UNIVERSITY of HOUSTON | ENGINEERING

PARAMETERS

Cullen College of Engineering Magazine • Fall 2019

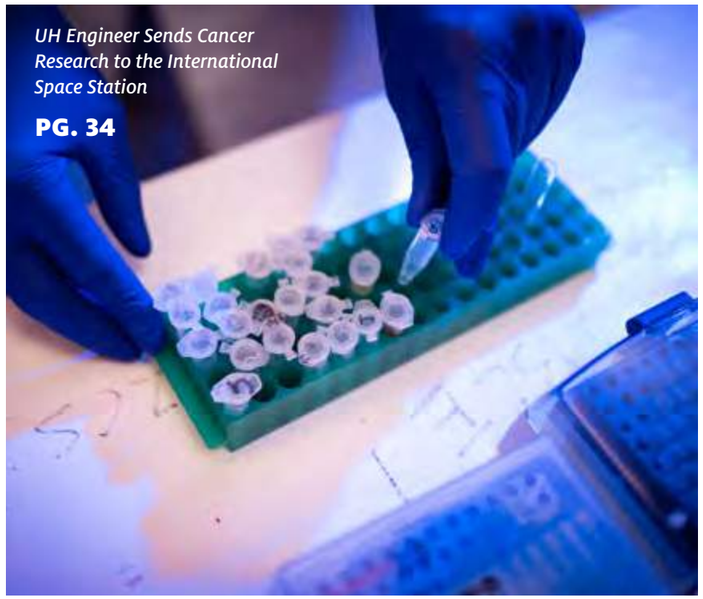
A NEW ERA

OF ENGINEERING EXCELLENCE

University of Houston at Katy Opens Its Doors to the Public

Fostering New Generations of Innovation & Entrepreneurship


14 NATIONAL ACADEMY OF ENGINEERING MEMBERS
ENGINEERING EXCELLENCE
Since 1941
UNIVERSITY of HOUSTON | ENGINEERING



IN EVERY ISSUE

Cullen College of Engineering

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Joseph W. Tedesco

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Hanadi Rifai

Associate Dean for Graduate Programs & Computing Facilities
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PARAMETERS
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UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

DEAN'S LETTER

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

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

UH Engineering has entered a new era of engineering excellence.

However, our college is not one to settle, and there is still much work to be done. How can we keep growing? How can we keep making the greatest impact possible on Houston and the world beyond?

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

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

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

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

Warm regards,

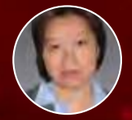
Joseph W. Tedesco, Ph.D., P.E.
Elizabeth D. Rockwell Dean and Professor

THE DISTINGUISHED

ROCKWELL

LECTURE SERIES


KATIA BERTOLDI


LAI-YUNG RUBY LEUNG, NAE


GILDA BARABINO, NAE


JAMES SKINNER


ORLIN VELEV


YI CUI


DONALD GOLDFARB

For the most up-to-date information on lecture times and locations, visit **egr.uh.edu/our-college/rockwell-lecture**

SEPTEMBER 12, 2019

KATIA BERTOLDI

William and Ami Kuan Danoff Professor of applied mechanics, John A. Paulson School of Engineering and Applied Sciences, Harvard University

Kirigami-Inspired Metamaterials — from Morphable Structures to Soft Robots

SEPTEMBER 13, 2019

LAI-YUNG RUBY LEUNG, NAE

Battelle Fellow, Atmospheric Sciences and Global Change Division, Pacific Northwest National Laboratory

Global Warming and Extreme Events

OCTOBER 11, 2019

GILDA BARABINO, NAE

Dean, Grove School of Engineering and Daniel and Frances Berg Professor, The City College of New York

Cell Biomechanics: Unlocking Determinants of Human Health and Disease

NOVEMBER 8, 2019

JAMES SKINNER

Crown Family Professor of molecular engineering, Director of the Water Research Initiative and Deputy Director for Faculty Affairs, the University of Chicago

Anomalies in Ambient and Supercooled Water: Is There a Second Critical Point Lurking Nearby?

