugs do not always cooperate, they can also be antagonistic. Our purpose is to study the interactions between artemisinin and the drugs with which they are combined to fight malaria," said **Peter Vekilov**, Moores Professor of Chemical and Biomolecular Engineering at the University of Houston. Vekilov received $1.2 million from the National Institute of Health, in partnership with Johns Hopkins University, to study the interactions of the drugs. Working with Vekilov is **Jeff Rimer**, Abraham E. Dukler Professor of Chemical and Biomolecular Engineering at UH.

As their name indicates, parasites know how to survive and adapt. When they begin to eat away at hemoglobin, hematin is produced. The toxic hematin itself could kill the parasite, but the parasite makes quick work of the hematin.

"The parasite knows how to deal with hematin, by sequestering it as innocuous crystals called hemozoin which are no longer toxic," said Vekilov. "There is a crucial gap in the understanding of interactions between drug pairs relating to how they inhibit hemozoin formation."

Many anti-malarial drugs work by inhibiting crystallization, which leaves the hematin soluble to kill the parasites. In previous work, Vekilov and Rimer proved artemisinin can also kill parasites by blocking crystallization.

Still, as a high-level organism, the parasite has adapted quickly and developed a pump, which pumps the drugs out in a process Vekilov likens to warfare.

"When you want to defend yourself against bullets, you use armor, but if you want to protect yourself against grenades, you throw them back," he said. "The parasite uses the second strategy."

Malaria kills more than 400,000 people around the world every year, mostly young children. Although it was eliminated from the United States 70 years ago, it still infects 2,000 Americans each year. According to the Centers for Disease Control and Prevention, malaria cases in the United States rose to 2,161 in 2017, the highest number in 45 years.

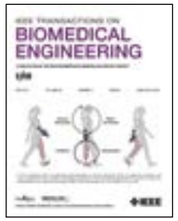
Artemisinin was discovered in 1971 by a Chinese scientist who won the Nobel Prize in 2015 for discovering its antimalarial properties.

"Our long-range goal is to develop a platform which will allow us to produce new drugs before the parasites develop resistance to the old ones, because that is inevitable," said Vekilov.

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

BY STEPHEN GREENWELL

A new paper from **Rose Faghih**, 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.



IEEE Transactions on Biomedical Engineering published "Identification of Sympathetic Nervous System Activation From Skin Conductance: A Sparse Decomposition Approach With Physiological Priors" in its May 2021 issue.

"We utilize physiological knowledge about the system for reliable identification of the solution," Amin said. "We address some of the vital challenges for rigorous analysis; by implementing our algorithm on data collected from 109 healthy participants, we establish that our approach can infer brain information with high reliability. Our novel inference engine will eventually help clinicians and researchers with accurate quantification of brain information for health tracking and other clinical/non-clinical applications."

Amin said that they compared their proposed method with previous approaches, and so far, their method is outperforming the others, especially when it comes to capturing brain activity while suppressing the noise.

"Inference of brain activation related to emotional status helps us track mental health and potentially prevent severe consequences such as suicide," Amin said. "Regular tracking of brain activity using our approach can also lead to the early detection of diseases like diabetic neuropathy. The transmission of brain activation, including the ones related to EDA, is performed by small nerves to the different regions of the body. EDA can be measured and monitored regularly at neuropathy-prone skin regions of the body to track the received brain activation. If a skin location has neuropathy – if the small nerves are damaged – that region will not receive this brain activation. Our approach can accurately detect the amount of brain activation received in different skin locations for a given stimulus. Thus, our method has the great potential to help to detect diabetic neuropathy."

Faghih pointed out that there were several other applications for their research, such as tracking pain, cognitive stress tracking and wakefulness, among other things.

"For example, a baby patient experiencing severe pain after a surgical procedure cannot express the level of pain," she said. "Doctors can eventually utilize EDA recordings and inferred brain activation to evaluate how much pain the baby patient is experiencing to provide necessary intervention."

Outside of medical applications, Faghih noted that day-to-day tracking of brain activation and arousal levels with their EDA-based approach could enable designing interventions for optimizing productivity.

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Non-Invasive *Eye-Movement* ***Sensors***

BY STEPHEN GREENWELL

Jae-Hyun Ryou, Ph.D., an Associate Professor of the Mechanical Engineering Department at the University of Houston's Cullen College of Engineering, is the lead author for a new research article describing eye-movement sensors that can record data by less obstructive methods than previously thought.

"Highly-Sensitive Skin-Attachable Eye- Movement Sensor Using Flexible Nonhazardous Piezoelectric Thin Film" was published by *Advanced Functional Materials* in February. Additional authors from UH include Ryou's students – **Nam-In Kim**, **Jie Chen**, **Weijie Wang**, **Mina Moradnia** and **Sara Pouladi**. Other listed authors include Min-Ki Kwon, a visiting scholar while on sabbatical from Chosun University; Ja-Yeon Kim, a visiting scholar while on sabbatical from Korea Photonics Technology Institute; and Xiaohang Li, a professor at King Abdullah University of Science and Technology, who was involved in the discussion and analysis of data with Ryou's students.

According to the paper, Ryou 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 developed as well. The sensor is fabricated from single-crystalline III-N thin film, by a layer-transfer technique that is highly sensitive and can detect subtle movements of the eye.

Ryou 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 healthcare monitoring systems, and to detect early symptoms of abnormality and diseases of the human body for medical diagnosis and safety systems. We developed a sensor network that can measure pulse waves in various arterial sites and demonstrated that it can continuously monitor pulse wave velocity and artery augmentation index, which are important physiological parameters to detect several cardiovascular diseases."

From there, Ryou said he and the group were intrigued about expanding the research to take into account eye movement, after reading an article about military training. Ryou noted that according to the article, fatigue and poor sleep – which can be monitored by eye movement – were contributing factors in 628 U.S. Army accidents, and in 32 deaths.

"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 the 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 (ETSs) relying on a computer-vision-based system is difficult to be miniaturized. This problem is particularly 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 movement?"

Ryou 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," Ryou said. "The sensor attached on the temple area is sensitive enough to detect various movements of the eyelid and eyeballs." Ryou said that the 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 connected organs to the brain through nerves and muscles," he said. "Therefore, many brain-related diseases are accompanied by abnormal eye movements. We are further developing the sensors to detect the early symptoms of brain-related diseases, such as ADHD, Parkinson's diseases, traumatic brain injury and other issues. Also, we plan to extend our sensor development to measure the level of human stress toward an overarching goal of fatigue and stress monitoring of individuals in daily life."

Read Research Article:
Highly-Sensitive Skin-Attachable Eye-Movement Sensor Using Flexible Nonhazardous Piezoelectric Thin Film

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BY STEPHEN GREENWELL

A professor at the University of Houston's Cullen College of Engineering received $900,000 in grant funding from the U.S. Air Force Research Laboratory to continue developing anti-ice coatings for aircrafts.

The funding was awarded for two proposals submitted, "Ice Shedding 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 corporation established for Ghasemi's lab's commercial work.

The research builds upon previous work by Ghasemi's lab on rotor protection tape for several different Air Force programs.

"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, addressing 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 a new ice-shedding coating for their aircraft wings," he said. "The qualification 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 presentation 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 experience 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 provided a promising solution that has been currently used in few applications internationally and continue to be adopted in the industry. It has been a fruitful 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."

Micro-CT for Advanced Materials Development

BY STEPHEN GREENWELL

Professors at the University of Houston's Cullen College of Engineering have received a $904,554 grant from the Office of Naval Research to procure equipment with Micro-CT imaging capabilities, which utilize x-rays to see inside of an object, with the goal of significantly improving the development of advanced materials.

The grant, "Micro-Computed Tomography (Micro-CT) for Non-destructive Evaluation of Advanced Materials and Devices for Defense Applications," was approved in September 2020. According to **Venkat "Selva" Selvamanickam**, the M.D. Anderson Chair Professor of Mechanical Engineering, the imaging equipment was delivered in March and installation began in April.

Micro-CT works similarly to hospital CT or CAT scans. However, it typically works at a much finer resolution, and without destroying the sample. Micro-CT is also known as microtomography or micro computed tomography.

According to Selva's proposal, Micro-CT combines x-ray absorption 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 computed, 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.

From Toxic Ions to Single-Atom Copper

BY SARA STRONG

Copper remains one of the single most ubiquitous metals in everyday life. As a conductor of heat and electricity, it is utilized in wires, roofing and plumbing, as well as a catalyst for petrochemical plants, solar and electrical conductors and for a wide range of energy related applications. Subsequently, any method to harvest more of the valuable commodity proves a useful endeavor.

Debora Rodrigues, Ezekiel Cullen Professor of Engineering at the University of Houston Cullen College of Engineering, in collaboration with Francisco C. Robles Hernandez, professor at the UH College of Technology, and Ellen Aquino Perpetuo, professor at the University of Sao Paulo, Brazil offered conclusive research for understanding how bacteria found in copper mines convert toxic copper ions to stable single-atom copper.

In their co-authored paper, "Copper Mining Bacteria: Converting toxic copper ions into a stable single atom copper," their research demonstrates how copper-resistant bacterium from a copper mine in Brazil convert $CuSO_4$ (copper sulfate) ions into zero-valent Cu (metallic copper).

"The idea of having bacteria in mines is not new, but the unanswered question was: what are they doing in the mines?" Robles said. "By putting 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 estimated in global reserves, according to the Copper Development Association Inc., with roughly 12.5 million metric tons per year mined.

This aggregates to roughly 65 years of remaining reserves. Part of the supply challenge comes from limited available copper in high concentration in the earth's crust, but the other challenge is the exposure to sulfur dioxide and nitrogen dioxide in the copper smelting and production process to concentrate the metal into useful quantities.

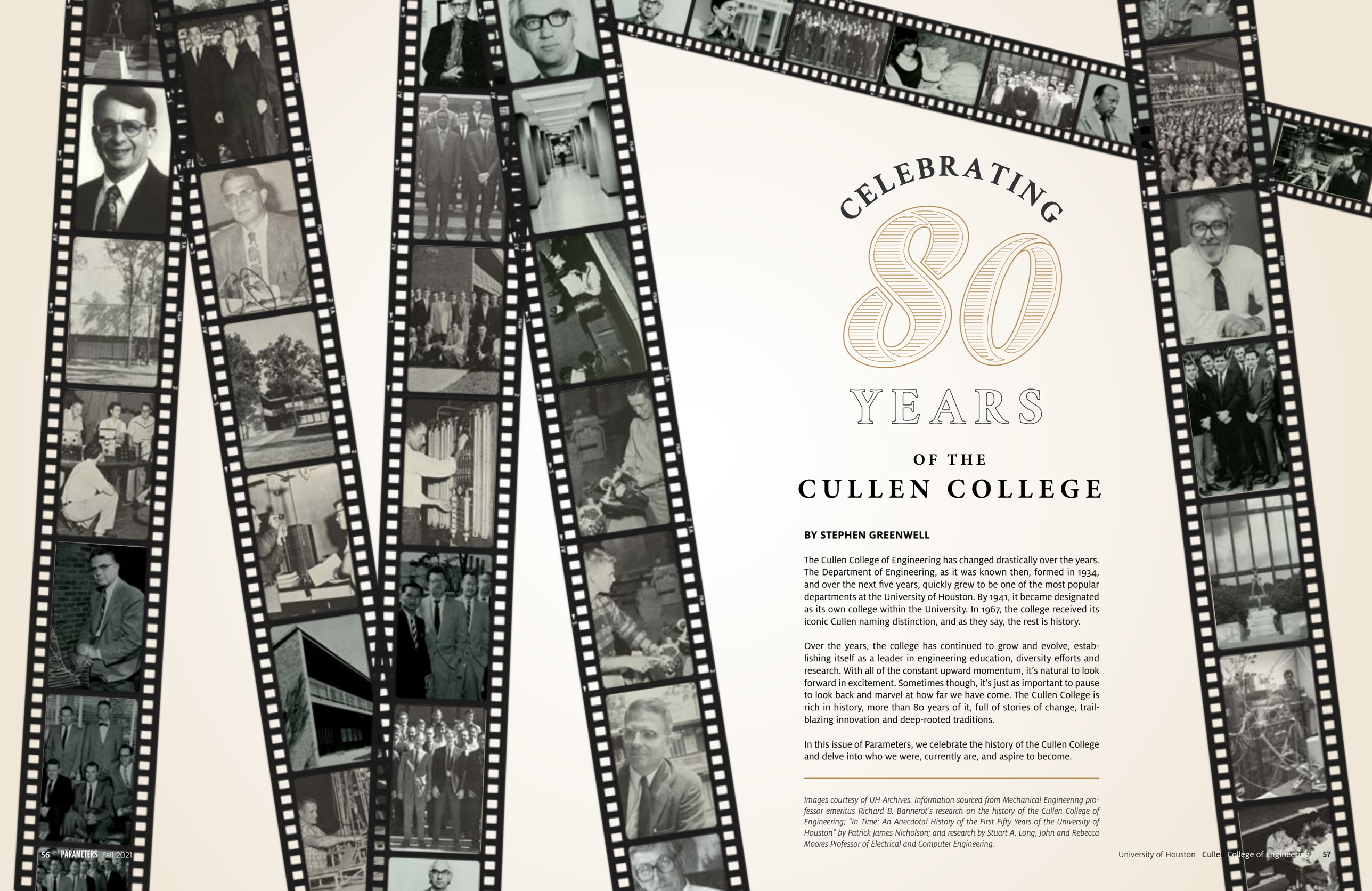
"The novelty of this discovery is that microbes in the environment can easily transform copper sulfate into zero valent single atom copper. This is a breakthrough because the current synthetic process of single atom zerovalent copper is typically not clean, it is labor intensive and expensive," Rodrigues said.

"The microbes utilize a unique biological pathway with an array of proteins that can extract copper (II) (Cu^{2+}) and convert it into single-atom zero-valent copper (Cuo). The aim of the microbes is to create a less toxic environment for themselves by converting the ionic copper into single-atom copper, but at the same time they make something that is beneficial for us too."

With a focus in electronic microscopy, Robles examined samples from Rodrigues' findings in Brazilian copper mines and he determined the single atom nature of the copper. Rodrigues and Aquino's groups further identified the bacterial process for converting copper sulfate to elemental copper – a rare find.

Research results demonstrate this new conversion process as an alternative to produce single atoms of metallic copper is safer, and more efficient versus current methods (i.e. chemical vapor deposition, sputtering and femtosecond laser ablation).

"We have only worked with one bacterium, but that may not be the only one out there that performs a similar function," Rodrigues concluded. "The next step for this particular research is harvesting the copper from these cells and using it for practical applications."



CELEBRATING 80 YEARS OF THE CULLEN COLLEGE

BY STEPHEN GREENWELL

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.

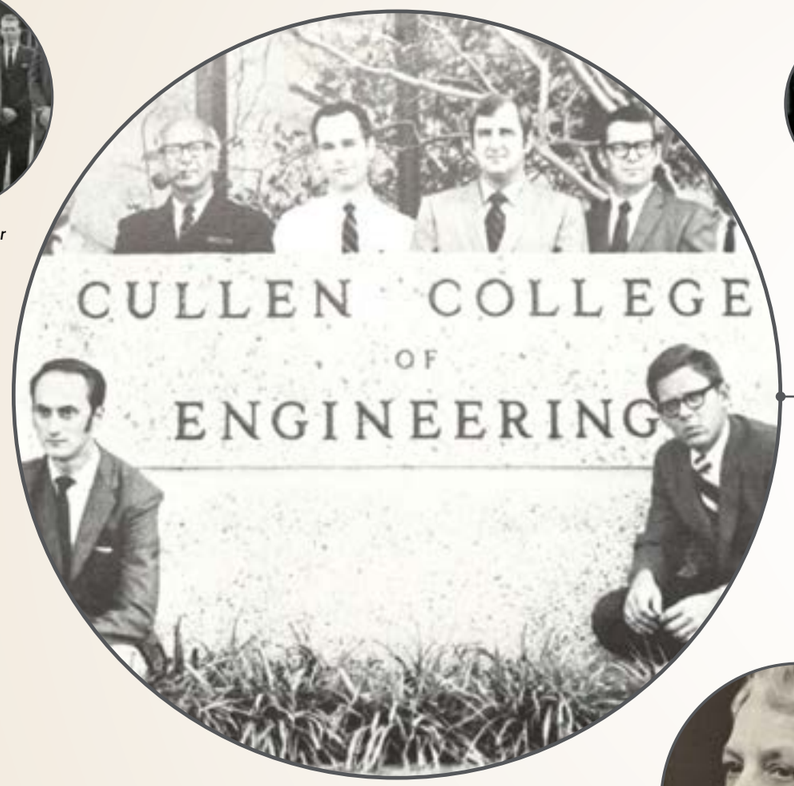
Over the years, the college has continued to grow and evolve, establishing itself as a leader in engineering education, diversity efforts and research. With all of the constant upward momentum, it's natural to look forward in excitement. Sometimes though, it's just as important to pause to look back 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.

Images 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.

A HISTORY OF THE

Tau Beta Pi Chapter



1977 Mechanical Engineering Faculty

Civil Engineering Faculty 1960

Mrs. H. R. Cullen

John Edward Hoff

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**.

Aerial View of Campus 1939

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.

Mr. H. R. Cullen

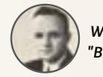
At the January 13, **1941** meeting of the Board of Trustees, **John Edward Hoff** was appointed as an instructor of engineering effective February 3 of that year. His salary was $2,200 for nine months. Hoff was a volunteer tennis coach for more than 20 years, the first chairman of the Civil Engineering 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.

At the February 10, **1941** meeting, four part-time engineering instructors were approved at the rate of $36 for one course, or $30 per course for two or more courses. The employees were **Andy Rasmussen**, **H.H. List**, **Robert Haldane** and **L.B. Fields**. Rasmussen would stay at UH until 1969, except for his war service from 1943 to 1946, and serve as the first chairman of the Mechanical Engineering Department in 1950.

Andy Rasmussen

L.B. Fields

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.



Walter William "Bill" Kemmerer

At this time in **1946**, **M.L. Ray** was listed as the "acting director" or dean, and a lecturer for engineering. He served in this role until March 1955, but was never named as the permanent dean.

M.L. Ray

By the June 16, **1946** meeting, there were five engineering faculty members – **John Edward Hoff, J.R. 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.

R.W. Lilliott

Thomas Whitaker

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. »

Edison E. Oberholtzer

Y-Building Demolition

On April 18, **1947**, the Y-Building (shown above) was proposed as a "temporary" structure, 300 feet by 140 feet, at a cost of $105,000 for the building, $45,000 for the electrical and mechanical work, and $150,000 for the equipment. Approval was given at the May 1 meeting. It outlasts nearly everything else on campus, until its demolition in 2012.

Y-Building

1947

As of the **1947-48** academic year, the faculty head count is 11. At the September 17, 1947 meeting, **Charles V. Kirkpatrick** is hired as an instructor, focusing on petroleum. He would later become a member of the Petroleum Engineering Program, and he was the second dean of the College of Engineering from 1964 to 1976. Also at this meeting, **J.T. Elrod** is hired as an assistant professor in engineering and business. He would later leave to get his doctorate at Ohio State, but then return to UH as an original member of the industrial engineering department, and later, chairman.

Charles V. Kirkpatrick

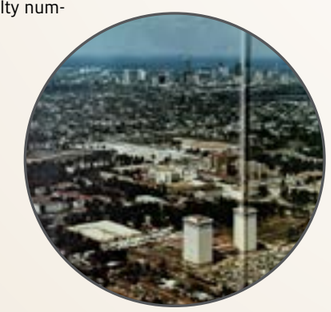
J.T. Elrod

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 37 years, 25 of his teams finished in the top three. Now known as the "Father of College Golf," the Golf Coaches Association of America named their Coach of the Year award after him.

William Prengle

1948-49

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.



In September **1952**, **Abraham Dukler** and **William Prengle** – formerly research engineers with Shell – were promoted from part-time to full-time instructors. **Joe Crump**, from Harvard, was also onboarded to establish the Chemical Engineering Department and to become its first chairman; Along with Crump, the three would remain at UH until retirement, and form one of the strongest departments on campus. Crump would be promoted to Associate Dean of Engineering in September 1958, as well as made the first Director of Research.

Joe Crump

1950

The College of Engineering was formally divided into departments after a vote by the board at the June 20, **1950** meeting. A Petroleum Engineering Department building was proposed at this time at a cost of $3 million, but it ultimately wasn't built, and there wouldn't be a building for the department until 2010.

Significant hires in this time frame included **Leo John Castellanos**, a 24-year member of Mechanical Engineering; **Albert Bonnar**, a Civil Engineering professor for 25 years; and **Bill Kittinger**, recognized as an excellent teacher of Electrical Engineering, and winner of the CCE's first teaching award in the mid-1960s. The award was renamed in his honor shortly after his death.

Leo John Castellanos

Frank M. Tiller was appointed the first "permanent" dean of the college on March 14, **1955**. Known as the "Father of Modern Filtration Theory," he was fluent in English, Spanish and Portuguese, and served as dean until 1963. He pushed for more faculty members to earn their doctorates. When he started, only 14 percent of faculty had Ph.D.s, and by the end of his tenure as dean, it was 40 percent. In 1963, Tiller became director of the newly-formed UH Office of International Affairs, before returning to teaching and research in 1972. At the time of his death in 2005, he was the M.D. Anderson Distinguished Professor of Chemical Engineering emeritus.

Betty J. Barr received her B.S., M.S. and Ph.D. in mathematics from UH in **1967,** 1969 and 1971, and she joined the Industrial Engineering Department as an instructor in linear algebra. She is believed to be one of the first women faculty members. She had a 40-year career at UH, retiring in 2011.

Betty J. Barr

1960

In December **1956, Hugh Roy Cullen** announced that his foundation would finance the design and construction of the engineering building – the third significant donation from Cullen for an engineering building. As a result, there was a suggestion to name the entire university after him, but he vetoed this, and instead it was agreed that the College of Engineering would bear his name, although at his request this honor was kept private. However, the $1.5 million that Cullen pledged at this time needed to be used to prevent the university from going insolvent in November 1959, and the engineering building was postponed as a result. The College's name was finally changed in **1967,** about a year before the new engineering building opened on May 3, 1968.

1970

Abraham Dukler became dean of the College of Engineering in **1976**. He returned to research – described as his first love by colleagues – in 1982. A member of the NAE and a fellow of the American Institute of Chemical Engineers, he had a 37-year career at UH. His tenure was noted for procuring large grants at the time to beef up the College's research capabilities.

Abraham Dukler

Roger Eichhorn becomes the dean of the College of Engineering and a professor of Mechanical Engineering in May **1982**, leaving a similar position at the University of Kentucky for UH. Under Eichhorn's leadership, the college raised student admissions standards, elevated the quality of the faculty and greatly expanded the college's public identity and community presence. In 1994, research awards hit a then-peak of $10 million, and enrollment peaked at 3,835 in 1983. He returned to teaching in 1996, and retired in 2002.

Roger Eichhorn

Eichhorn was succeeded by **Raymond Flumerfelt**, who served as the College's fifth dean from **1996** through 2007. He continued the work of Dukler and Eichhorn, emphasizing the pursuit of research, and dealt with challenging budget situations in the 1990s and early 2000s.

2021

Joseph Tedesco was hired as the College's sixth dean, effective Jan. 1, **2008**. Known for his ability to attract funding and support for research while chairman of the Civil and Coastal Engineering Department at the University of Florida, Tedesco has led the College to new milestones for research funding and enrollment.

Joseph Tedesco

STORIES FROM THE OLDEST LAB ON CAMPUS

For more than 50 years,

the Chemical Engineering laboratory – Room S144 of Engineering Building 1 –

has been the space where students are forced to put the knowledge they've acquired

from their courses and their books to practical use, on a variety of

modern and far-from-modern equipment.

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 & Biomolecular 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 alumni told him that it was a working trade show exhibit that was donated to the university afterward.

"What makes it unique are these distillation trays, so that you can actually see it working. Most distillation columns you can't do that with," 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."

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.

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?"

CELEBRATING 80 YEARS

LOOKING FORWARD

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.**

"I'm proud that during my tenure, the Cullen College of Engineering has been recognized as a Tier One Research University, undergraduate admission has more than doubled, and we have grown our tenured and tenure-tracked employees by more than 65 percent," he said. "However, I'm excited to take on the next challenges of my role, as we focus on increasing the quality of our research and the range of opportunities for our students, regardless of where they might be physically located."

Tedesco first joined UH in 2008, after successfully leading his Civil and Coastal Engineering Department at the University of Florida to a Top Ten national ranking. While other colleges tried to interview him for openings, it was the potential to build a program that would match the world class city it was in that attracted him to Houston.

"Houston is one of the best cities in the world, and part of that is having a flagship university that can supply the educated, high-quality graduates needed," he said. "Thanks to our location, our graduates have the potential to get a return on their time and financial investment immediately upon graduation, as long as we continue to provide them with the combination of educational bedrocks and practical information they'll need in the field."

The University of Houston was listed as the 7th best public university when it came to return on investment, 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-tracked 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 undergraduate, masters' and doctoral students need to be engaged in research to reach their full potential, which generates the best results from our professors as well."

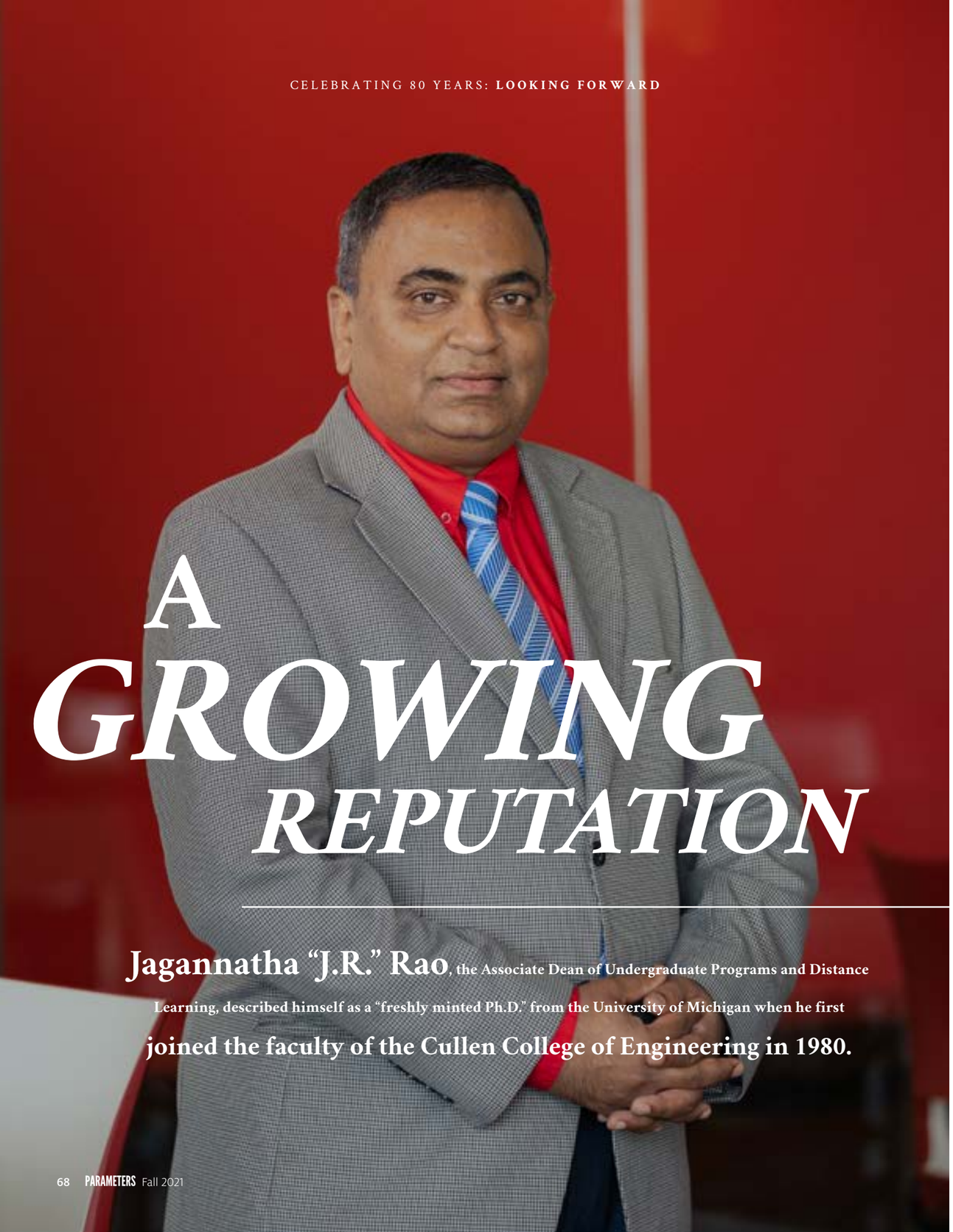
The Cullen College of Engineering enrolled more than 3,200 undergraduate students and 1,000 graduate students for the 2020-21 academic year. The numbers will only continue to grow thanks to co-enrollment initiatives with Houston Community College and Dalian Maritime University in China, in addition to 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 education given to the student. Undergrad enrollment was 1,374 in Fall 2008 – about a third of the current student body – but SAT standards have increased as well, and the Honors Engineering Program was established in 2010. For students 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 recruit 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."

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."



A GROWING REPUTATION

Jagannatha "J.R." Rao, the Associate Dean of Undergraduate Programs and Distance Learning, described himself as a "freshly minted Ph.D." from the University of Michigan when he first joined the faculty of the Cullen College of Engineering in 1980.

"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 12 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 alumni 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 - while they're a student, the internships and co-ops they can do in the summers are substantial."

Rao assumed his first leadership role about 11 years ago.

"Dr. Charles Dalton, who served in various roles including Associate Dean here and who was my fellow faculty member in Mechanical, retired," Rao said. "ME is unique as it is perhaps the only program, not only in engineering, but on the whole campus, that doesn't have any dedicated academic advisors - our faculty do all of the advising. We are very proud of that tradition. Dr. Dalton was a faculty advisor, and I took over from him. And then two years later, I became the Associate Chair, then three years later, Dean Tedesco appointed me the Director of Online Programs, and then you know, Director at Katy, and then last fall as Associate Dean."

Like several other administrators, Rao has been proud to see the College grow during his time in a leadership role. From 2014 to 2020, undergraduate enrollment in the Cullen College of Engineering doubled – just short of 3,200 students for Fall 2020.

"We have benefited from being a destination major," he said, noting that engineering enrollment has increased nationwide. "At any given time, there are about 100 students at 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 two 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 U of H.' I would put that near the top of my initiatives, to stay busy and active developing those agreements."

Shown above (top to bottom): *UH/HCC Engineering Academy at Katy (Katy, TX), UH/HCC Engineering Academy at Fraga Eastside (Houston, TX) and UH-DMU international Institute (Dalian, China).*

TRANSFORMING FROM THE INSIDE OUT

For **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**.

"I was very dedicated to supporting Dean Tedesco in increasing the number of female faculty and underrepresented faculty, and promoting female faculty toward higher ranks and retaining them," she said. "We can't have them leaving the college after making a big investment in them. I was very supportive of that initiative."

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.

"We have met or exceeded the national norms when it comes to female faculty, and many have been retained and promoted with the national accolades that they deserve," Rifai said. "We continue to try to expand and to support initiatives when it comes to the faculty. From the research standpoint, we were able to realize continued expansion year over year. The path had been started before I joined, with an emphasis on research and scholarship, to help faculty achieve their potential. In the last 10 years, we've been able to double research productivity by the college, and to expand the head count of those doing research."

When she joined the university in 1997 as an Assistant Professor of Civil and Environmental Engineering, Rifai said the student and faculty populations were substantially different. There were less women attending the Cullen College of Engineering, and "hardly any female faculty" that were on tenure-track.

"There was more emphasis on teaching than research, but there was quite a bit more interest in increasing research activity in the college even back then," she said. "The student body was much smaller then, a greater percentage of students were commuters, and the majority of our students had employment outside of the university, so they weren't always completely focused on their degrees."

As she has gotten deeper into her tenure as Associate Dean and built on the work of her predecessors, Rifai said she is always on the lookout for ways to strengthen the connection to industry and to expand the facilities available for professors and students.

"In addition to strengthening our ties to industry, some of the things we're proud of are bringing the Durga D. and Sushila Agrawal Engineering Research Building online, 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.

"A big emphasis has been supporting the population of Ph.D. graduates," she said. "We now graduate 80 to 100 Ph.D. candidates a year. We'd like to have a student success focused facility that has spaces for studying, collaboration and entrepreneurship. Then, you're closing the loop on all of the strategic planning initiatives. It makes interactions with industry more accessible to undergraduates, thanks to being vertically integrated, and not just for the Ph.D. students."

She added, "We've maintained a 10 percent 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 industrial support. That's helped make our journey so much easier and enjoyable. We look forward to the next strategic plan, which we're developing right now."

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 step.

"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 to on to pursue Ph.Ds."

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 those numbers already, but pointed to the an inhospitable environment for international visas the past four years and the pandemic as effecting 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.

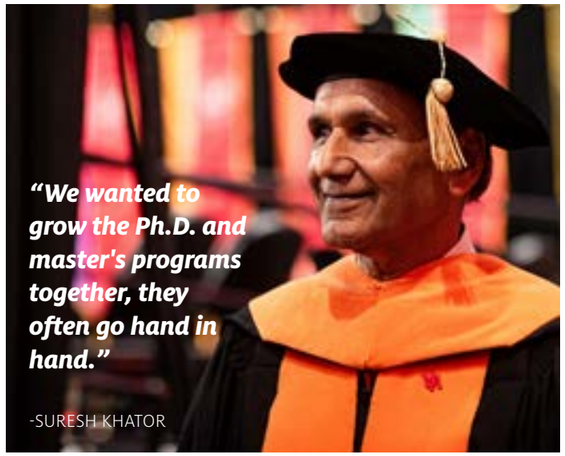
In his 13 years at the university, Khator noted that they've been able to establish three more doctoral programs – Biomedical Engineering, Petroleum Engineering and Geosensing Systems Engineering – and hope to establish another one soon.

"I've shepherded through the three doctoral programs, but I'm not the originator. It is the individual departments, but I've helped to chaperon 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."



DIVERSIFYING THE FIELD

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.

"It was an exciting time, a time of change in my career," he said. "I was moving to a new city, a whole new state, and transitioning from being a part of a chemical engineering department to being a part of the first-year engineering experience. That's really why I came to UH. I wanted to be able to impact students in the first year."

Henderson noted that this earlier 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."

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 underrepresented students," he said. "The experiences of Black males throughout lifespans is my research focus. I'm interested in how Black boys become interested in STEM or engineering. What happens to them when they go through a major? What are some of the factors that impact their persistence, their graduation rates, and then, in particular, what impacts their decisions to pursue and earn advanced degrees in engineering?"

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."

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."

PAUSING FOR REFLECTION

When **Fritz Claydon** was hired in August 1999 by Dean Raymond Flumerfelt to lead the Department of Electrical and Computer Engineering, he did not realize how **widespread his duties and initiatives at the Cullen College of Engineering would become over the next 22 years**.

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 scientific, engineering and technologically literate society. In addition, the Fellows will be better able to make policy recommendations to government agencies and political entities given their summer training on teaching science and their work in local school districts. Finally, the acquisition of cutting-edge knowledge in science and engineering holds the potential for these professionals to effectively communicate technical information to others, especially to the layperson."

For the past 16 years, the GRADE – Girls Reaching and Demonstrating Excellence – Camp has provided direct and formative exposure for high school students in science, math and engineering principles by providing week-long summer day camps that are designed to be interesting and fun. There have been about 1,100 participants since 2004. The program officially retired this year.

"Many of the students we serve in our summer programs represent the first generation of college-bound students for their families," he said. "They come from minority-serving schools where a large percentage of the student body participates in the Free or Reduced Meal Program. We wish to attract first generation, under-represented minority students and women to our programs. While students selected for our programs often have financial or other obstacles to pursuing science, technology, engineering and math (STEM) degrees in college, they are academically able. Our programs provide a college-based experience and access to successful peer mentors who come from similar backgrounds. This is often very important in leading these students to choose a college path and STEM careers."

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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HONORED WITH

2020-21
FACULTY AND STUDENT EXCELLENCE AWARDS

FROM THE UNIVERSITY OF HOUSTON
CULLEN COLLEGE OF ENGINEERING

BY STEPHEN GREENWELL

The Cullen College of Engineering at the University of Houston and **Joseph W. Tedesco**, Ph.D., P.E., the Elizabeth D. Rockwell Endowed Chair and Dean, are pleased to share the 2020-21 Faculty and Student Excellence Award winners. The initial announcement was made during the virtual Spring 2021 State of the College Address in May.

The W.T. Kittinger Teaching Excellence Award

is traditionally the highest teaching award given in the College. It recognizes 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
- **Holley 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
- **Sihong He**, teaching assistant, Mechanical Engineering

The Cullen College of Engineering Faculty Excellence Award

is the highest honor afforded to a member of the faculty for research. The award recognizes career excellence in research, teaching and service. **Peter Vekilov** of the William A. Brookshire Chemical and Biomolecular Engineering Department was this year's winner.

The Research Excellence Award

recognizes faculty for their outstanding research contributions. Typically, four college research awards are granted, two to non-tenured, junior faculty members, and two to senior faculty members for excellence in research.

This year's recipients are:
- **Cunjiang Yu**, senior faculty member, Mechanical Engineering
- **Sergey Shevkoplyas**, senior faculty member, Biomedical Engineering
- **Taewoo Lee**, junior faculty member, Industrial Engineering
- **Rodolfo Ostilla Monico**, junior faculty member, Mechanical Engineering

The Best Dissertation Awards

are given to doctoral students who developed the best dissertation and presentation that year.

This year's recipients are:
- **Aseem Chawla**, Chemical and Biomolecular Engineering
- **Musa Ozturk**, Biomedical Engineering

The Andrea Prosperetti Research Computing Faculty Award

recognizes tenured 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 Biomolecular Engineering.

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

This year's recipients are:
- **Kosar Mozaffari**, 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 tenured 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 tenure-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.

CULLEN COLLEGE ADDS 2 NEW NAE MEMBERS TO FACULTY RANKS

BY STEPHEN GREENWELL

Don Wilton

Donald R. Wilton, a professor emeritus of the Electrical and Computer Engineering Department at the University of Houston's Cullen College of Engineering, has added another impressive honor to his career of distinction with his election to the 2021 Class of the National Academy of Engineering.

Wilton joined the university's faculty in 1983, and served as a professor of electrical engineering for 29 years, retiring in 2012. Wilton earned his B.S., master's and doctorate degrees from the University of Illinois at Urbana-Champaign in 1964, 1966 and 1970.

Wilton's primary research interest is on the application of mathematical and numerical methods for solutions of antenna, guided wave and electromagnetic scattering problems. Regarded as one of the leading authorities in the field of computational electromagnetics, he is perhaps best known for establishing a framework for using computer modeling to study electromagnetic scattering by irregular surfaces, such as the curved wing of an airplane. A 1982 paper on the subject has been cited more than 3,700 times.

In 2014, Wilton was the recipient of the inaugural Harrington-Mittra Award in Computational Electromagnetics from the Institute of Electrical and Electronics Engineers Antennas and Propagation Society. The next year, he was selected as a Technical Field Award winner. He also received the IEEE Third Millennium Medal in 2000, and he is a Life Fellow of the organization, at times serving as an associate editor for their publications and a distinguished lecturer.

Wilton received the inaugural Computational Electronics Award from the Applied Computational Electromagnetics Society in 2013. In 2009, Wilton won a Cullen College Outstanding Teaching Award.

Election to the academy is one of the highest marks of distinction in the field. The total United States membership for the academy is 2,355, with another 298 international members. Wilton was elected "for contributions to computational electromagnetics of highly complex structures," according to the organization.

Hao Huang

An aviation industry veteran with more than 30 years of experience at General Electric and 80 patents to his name has joined the Cullen College of Engineering's Computer and Electrical Engineering Department as a Distinguished Adjunct Professor, to teach a new generation of students.

Hao Huang, Ph.D., started at the University of Houston in July 2021. He retired from the position of Technology Chief of G.E. Aviation – Electrical Power in 2020 after 33 years of serving in various aviation and land vehicle electrification industries. He was responsible for generating technical directions, innovation strategies and multi-generation product roadmaps, and contributing innovations and inventions of aircraft electrical power technologies.

"I had 80 U.S. patents and pending in electrification" he said. "In February of this year, I was elected as a member of the National Academy of Engineering (NAE) with citation 'for contributions to advances in electric machines and power electronics technologies for aerospace electrical systems.' Election to NAE membership is one of the highest professional honors given to an engineer."

In addition to NAE membership, Huang is a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) as of 2013, and a Fellow of the Society of Automotive and Aerospace Engineers (SAE) as of 2014. He was also the winner of 2019 IEEE Transportation Technologies Award.

After retirement, Huang thought about what he wanted to do next, and the field of education appealed to him.

"After my retirement from GE and the election to the NAE, I thought a lot about what I should do for society in the rest of my retirement life," he said. "Helping engineering education was the idea that jumped to the top of my list. When I was in industry, particularly at GE Aviation and Smiths Aerospace, I saw the great needs to fill some gaps to accelerate young and just-graduated engineers from universities to perform their jobs, to accelerate their industrial learning, and to grow their capabilities to serve companies. I realize that if I am helping with teaching as well as research in one or two universities, I may be able to help »

the universities and industries to effectively narrow these gaps due to my experience, knowledge and vision in field."


HAO HUANG

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 NAE, IEEE and SAE.

"He has been a member of the NAE for years, and he also came from the aerospace industry, although he came in at much younger age. He understood my desire and was very supportive, and he introduced me to the department chair Professor **Badri Roysam**," Huang said. "I then had an opportunity to meet 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 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. "Utilization of 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 mega 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 NAE "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) (250kW) with regenerative and sensorless commutation capabilities for Aerospace.

• The world's first aerospace 1 MW dual spool electrical power extraction (250kW 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 subsystems for next generation narrow body aircraft funded by the FAA.

• The aerospace industry'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 propeller.

• The world's most advanced electrical power integrated systems center (EPISCenter) 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."

BY STEPHEN GREENWELL

A well-rounded career with achievements in industry and academia resulted in distinction for University of Houston professor **Kaushik "Raja" Rajashekara**, as the Institute of Electrical and Electronics Engineers awarded him the 2021 IEEE Medal for Environmental and Safety Technologies.

Sponsored by Toyota, the award is for outstanding accomplishments in the application of technologies that improve the environment and/or public safety. Rajashekara, a Distinguished Professor in the Electrical and Computer Engineering Department, was chosen at the November meeting of the IEEE Board of Directors. Criteria for the award includes public benefits of the contributor; degree in improvement in important performance metrics; innovative design, development, or application engineering; favorable influence on the contribution on technical professions; and quality of nomination.

Rajashekara was notified last fall that he won the award.

"I felt very happy that I was selected for this award," he said. "This is an important award for me because I worked for more than 30 years on contributions to Transportation Electrification to increase the energy efficiency and improve the environment."

Rajashekara was the subject of a July 2017 profile published on the Cullen College of Engineering's website, and he also contributed a memoir article, "Learning Never Stops," for the 2016 September/October edition of the IEEE Industry Applications Magazine. In both, he detailed his educational and life journey.

"I grew up in a small village in India, studying under kerosene lamps and binding notebooks from spare pages," he wrote in the memoir piece. "I never imagined that one day I would work for prestigious corporations and be mentored by inspiring engineers and leaders. After completing my undergraduate degree in 1974, I would have worked at any engineering company, but I ended up at Cutler-Hammer and then Debikay Electronics, entering the field of power electronics. I worked on thyristor drives for paper and rolling mills and learned that a solid foundation in the basic elements of engineering is requisite for real world practical systems."

Rajashekara joined the UH faculty in September 2016, after holding a similar position at the University of Texas at Dallas since August 2012. Before that, he worked as a chief technologist, chief scientist and senior project engineer for some of the world's biggest companies –Rolls-Royce, Delphi, and General Motors – for more than 25 years. He was part of the team that developed General Motors' EV1, the first mass produced electric car from a major automaker.

"I always knew I wanted to get back to academia," he said. "Before joining the industry, I was a faculty member for seven years at the Indian Institute of Science in Bangalore. When I was in industry, I continued to teach and worked on research projects with several universities in the U.S. and U.K."

In the 2017 article, Rajashekara identified his focus as the future. It shows in his current research, which contains overlapping and multi-discipline areas, and the tantalizing idea of flying cars.

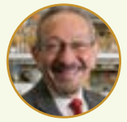
"We continue to focus on the area of electric vehicles, with a particular emphasis on electric vehicle charging, and in the Aerospace area my interest is on electric/hybrid vertical take-off and landing vehicles and flying cars," he said. "Our team at UH is also working on Subsea Electric power systems to reduce pollution from the extraction of oil and gas in subsea. Another area of our focus is grid integration of energy storage systems and renewable energy sources."

AL-UBAIDI, ARDEBILI

HONORED BY

FACULTY
EXCELLENCE AWARDS

A pair of Cullen College of Engineering professors were honored in the University of Houston's 2021 Faculty Excellence Awards.



Muayyad Al-Ubaidi, a professor of Biomedical Engineering, was one of three faculty members chosen for the Moores Professorship. The five-year, renewable professorship is awarded to faculty in recognition of outstanding teaching, research and service. Last year, Stuart Long of the Electrical and Computer Engineering Department earned the distinction. The award comes with an annual stipend of $10,000 for five years.

Haleh Ardebili, Bill D. Cook Professor of Mechanical Engineering, was also one of three professors recognized with the Undergraduate Research Mentor Award. The award recognizes the mentorship efforts of UH faculty at all stages of their careers, in addition to making a significant impact in their field by supporting and mentoring undergraduate students in research and scholarship endeavors. Professors must demonstrate at least five years of involvement to receive the award.

The Faculty Excellence Awards are administered by the University of Houston's Office of the Provost. The Teaching Excellence Awards Committee – composed of faculty, students and alumni – reviewed the nominations and made recommendations to Provost Paula Myrick Short, the Senior Vice Chancellor for Academic Affairs.

BY STEPHEN GREENWELL

A professor at the University of Houston's Cullen 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.

Jerrod A. Henderson, the director of the Program for Mastery in Engineering Studies (PROMES) and an Assistant Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, earned the Black Engineer of the Year (BEYA) Educational Leadership – College-Level Promotion of Education Award. He was nominated for the honor by **Michael P. Harold**, the chairman of the department at the time.

Henderson was notified of the honor in early December.

"My immediate reaction was an overwhelming sense of joy, appreciation and gratitude," he said. "It's nice to be recognized for simply doing what you love doing – teaching, mentoring, and providing leadership, academic and engagement opportunities for students. This recognition is full circle for me. My first time attending a BEYA conference was as a sixth grade student in the 'MENTOR Program,' founded by Mr. Nathaniel Vause in Kinston, North Carolina, now here I am earning a BEYA award."

According to correspondence from the magazine's editor, "Dr. Henderson's achievements in STEM stood out among the hundreds of nominations that were evaluated by the BEYA Selection Panel."

Henderson attributed his success to support he has received from the administration at UH and fellow professors.

"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. Roshawnda Anderson**, **Monique Jones**, **Rachell Underwood**, **Dr. Hanadi Rifai**, and **Dr. Michael Harold** 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 2019, and earned the CIEE [Council on International Educational Exchange] grant to take 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 400 to 600 scholars in the next year, 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."

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 420,000 members. I am highly 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 Subraminam (UCSD), Paolo Bonato (MIT/Harvard), Colin Brenan (1CellBio Inc.) and with the participation of 27 exceptional plenary speakers," 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 us to build a platform that strengthens our collective capability to exchange ideas as well as share, access and manage data, models and latest reports regarding COVID-19 research. I am confident that it will also accelerate the rapid scientific innovation and reproducible research needed to find solutions in the global battle to contain the COVID-19 pandemic."

Akay identified three more topics that would warrant a public Grand Challenge Forum in the coming years.

"I will continue working with my colleagues to organize and lead three additional paradigm-shifting public Grand Challenges Forums on (1) Data Science and Engineering in Healthcare, (2) Technologies for Mental Health Initiatives, and (3) Healthcare Innovations and Entrepreneurship in 2021, with the participations of global scholars, leaders from the healthcare industry, research institutions and Academia," he said.

Akay joined the faculty at the University of Houston in 2010, as the founding chairman of the Biomedical Engineering Department and as the John S. Dunn Endowed Professor. He previously served as a professor and interim chairman of the Harrington Department of Bioengineering at Arizona State. He is a native of Turkey, earning his B.S. and M.S. in Electrical Engineering from Bogaziçi University in Istanbul in 1981 and 1984, respectively. He received his doctorate in Biomedical Engineering from Rutgers University in 1990.

As part of his agenda as IEEE EMBS president, Akay also said that he would push for greater diversity in the field.

"We acknowledge women play a large part in our scientific success and look forward to helping them obtain the rightful recognition and opportunities they deserve," he said.

"It is imperative for our society to promote female healthcare researchers, physicians and industry professionals. I pledge to continue to promote female scientists and engineers by encouraging active involvement in our conferences, publications, technical committees, and membership activities. I will continue working with my colleagues toward maintaining the highest quality of innovations that will propel our society to greater heights."

Akay is looking forward to the challenges he will tackle during his presidency of the society.

"I am confident that during my tenure, our society will play a role in advancing engineering innovations into healthcare," he said. "Our society will continue to make meaningful differences in the lives of others and impact the careers of our students and members. Ultimately, we will increase public awareness of the role of biomedical engineers and healthcare innovations in our global community. I have the energy, vision, and network to achieve these goals."

BY STEPHEN GREENWELL

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

Thomas T.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.

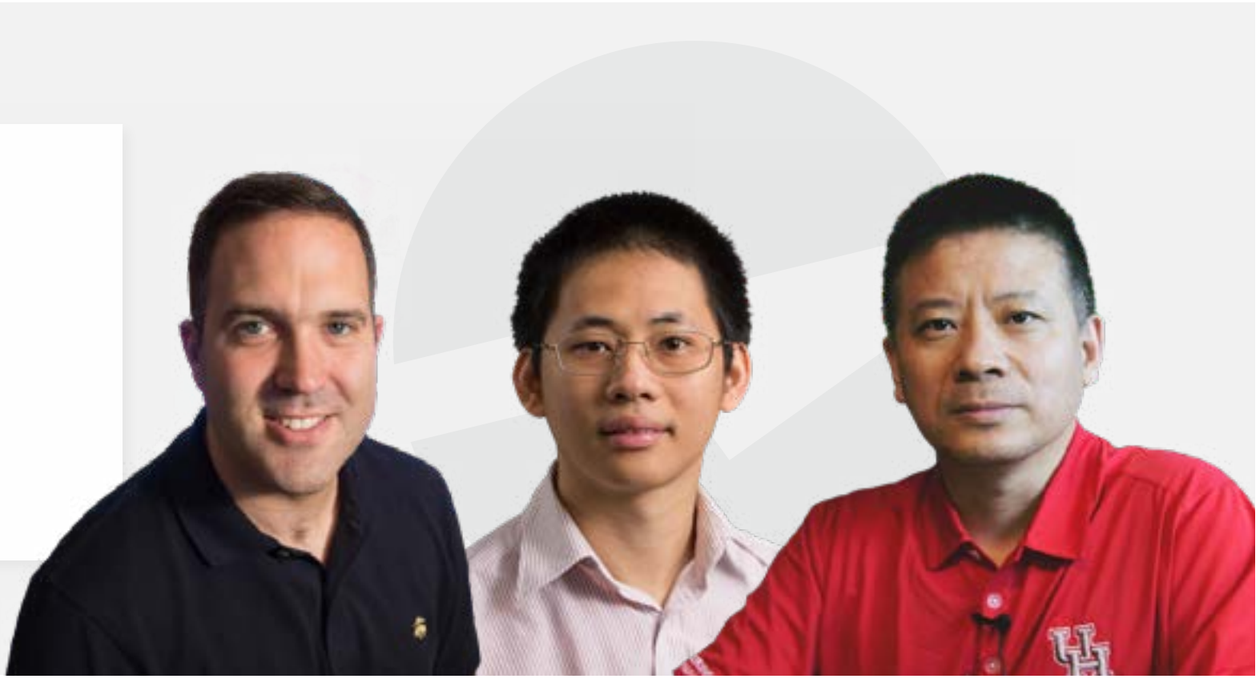
"The Unified Theory of Concrete Structures (2010, John Wiley) proposed by Professor Hsu introduced the fundamental nonlinear relationship of constructional materials and has been implemented into existing finite element simulation software," the statement reads. "Based on high-performance computing, the proposed theory can be applied to conduct design and analysis of various infrastructure systems, including buildings, highways, bridges, marine platforms and containments in nuclear power plants. The fundamental theory of shear and torsion performance of reinforced concrete structures is comprehensively 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 THSRL [Thomas 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 **Roberto Ballarini**, as well as others. I have worked at University of Houston for 41 years and have many fond memories of cooperating with colleagues 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 in civil engineering in that country. Hsu also established collaborations between researchers in the United States, Taiwan and Italy on a long-term seismic engineering project.

THREE UH ENGINEERS NAMED TO NATIONAL ACADEMY OF INVENTORS



BY SARA TUBBS

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. Dukler Endowed Chair, William A. Brookshire Department of Chemical and Biomolecular Engineering; and **Gangbing Song,** Moores Professor of Mechanical 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 for academic affairs and provost at UH. "I congratulate 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 development 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 Elnashai,** 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 617 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."

Following a nomination for NAI Senior Member, individuals undergo a rigorous selection process by the NAI Advisory Committee, which is composed of elected NAI members and other professionals considered pioneers in their respective field. Senior Members are elected biannually, and nominations are accepted on a rolling basis.

Faculty Accolades

Wei-Chuan Shih — *Promoted to SPIE Fellow*

Wei-Chuan Shih, a professor of Electrical and Computer Engineering, was promoted to a Fellow by SPIE for his contributions in novel imaging methods, spectroscopic techniques and plasmonic nanostructures with various applications in chemical and biosensing. Founded in 1955, SPIE is the largest international professional society for optics and photonics and a leader in the fields of optics and photonics when it comes to conferences and education programs. Shih currently serves as an associate editor for SPIE's *Journal of Nanophotonics* and as a member of several conference program committees. He has frequently given presentations at SPIE conferences since he was a doctoral student at MIT.

Yasemin Akay — *Elevated to IEEE Senior Member*

Yasemin M. Akay, an instructional associate professor in the Biomedical Engineering Department, was notified by the Institute of Electrical and Electronics Engineers that she was promoted to Senior Member status in December 2020. Akay has been an active member of the organization for more than three decades. Akay gives keynote lectures for several conferences, and she was the first female keynote speaker in CISP BMEI at the 2019 Conference in Beijing, China. She also serves as an associate editor for one of the flagship journals of the IEEE, as well as an associate editor for the IEEE Conference on Neural Engineering 2021. She noted that those positions, as well as the regular conferences, allow her to network with her fellow researchers and to stay current with developments in various fields.

Jeffrey Rimer — *Picked as Associate Editor for ACS' Crystal Growth & Design*

Cullen College of Engineering professor **Jeffrey Rimer** was selected as the newest Associate Editor for *Crystal Growth & Design,* a monthly peer-reviewed journal published by the American Chemical Society. Rimer, the Abraham E. Dukler Professor of the William A. Brookshire Department of Chemical and Biomolecular Engineering, has been a contributor and member of ACS since 1997, when he was an undergraduate student. He provided the organization an interview in March about his goals for the position and his interest in the field. *Crystal Growth & Design* is one of the most prestigious journals in the field, with nearly 31,000 citations in 2019.

Yashashree Kulkarni — *Appointed as Diversity Advocate*

Yashashree Kulkarni, Bill D. Cook Professor of Mechanical Engineering, was appointed to the journal *Applied Mechanics Reviews* editorial board as a Diversity Advocate for a two-year term. According to the publication, Diversity Advocates are "individuals with a demonstrated commitment to the applied mechanics discipline and technical community, as well as the mission of ASME to promote engineering science to the benefit of humankind." Responsibilities include advocating for diverse representation and diverse voices in all matters pertaining to the journal's function and editorial board constitution.

Roberto Ballarini — *Honored with ASCE Distinguished Member Status*

Roberto Ballarini, Thomas and Laura Hsu Professor and Department Chairman of Civil and Environmental Engineering, was elected as a Distinguished Member of the American Society of Civil Engineers (ASCE). Distinguished Membership is the highest honor the organization can bestow, with one class of recipients formally inducted annually. According to ASCE, "A Distinguished Member is a person who has attained eminence in some branch of engineering or in the arts and sciences related thereto, including the fields of engineering education and construction." Since 1853, only about 700 people have been elected to this elite membership grade.

Jacinta Conrad — *Named Fellow of the Society of Rheology*

Jacinta Conrad, Ph.D., Frank M. Tiller Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering, was elected a Fellow of the Society of Rheology. The Society of Rheology is composed of physicists, chemists, biologists, engineers and mathematicians interested in advancing and applying rheology, which is defined as the science of deformation and flow of matter. To qualify for Fellow status, members must be in good standing for at least eight years and be selected by a five-member committee. The number of Fellows is capped at 5 percent of the society's membership. »

Cullen College of Engineering welcomes 12 new hires

BY STEPHEN GREENWELL


JERROD HENDERSON


GÜL ZERZE


BEHROOZ FERDOWSI


PIETRO MILILLO


MIM RAHIMI


MAHDI SAFA


DEEPA RAMACHANDRAN


NATHANIAL WIGGINS


TIAN "TIM" CHEN


DANIEL FLORYAN


BO ZHAO


ZEINAB ZARGAR

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 Princeton University. Her research primarily covers the fundamental understanding of molecules of life via molecular simulation methods and theory. She will join the Cullen College in January 2022.

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 Mililllo, assistant professor. Mililllo worked as a scientist and postdoctoral fellow for the NASA Jet Propulsion Laboratory in Pasadena, California, before being hired by UH. His thesis was on the synergistic use of synthetic aperture radar (SAR) constellations for studying natural and anthropogenic phenomena.

Mim Rahimi, assistant professor. Rahimi was a postdoctoral associate in the Department of Chemical Engineering at MIT from 2018 to 2021. He completed his doctorate at Penn State in 2017. In his lab, electrochemical processes are developed to help industries become more energy-efficient and to capture CO_2 from either point sources or air.

Mahdi Safa, senior lecturer. Safa served as an assistant professor of Construction Management at Sam Houston State for the past three years. He also taught at Lamar University for three years. Safa began working as a lecturer at the UH at Katy instructional site during the summer.

Electrical and Computer Engineering:

Deepa Ramachandran, senior lecturer. Ramachandran served as a freelance teaching consultant for the Wennovation Hub, a tech incubator and non-profit that provides consultant services for businesses wanting to do work in Africa, for the past three years. She was also a lecturer at Rice University from 2015 to 2018. She began working as a lecturer for the Cullen College at UH at Katy during July of this year.

Industrial Engineering:

Nathanial Wiggins, senior lecturer. Wiggins has been a distinguished professor of Engineering and Mathematics at San Jacinto College for 12 years. He began at UH at Katy as a lecturer in August.

Mechanical Engineering:

Tian "Tim" Chen, assistant professor. Since 2019, Chen has been a postdoctoral scientist at the EPFL's Flexible Structures Laboratory & Geometric Computing Laboratory in Switzerland. He received his doctorate in Mechanical Engineering from ETH Zurich in Switzerland.

Petroleum Engineering:

Daniel Floryan, assistant professor. Floryan was a postdoctoral research associate in the Complex Flows and Fluids Research Group at the University of Wisconsin-Madison. He earned his doctorate from Princeton in 2019. He is slated to join the College in October.

Bo Zhao, assistant professor. Since February 2017, he has worked as a postdoctoral research associate at Stanford University, after earning his doctorate from Georgia Tech in 2016. The Zhao Group is engaged in theoretical and experimental understanding of photonic transport processes for thermal management, energy conversion and information processing.

Zeinab Zargar, lecturer. Zargar has worked as a research assistant in Petroleum Engineering at the Cullen College of Engineering since 2018. She earned her doctorate in Petroleum Engineering from the University of Calgary in Alberta, Canada in 2017.

Renita Horton
Recognized with Ralph E. Powe Junior Faculty Enhancement Award

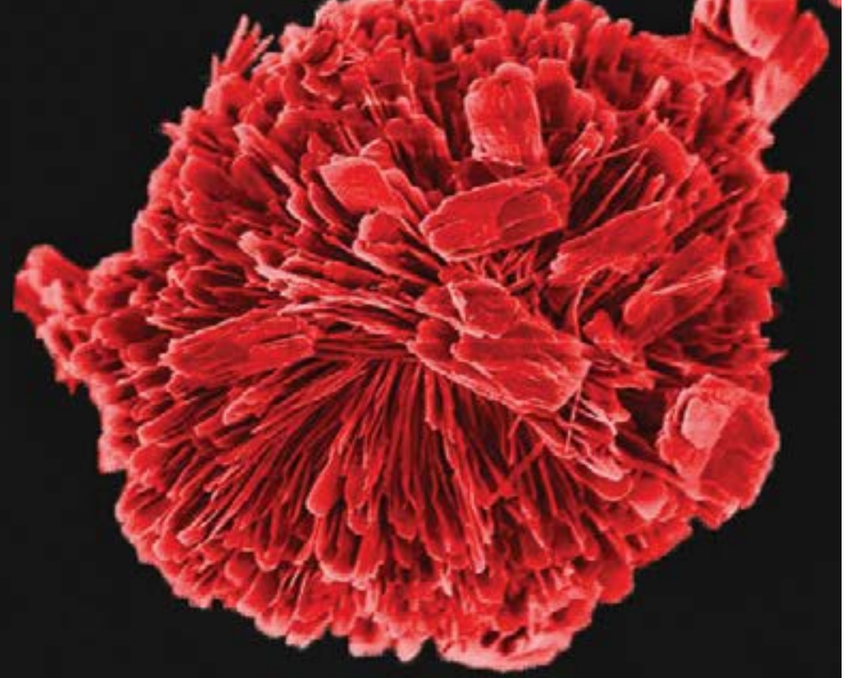
Renita Horton, an assistant professor in the Biomedical Engineering Department of the Cullen College of Engineering, was selected as one of the 35 2021-22 recipients of the Ralph E. Powe Junior Faculty Enhancement Award from the Oak Ridge Associated Universities consortium. Named in honor of Powe, who served as the ORAU councilor from Mississippi State University and was elected chair of ORAU's Council of Sponsoring Institutions, the competitive research award provides seed money for junior faculty members that often result in additional funding from other sources.

Anil Bhowmick
Presented with Innovation Award from Polymer Processing Society

Anil Bhowmick, Ph.D., a Research Professor in the William A. Brookshire Department of Chemical and Biomolecular Engineering at the Cullen College of Engineering, was the recipient of the 2021 James L. White Innovation Award from the Polymer Processing Society. The award is given yearly by the society, and honors outstanding researchers or inventors from academia and industry, either as individuals or as a group, in the area of polymer processing and related fields. The award is for an innovative development in the field of polymer processing technologies with recent commercial impact. It aims to recognize originality, innovation and creativity among researchers or inventors in the science and technology of processing polymers and polymeric products.

Stanko R. Brankovic
Named Fellow of Electrochemical Society

Stanko R. Brankovic, Ph.D., a professor in the Electrical and Computer Engineering and Chemical and Biomolecular Engineering departments of the University of Houston's Cullen College of Engineering, was selected as a Fellow of the Class of 2021 for the Electrochemical Society (ECS). The Fellow level of membership for the ECS was established in 1989, for advanced individual technological contributions in the field of electrochemical and solid state science and technology; and active membership and involvement in the affairs of the society. Those selected must receive at least three nominations from members of the ECS.



Chakrabarti

earns **Artistic Honor** *for* **Crystal Art**

BY STEPHEN GREENWELL

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 Chemical and Biochemical Engineering Department, was honored for her submission, "Colour 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 that I color my 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 from," 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 work on understanding the fundamentals of crystallization. Crystallization 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."

UH INFORMS

Earns Summa Cum Laude *Distinction*

BY STEPHEN GREENWELL

The University of Houston's student chapter of the Institute for Operations Research and the Management Sciences (INFORMS) was awarded summa cum laude distinction for 2020, one of only five chapters internationally to earn it.

INFORMS is an international society for practitioners in the fields of operations research, management science and analytics. INFORMS promotes greater public awareness, interest and understanding about the benefits of these fields, and provides a variety of programs and services that support lifelong learning and networking. This includes publishing 16 peer-reviewed journals, hosting numerous conferences and meetings, providing continuing education courses and professional certification, and administering dozens of special-interest communities that help professionals network and collaborate with colleagues from around the world. President **Zahed Shahmoradi** and Secretary **Poria Dorali** praised the work of their members and coordination with the faculty as reasons why their work was recognized.

"Our chapter has won other awards in the past but it was the first time from the day of its establishment to win an award in the level of summa cum laude," Shahmoradi said. "This makes the award very special and makes the next teams believe that they can always be among top student chapters. We are all very thankful that our efforts and dedications have paid off and that our performance and achievement can lead to more recognitions in future. I believe winning more of such awards will earn our department more international renown and further boosts the chance of industrial engineering and operations research to be chosen as majors of study."

UH INFORMS MEMBERS [LEFT TO RIGHT] MARYAM TORABBEIGI, PORIA DORALI, ZAHED SHAHMORADI, BILAL MAJEED AND SABA EBRAHIMI.

Dorali added, "As an organization we recognize that we may not be the biggest, but we always strive to prioritize our members in order to facilitate a community environment for learning and growth. We took some risks with expanding our efforts in the previous year and we are humble and thankful to be recognized for what we were able to accomplish. This is definitely not the end but the beginning of continuing our success as an organization."

> *"This is definitely not the end, but the beginning, of continuing our success as an organization."*
>
> - PORIA DORALI

The group has about 100 members at UH. Other officers include Treasurer **Bilal Majeed**, Vice President **Saira Alam**, Webmaster **Saba Ebrahimi** and Activity Coordinator **Maryam Torabbeigi**.

Shahmoradi said that the pandemic has unfortunately limited their ability to offer similar opportunities. However, the group is networking with other chapters across the country to determine what programs they can offer later this year.

"Our number one focus as an organization is to prioritize our members to maximize the benefits they have being part of our community," Shahmoradi said. "While the pandemic has been especially difficult on our organization, as a lot of our members are international students, we are greatly looking forward to meeting in person soon and to continue to build on the community we have. There are a number of initiatives we are considering in the future. We feel that it's important for our community to have a balanced approach – to give back to the community that gives to them – and as such volunteer opportunities around Houston is at the top of our list. We are currently examining working with other INFORMs student chapters around the country to utilize the virtual phenomenon we're in as networking opportunities which otherwise would be unlikely. Finally, as we are annual attendees of the INFORMS conference, we will continue to foster an environment for academics and researchers to collaborate and to learn with one another through workshops, virtual coffee hours, and hopefully even some in-person events in the future."

For the 2020 award, the UH student chapter was recognized for a variety of events they held or supported:

• Vallourec Field Visit and Internship Day (March 2019): Vallourec is a manufacturing company which specializes in hot rolled seamless steel tubes. The one-day plant tour was a networking opportunity for students, and two of them arranged future visits as part of their class project. The next day, the group was excited to hear that recruiters from Vallourec interviewed some of our students who had visited the plant, and two of them were offered internship positions.

• Student Leadership Conference (April 2019): Four of their officers attended the Student Leadership Conference held in Baltimore. This was a unique opportunity to learn from the experiences of the other student chapters, in order to set a formidable foundation to grow the INFORMS UH chapter.

• 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 Corning Incorporated. 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 where more than 200 high school students could learn more about future opportunities past high school. A joint officer team composed of members from IISE and INFORMS went to Ronald Reagan high school and taught students about the nature of IE, including a special emphasis on operations research and provided them with information and prizes for attending their information booth. Students were introduced to what the IE degree had to offer and the many different ways operations research can be applied in industry and everyday life.

• INFORMS Game Night (December 2019): As a celebration of finishing the semester and exams, the chapter organized a game night and dinner party in the university's game room. The attendees played bowling, billiards, table tennis and board games.

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

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 did not feel alone. I was not alone."

That speech started a whirlwind of activity on Combs' part, starting with a first place finish as a high schooler 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) STEM 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 Jarie and his family, which is understandable – Combs is one of 10 siblings, the oldest of Caleb, Alanna, Laila, Cameron, Sara, Joshua, Micah, Jessica and Julia.

A generous scholarship offer and UH's standing as a Tier One research facility 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. **Jakoah Brgoch** gave me my first undergraduate research opportunity while **Holley Love** and **Farah Hammami** have been my favorite mechanical engineering professors because of their passion for helping students succeed in difficult classes. **Jerrod Henderson** and **Eduardo Cerna** have given me opportunities to tutor, advise 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 and 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 bus. That was the first time I had the chance to publicly present my STEM experiences. It was also the moment I realized how satisfying it is to inspire others."

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

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

BY STEVEN GREENWELL

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 devices. A few years ago, I experienced a health scare while in Taipei. 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 diagnoses. 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 master's 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 engineering applied to medicine 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 solution to a problem. **Dr. Nuri Ince** gave me the chance to work on his research project, learning new ways to use today's technology to solve complex problems in medicine."

ChBE Student Earns

ACS

Development Award

BY STEPHEN GREENWELL

> *"I am always seeking growth and self-improvement opportunities, and my drive and curiosity have also played a big role."*
>
> - ROSA MIRALDINA FUTY

Learn more about the American Chemical Society and their awardees at:

www.acs.org

Her work as an undergraduate computational researcher, as well as a strong support system inside and outside of the University of Houston system, allowed then senior **Rosa Miraldina Futy** to excel in her studies, which includes being selected for an American Chemical Society Bridge Career & Professional Development Award.

The award is open to undergraduate students interested in the Chemical Sciences and that are from groups traditionally underrepresented in the field. As part of winning the award, Futy also gave a poster presentation during the ACS Spring 2021 meeting in April on CH4 activation on promoted PGM catalysts.

Futy, a Chemical Engineering major with minors in Chemistry and Energy & Sustainability, was notified of her selection for the award by email.

"When I received the email, I felt very excited," she said. "Becoming an undergraduate computational researcher sparked my curiosity about the different facets of Chemical Sciences 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] Debtanu Maiti 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 National Society of Black Engineers, and professional development and career fair committee advisor for the UH Society of Women Engineers. She has also completed an internship at Praxair Inc. and a chemical engineering R&D co-op at Albemarle.

"I attribute all of the accomplishments and opportunities I have had to God and to the strong support system I have," she said. "My faith gives me a sense of purpose and direction, and the positive influence from my father, Henrique Futy, and mother, Filomena Lulu, has helped me believe in myself and become more determined. Additionally, my peers, professors, and mentors have added so much value to me and helped me become a more well-rounded individual. I am always seeking growth and self-improvement opportunities, and my drive and curiosity have also played a big role."

Futy said she was already interested in finding out the inner mechanics of nature, which made Chemical Engineering a natural fit for her.

"Growing up as an inquisitive kid, I have always been passionate about nature and technology, and trying to understand why and how things work," she said. "Chemical Engineering was among the few majors that I found to allow me to merge both science – physics, chemistry and biology – with technology and engineering. Additionally, the critical thinking and problem-solving focus of the chemical engineering curriculum also led me to pursue this major. As a results-oriented individual, I have always wanted to take on roles that would allow me to cause change and make an impact. Chemical Engineering gave me the sense that I can make a difference, and that I can improve lives!"

Futy graduated in May 2021, at which time she had a job opportunity lined up with Micron Technology, an international producer of computer memory and data storage with more than $20 billion in annual revenue.

"I am excited about what's coming next," she said. "I also plan to pursue a master's degree in the future. Moreover, giving back is one thing that I am passionate about, so I plan to find opportunities to continually give back to my alma mater and the student organizations I am involved with."

ME Student Earns Provost's

Undergraduate Research Scholarship

BY STEPHEN GREENWELL

When **Pemu Utienyin** examines the world she inhabits every day, the University of Houston junior says that she can't just ignore the ways in which she could help.

"As I walk, I see things, changes that need to be made," she said. "Changes that I want to make. To do that, I have to keep looking forward to achieving my goals. A good friend of mine always says, 'Don't worry, just get it!' I live by that mentality. Believing in myself and trying my best to get what I want."

It is that mindset and hard work that has led her to being chosen for the Provost's Undergraduate Research Scholarship (PURS) program. Recipients receive a $1,000 scholarship to conduct a one-semester research project with a faculty member. Pemu is majoring in Mechanical Engineering and minoring in Mathematics and Business Administration.

"I am working with **Dr. Stacey Louie,** and our research is primarily focused on investigating the binding affinity between Natural Organic Matter and pollutants of different forms," she said.

As with most aspects of life now, Pemu was notified of the scholarship by email.

"I remember doing schoolwork with friends and I just casually checked my email," she said. "I was so excited because I know the program is very competitive and was more than honored to be a recipient for the scholarship."

The scholarship isn't the first time that Pemu's hard work and skill have been recognized, though. She completed an internship for CHEVRON in the summer of 2019, and this fall, she started experimenting with soil pollutants for ECOLAB research at UH.

Since August 2019, she has also worked as an assistant academic facilitator, mentoring and tutoring students on campus. In the coming year, she will start an internship with Celanese and a co-op with Clayco Inc., multi-billion-dollar companies in the chemical and construction fields.

In addition to her classroom pursuits, Pemu is involved in several student organizations. She is the International Students' Committee Chairwoman and the Academic Excellence Chairwoman for the National Society of Black Engineers. In the past, she has also served as the Community Relations Chairwoman for the Society of Women Engineers.

Pemu noted that support from friends and family members has spurred her toward her goals.

"Throughout my career, I have had so many people inspire me in different ways, that it would be a lie to say that I have achieved all that I have on my own," she said. "My parents have been a major influence in my educational career. My dad, Jude Pemu, is also an engineer and was an inspiration for me to get into the field. Ensuring I get a good education is one of the many things he's done for me. Another person who has supported me is my aunt, Winifred Owumi. Coming into college, regardless of her busy schedule as an urologist, she never fails to follow through with my progress and is always ready to advise me when needed."

She initially chose the University of Houston because of the diversity that the campus offered.

"I wanted to go somewhere I could not only learn and get a degree, but also learn from different people and cultures," she said. "Our differences make life more beautiful and that was the one thing that drew me to Houston, and eventually UH."

Pemu expects to graduate with a B.S. in Mechanical Engineering in December 2022, although she currently plans to explore other fields in graduate school.

"I hope to get a graduate degree in civil engineering, as this is something I am very passionate about," she said. "Currently, I'm a business administration minor and I will be working towards an MBA in the near future as well."

Undergraduate Named

2021 Goldwater Scholar

BY STEPHEN GREENWELL

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.

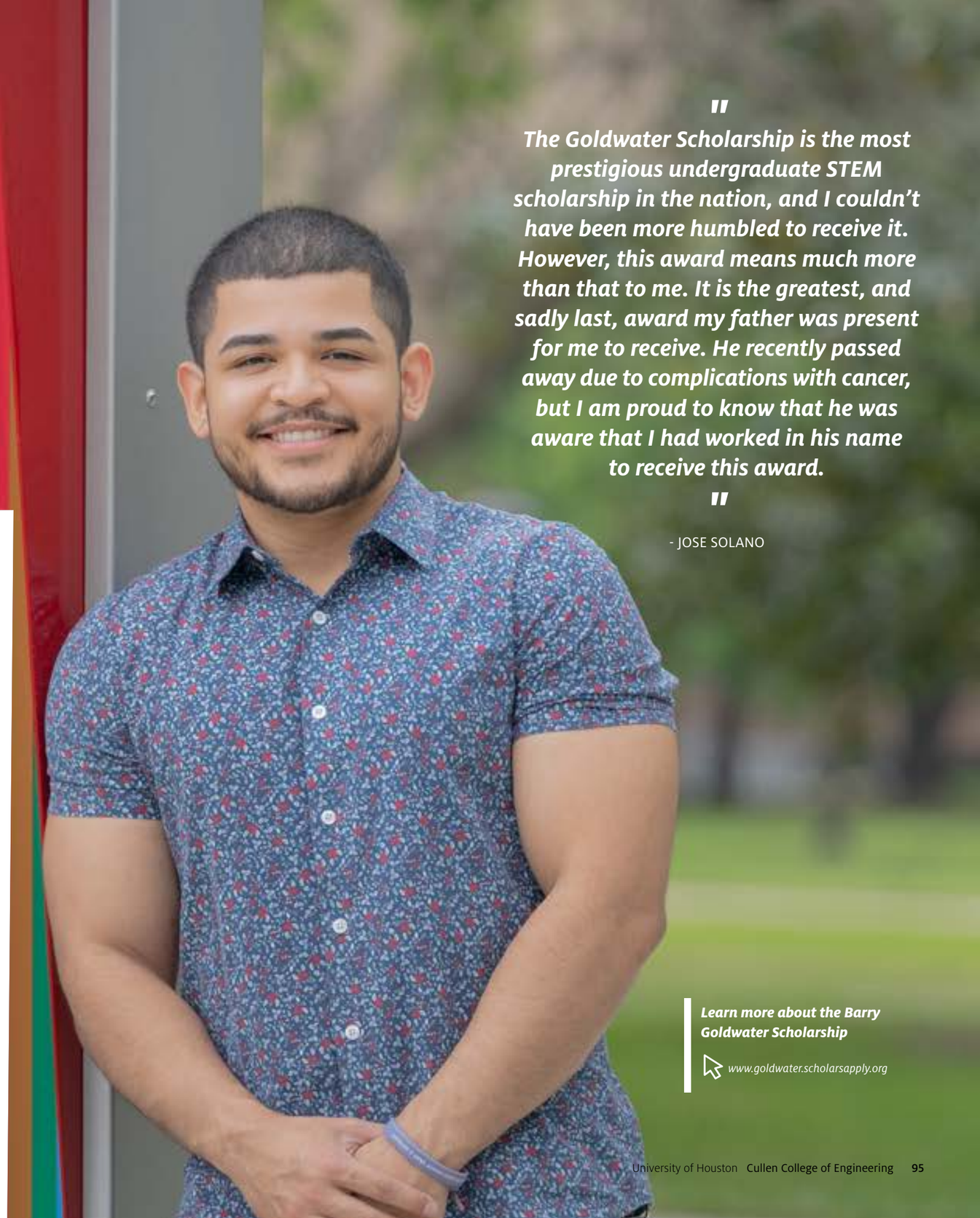
"Without each of them I definitely wouldn't be the academic I am today," he said. "Coming into college, I had a lot on my plate, and I believe that the wrong influences would've instead pushed me to ignore my responsibilities. Dr. J and Dr. B taught me how to deal with these responsibilities through 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 Ballarini**. My experiences with them range from working in Dr. Yu's lab, to a simple one-time discussion about engineering literature with Dr. Ballarini. 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."



> ***"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. 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."***
>
> - JOSE SOLANO

Learn more about the Barry Goldwater Scholarship

www.goldwater.scholarsapply.org

ENGINEERING THE FINAL FOUR

BY STEPHEN GREENWELL

> *"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 1 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.

"I always had an insatiable curiosity about electronics and gadgets," 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 »

CALEB BROODO BALANCES HIS LOVE OF BASKETBALL AND ENGINEERING

his office hours, and just talking with him. He really helped me when it came to those sorts of things. I had doubts about whether or not I could do basketball and electrical engineering. And he said, 'You know what, Caleb? It's been done before.' He pointed me to Kurt Ederhoff, a student he taught in the 90s that played basketball for UH, who then went on to earn his Ph.D. in Electrical Engineering and P.E."

Ironically, another professor that Broodo said has had a positive influence on him was the one that gave him a failing grade the first time he took Circuit Analysis I – **Leonard P. Trombetta**, Ph.D., the Associate Department Chair. However, Broodo said that thanks to Trombetta, he knew he needed to adjust his approach from high school as he transitioned into college.

"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 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.

"The project manager who was supervising me told me that he had kids in his junior year," Broodo said. "And I was like, 'This guy graduated with a degree in electrical engineering, while raising children.' What I'm doing is really hard. But, you know, it can't possibly be as hard as that."

Broodo stays organized with a physical calendar on his desk, and by writing everything down. He admits with a laugh that if he had been this organized in high school, he would have had a 4.0 GPA.

"I stay incredibly organized, and I cannot procrastinate," he said. "Not because I don't want to procrastinate, just because I can't afford to, with homework, lab work, I have to get on it immediately. I have a calendar with all of my exams and assignment 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 had this semester – **Gulin Aksu**, 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.

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 chirp 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 me 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."

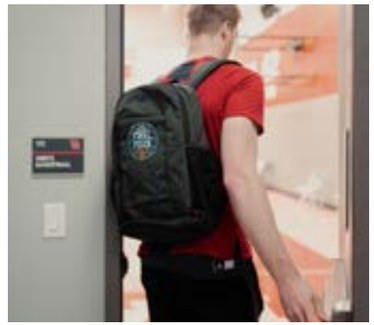
Broodo added, "I hadn't realized until November of last year that he was going through all of these things related to his health while I was doing research with him. Despite dealing with that, he still found a way for me to come over his house, and to give lectures to me. That's the highest level of 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 Kouri 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 continue mentoring me after Dr. Kouri's passing. I'm very much looking forward to the work he and I will be doing together."

"I can't emphasize enough how much of an impact Dr. Kouri made on my life, and how he essentially motivated me to pursue science at the highest level," Broodo said. "That's a feeling I hope I can cultivate in someone, not even necessarily about science, but to give them a sense of passion of their choosing."

As of now, Broodo is interested in research opportunities and possibly teaching, after he



earns his advanced degrees.

"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 proposition 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 genius, took that a step forward by introducing general relativity, which incorporates the idea of the spacetime geometry. The more I learn about general relativity, such as how it demonstrates that gravity is illusionary, the more I get foaming at the mouth. Due to modern technology, 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 unbounded. The human brain is pretty amazing."

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

With another laugh, Broodo apologized for the "massive information dump."

"It's pretty obvious how much I enjoy talking about physics, isn't it?" he said.

FROM IRAN TO KANSAS TO TEXAS,

ZEINALI CONTINUES TO LEARN

BY STEPHEN GREENWELL

"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."

- LIEILA ZEINALI

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 Lorestan. For this purpose, he was using statistics – and later, I found out, geometry and trigonometry and algebra – for measurement purposes. The process was intriguing to me, and naturally, I developed a deep interest in all things mathematics, 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.

"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 was my husband, and the community of people around me, are all in the oil business, which further grew my interest in the profession."

After entering the program in the Fall of 2012, Zeinali said she immediately immersed herself in the study of fluid mechanics, reservoir rocks, 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 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. Among the valuable courses in Petroleum Engineering, I would like to single out the Capstone Project we designed hydraulic fracture optimization for a Kinder Morgen CO_2 segment. That was my first experience working in a multidisciplinary team in the industry."

LEILA ZEINALI IN THE LAB

Beyond the educational experience though, Zeinali highlighted the networking opportunities that UH's location provided her with, both in terms of professional organizations and industry. She recently placed first in the UH Society of Petroleum Engineers Master's student paper contest.

"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. 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.

"The UH Career Fair has given me three opportunities to experience the industry as a summer intern," she said. "In 2015, 2016 and 2019, I worked for GE Oil & Gas, and Baker Hughes. Working with a team taught me how to approach and troubleshoot problems and resolve the issues in a step-by-step fashion. It was an essential, valuable experience about how to work within a group of various disciplines and rely on them as a resource. Eventually, what gave me the most satisfaction was that I could use some of the learning from UH courses directly to a day-to-day industry problem."

Zeinali earned her bachelor's degree in December 2016, but decided to continue her education. She cited professors like **Dr. Michael T. Myers**, **Dr. Christine Ehlig-Economides**, **Dr. John Lee**, and **Dr. Ramanan Krishnamoorti** as positive influences on her learning environment. She received her master's degree in Spring 2021. While completing her graduate course work, she overlapped at UH with her son, Mohammad Mahdi Ghoraishy, a Computer Science student.

"My experience as an intern, my engagement in various professional societies, and interactions with professionals from the oil industry encouraged me to expand my technical depth," she said about her decision to pursue an advanced degree. "I also loved the thriving university environment, which gave me the energy and excitement to pursue my curiosity to learn. Among my options, UH was the most promising place to continue."

THE CREATIVITY BEHIND CHEMISTRY

BY NICOLE JOHNSON, PHOTOGRAPHY BY BEN CORDA

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.

JACKLYN N. HALL CONDUCTING RESEARCH IN THE LAB

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." »

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 (CH_4) to alcohols such as methanol (CH_3OH) 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 (CO_2) 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.

CELEBRATING 80 YEARS

FOREVER COG

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.

DIANA & ANDRES

MARROQUIN

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 »

A PHOTO FROM DIANA AND ANDRES' WEDDING RECEPTION

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 gas 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 faking 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.”

ANDRES PROPOSING TO DIANA AT THE UNIVERSITY OF HOUSTON'S BLAFFER ART MUSEUM

MACKRENA & MICHAEL RAMOS

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. »

MACKRENA AND MICHAEL RAMOS AT MOODY TOWERS IN 1996.

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.

"In 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 Mai's, Taquiria La Jaliscience, 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 honing 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 and 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 credit card balances he had "earned" in college, he bought a ring for Mackrena and proposed in November 2001. The couple married a year later.

"It was very important to us to get settled into our careers and accomplish our goals," Mackrena said. "It did take us a bit, but it all worked out, and we'll celebrate our 20 year anniversary in 2022!"

THE RAMOS FAMILY SPENDS SOME TIME REMINISCING AND LOOKING AROUND CAMPUS

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.

"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.

"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 1985."

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!"

CELEBRATING 80 YEARS

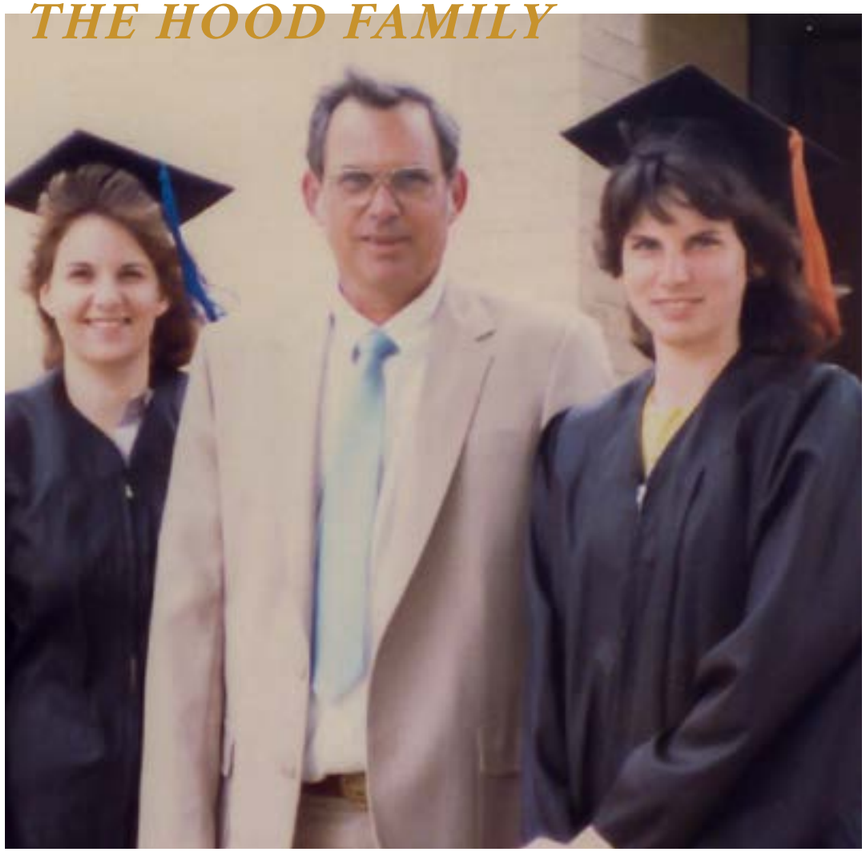
A FAMILY TRADITION

Cougar pride is something any alum knows all too well, but for some, it has become a family tradition.

Past graduates are now the proud parents and family members of a new generation of Cougar Engineers.

We caught up with some of our multi-generational Cougars, and asked them to reflect on their time and describe what it means to be alumni of the Cullen College.

THE HOOD FAMILY



LAURA HOOD (RIGHT) AT HER COLLEGE GRADUATION, PICTURED WITH HER FATHER, BEN HOOD (MIDDLE), AND SISTER, LESLIE (LEFT)

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 he thought it was important for me to see what engineers do before starting college. I had been to the office with him before, but this 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 U of H 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 on 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 communications class as an undergrad so I was ready for the change."

LESLIE AND LAURA HOOD

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 Accounting 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, »

LAURA, HER SISTER LESLIE, AND HER TWO SONS, SEAN BENJAMIN LOVSTUEN AND KYLE ALTON LOVSTUEN

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 servers 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."

ALL IN THE FAMILY

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.

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!"

UH Grad Walheim Continues to ***Plot Course for the Stars***

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 where he was a project manager and then commander 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 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."

REX WALHEIM

"I had a little wrist 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 screamin'."

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 preface 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 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 Axiom.

"At Axiom 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 Axiom, 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."

UH Alum Helping with ***Vaccine Labeling Project***

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 she had in mind when she 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 the vaccine when it was finished. According to information provided by Weiler, the labeler can handle speeds of more than 600 vials per minute.

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 in the 2017 NASA Swarmathon, and Weiler also uses small, nimble teams for each project.

"We only have about 65 people in the company and the way we compete with much larger firms is by offering more customization," she said. "We do have a few base models but almost all of our work requires us to add on some custom features. I program the software changes needed for a new machine, whether that's specific beacon behavior, new fault codes, or additional sensors and drives that the customer requested."

Dodge is one member of a small team of about 10 working on the labels for the vaccine. Dodge said this allows the team to remain nimble, and to provide a combination of speed and precision that is vital for vaccine and other medical labeling.

"It's satisfying to be able to build something, and to watch a machine I programmed label something at incredible speeds," she said. "It's satisfying to be able to contribute in a very tangible way. Mislabeled vials can have huge repercussions. Some machines can be used for a dozen different products, and a bad label can result in a patient getting the wrong drug, so how well I do my job matters and I take pride in that."

Adat ***Building on Skills from UH Education***

BY STEPHEN GREENWELL

Building on the skills he first learned while pursuing a master's degree in Industrial Engineering at the University of Houston's Cullen College of Engineering, **Arun Adat** is now in his second decade of a successful career at »

the Hewlett Packard Enterprise, a Fortune 500 company.

While at UH, Adat completed his master's degree while studying with **Dr. Ali K. Kamrani**. His thesis topic was "A Simulation-Based Methodology to Measure and Analyze the Required Inventory due to Product Proliferation," and he co-authored three papers. Adat now serves as a Supply Chain Leader for HPE.

"Over the past decade, I have held multiple roles in HPE's Global Operations Organization, spanning Procurement, Product Engineering, New Product Introductions and Supply Chain Strategy," he said. "In my current role at HPE, I serve as the Supply Chain Leader for HPE's IT transformation program aimed at streamlining, simplifying and standardizing critical business processes."

Adat also gives back to the university, participating in the Industrial Advisory Board for Industrial Engineering.

"I was nominated by [Department Chairman] **Dr. Gino Lim** to join the board," Adat said. "The board offers industry perspectives on current courses and feedback on student's capstone projects. The board also assists with recruitment activities for graduate and undergraduate students."

Lim brought up Adat's energy and advocacy for the Industrial Engineering Department when he was a student as reasons why he would be an effective board member.

"Mr. Adat has been a strong advocate for the IE department since he was student here at UH," Lim said. "He is energetic and forward thinking, and cares so much about the success of the department and UH. When I was looking for a new generation of IAB board member candidates, it did not take much time for me to invite him to join the distinguished group of leaders in the Houston community."

Adat pointed at UH's programs and a scholarship offer as primary reasons why he attended the university.

"Manufacturing and Operations have always been my passion," he said. "I was attracted to the UH program because of the strong faculty and course work in manufacturing and operations research. I was also fortunate to get a full scholarship from the university to pursue my master's and thesis. I graduated in 2005, and the UH program has provided me the foundation to be a confident operations professional."

JAVIER LOPEZ JR.

ME, Space Architecture Graduate ***Lopez*** *making his* ***Interstellar Mark***

BY STEPHEN GREENWELL

For University of Houston graduate and native Houstonian **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 traveling 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, a first-generation Mexican American graduate, has done his best to make that dream a reality, with hard work in high school – researching what degrees astronauts had and what majors were hired by NASA – followed by two years at Lone Star Community College, before transferring to UH.

"I ended up deciding to pursue a degree in Mechanical Engineering," he said. "Since then, I'm proud to say that I have graduated as a Mechanical Engineer and Space Architect from UH. The same passion that started in me as a little kid continued to grow and push me through my academic career, and now it's time to use what I learned and do big things. I'm still extremely fascinated by space exploration, learning more about where we came from, and finding out what other type of life exists in this universe. The dream of becoming astronaut still exists and I'm hoping that one day I can leave my footprints on the surface of the Moon."

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 very talented 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 **Olga Bannova**, as well as professors **Larry Bell**, **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 and 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 SHPE'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 your dream company or position. You know exactly what you are capable of and what you would be bringing to the table to your professional endeavors. Continue to work hard and push yourself until you're where you want to be."

UH alum Hazlett hired as ***Concordia University professor***

BY STEPHEN GREENWELL

Being from Canada, Professor **Melanie Hazlett** honestly hadn't heard much of the University of Houston before she began searching for graduate school opportunities. However, it was her mentor Professor William Epling that led her to Texas.

Hazlett completed her Bachelor of Applied Science in Honours Chemical Engineering at the University of Waterloo in June 2012. She received her Doctor of Philosophy in Chemical Engineering from the University of Houston's Cullen College of Engineering in December 2016.

"UH has a very strong reaction engineering and catalysis research foundation, through the great work of several professors in the department," she said. "So, it was a perfect place for me to go to pursue my research interests. Looking back, I see my Ph.D. as a time of not only academic successes but great personal growth."

In addition to Epling, Hazlett identified four other professors at UH that helped her greatly during her studies, including **Professors Lars Grabow**, **Jacinta Conrad, Pradeep Sharma** and **Fritz Claydon**.

Hazlett was hired as an Assistant Professor and started at Concordia University in Montreal in August 2020, and currently has her own lab with two doctoral students. She is always looking for new recruits – and they don't need to know how to speak French. For future Ph.D. graduates, she urged them to be patient during the hiring process, especially for jobs in academia.

Alum Santos Promoted to ***Distinguished Service Professor*** *at Binghamton*

BY STEPHEN GREENWELL

An alumnus of the University of Houston's Cullen College of Engineering was promoted to the position of Distinguished Service Professor of Systems Science and Industrial Engineering, building on the teaching experience he first acquired through the connections he made as a graduate student at UH.

Binghamton announced the promotion on April 13 for professor **Daryl Santos**, Ph.D. According to the press release, promotion to distinguished professor is the highest faculty rank that SUNY awards, and it is reserved for those who have achieved national or international prominence and an exemplary reputation within their discipline.

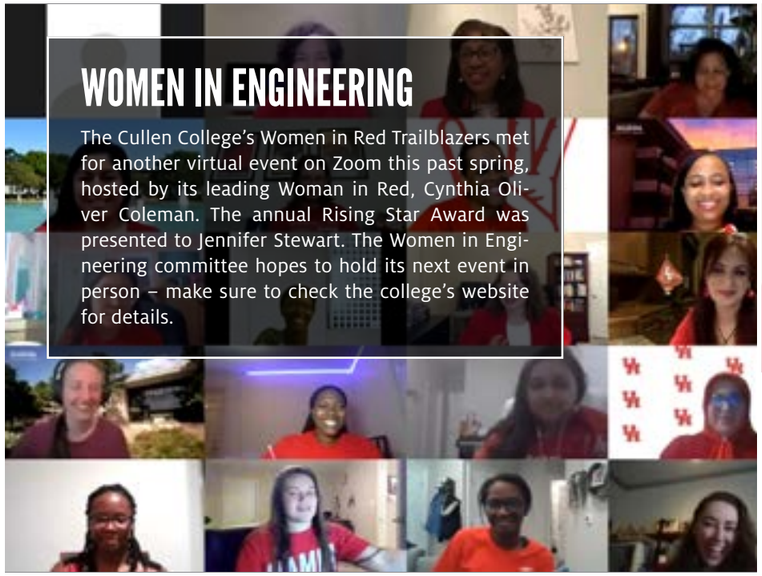
Santos serves as Binghamton's Vice Provost for Diversity and Inclusiveness. Santos also earned the Chancellor's Award for Excellence in Teaching in 2005, and the Chancellor's Award for Excellence in Scholarship and Creative Activities in 2011.

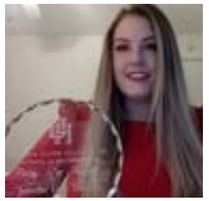
After earning his B.S. from Cornell University, Santos started at UH in 1987, pursuing his master's in Industrial Engineering. He earned this degree in 1990, and continued at UH through 1993, earning his doctorate in Industrial Engineering as well.

His time at UH is when Santos said that he learned how to conduct and publish research. It also allowed him to cut his teeth in teaching, as serving as an instructor for INDE 1331, a first year computer programming course for engineering students.

WOMEN IN ENGINEERING

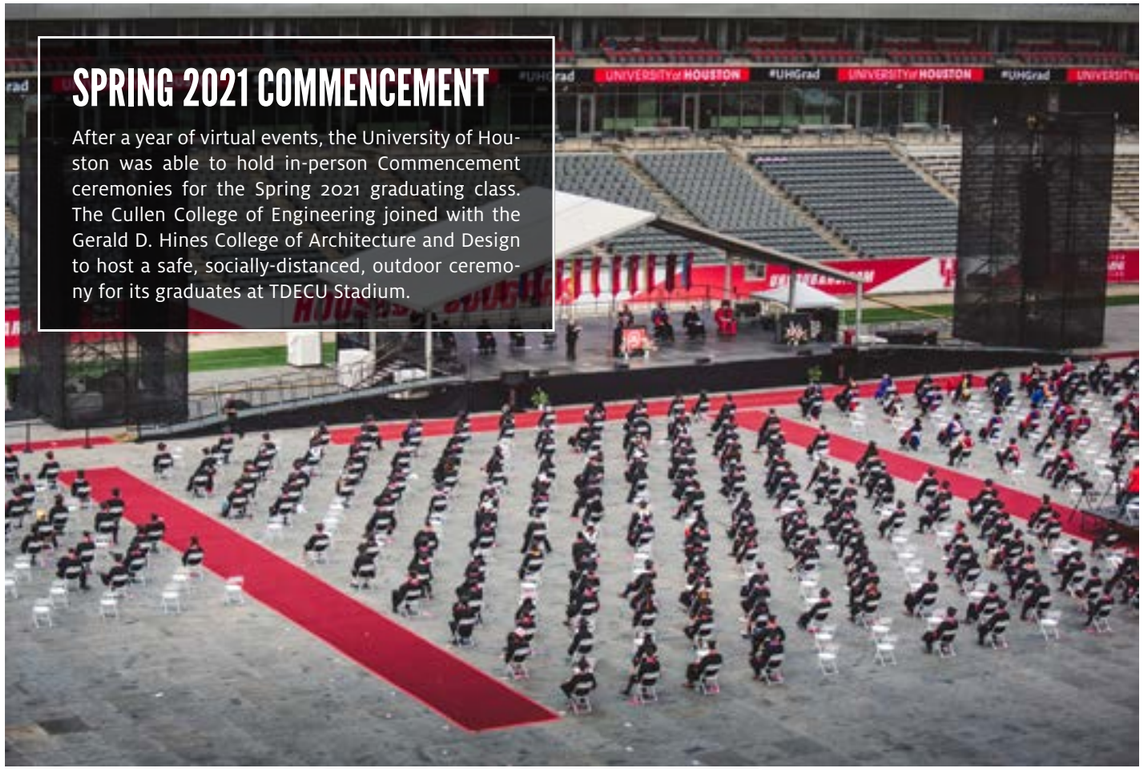
The Cullen College's Women in Red Trailblazers met for another virtual event on Zoom this past spring, hosted by its leading Woman in Red, Cynthia Oliver Coleman. The annual Rising Star Award was presented to Jennifer Stewart. The Women in Engineering committee hopes to hold its next event in person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





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.



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

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

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View more photos online at

www.flickr.com/photos/cullencollege/albums

ENGINES OF OUR INGENUITY

NO. 3255: ENGINEERING CAMPUSES AND REAL-WORLD TECHNOLOGICAL CHANGE

BY JOHN H. LIENHARD

THE ENGINES OF OUR INGENUITY IS BROUGHT TO YOU BY THE FRIENDS OF HOUSTON PUBLIC MEDIA

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.

LIENHARD VISITS MIT'S THERMAL ENGINEERING LABORATORY IN 1953, AND IS INTRIGUED BY A THEN-ALREADY-OUTDATED, SINGLE-STAGE, STEAM TURBINE. PHOTO BY P. P. ROY CHAUDHURY.

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, 2000): Chapter 1, Mirrored by Our Machines.

For a history of the steam engine, see J. H. Lienhard, "How Invention Begins: Echoes of Old Voices in the Rise of New Machines." (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 V, 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.

THE Y-BUILDING WHICH HOUSED ENGINEERING LABORATORIES AT THE UNIVERSITY OF HOUSTON THROUGH MUCH OF ITS HISTORY. Y-BUILDING PHOTO BY JOHN H. LIENHARD.

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