JANUARY 24, 2020

ORLIN VELEV

S. Frank and Doris Culberson Distinguished Professor, Department of Chemical and Biomolecular Engineering, North Carolina State University

Liquid Nanofabrication of Functional Multiphasic Soft Matter by Capillary Binding and Interfacial Templating

FEBRUARY 21, 2020

YI CUI

Professor of materials science and engineering, professor of photon science, senior fellow at the Precourt Institute for Energy and professor, by courtesy, of chemistry, Stanford University

Nanomaterials Design for Energy and Environment

MARCH 27, 2020

DONALD GOLDFARB

Alexander and Hermine Avanessians Professor of industrial and operations research, Columbia University

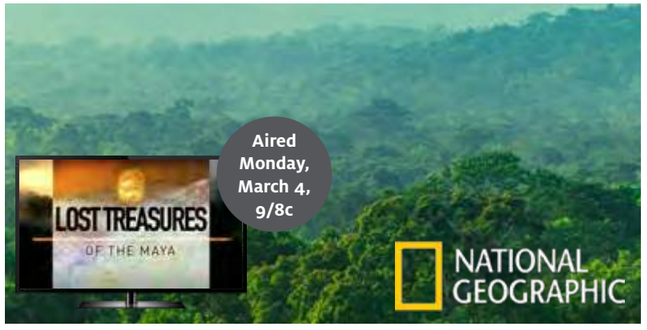
The Alternating Direction Method of Multipliers: Recent Advances and Applications

IN THE MEDIA SPOTLIGHT

npr

NPR's special video series "Future You, With Elise Hu" recently spotlighted **Jose Luis Contreras-Vidal**, Cullen Distinguished Professor of electrical and computer engineering, and his team's work on brain-controlled, robotic exoskeletons.

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



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

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

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

innovationmap

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

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

Breaking **BARRIERS**

Houston Public Media

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

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

UH ENGINEERING **BY THE NUMBERS**

BEST GRAD SCHOOLS U.S.News & WORLD REPORT ENGINEERING

#69
BEST ENGINEERING SCHOOL IN THE NATION

#14 Best Petroleum Engineering Program
#36 Best Chemical Engineering Program
#48 Best Industrial Engineering Program
#65 Best Environmental Engineering Program
#72 Best Electrical Engineering Program
#72 Best Civil Engineering Program
#77 Best Mechanical Engineering Program
#82 Best Materials Engineering Program
#80 Best Biomedical Engineering Program

996
graduate students

\+ **2,869**
undergraduate students

3,865
total students

1355
average SAT score of entering freshmen

139
TOTAL FACULTY

17
NSF CAREER AWARDS

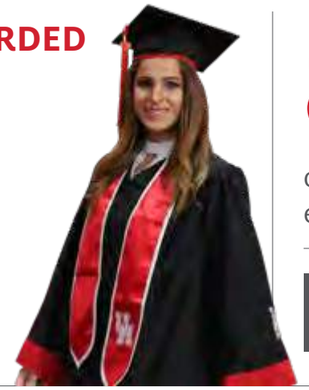
$30M+
annual research expenditures

14
National Academy of Engineering Members

1) Dan Luss; 2) Jerome Schultz; 3) James M. Symons; 4) Benton F. Baugh; 5) Charles D. Cutler; 6) John H. Lienhard; 7) Christine A. Ehlig-Economides; 8) Kaspar Willam; 9) Jamal J. Azar; 10) S.M. Farouq Ali; 11) Andrea Prosperetti; 12) Kaushik Rajashekara; 13) Ganesh Thakur; 14) Birol Dindoruk

DEGREES AWARDED IN 2018

688 B.S.
350 M.S.
84 Ph.D.
=
1,122 TOTAL



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

$99,230
average annual salary for engineers in Houston, Texas
(Source: U.S. Bureau of Labor Statistics, May 2018)

2019 AVERAGE ANNUAL SALARIES IN ENGINEERING

Median entry-level salary[1] | Mean annual salary[2] | Top 10%[3]

Aerospace
$66,892 | $117,100 | $164,210

Biomedical
$60,582 | $95,090 | $144,350

Chemical & Biomolecular
$65,469 | $114,470 | $169,770

Civil
$55,603 | $93,720 | $142,560

Computer
$70,470 | $117,840 | $172,630

Electrical
$64,489 | $101,600 | $153,240

Environmental
$55,288 | $92,640 | $137,090

Industrial/Manufacturing
$59,203 | $91,630 | $132,340

Materials
$65,027 | $96,930 | $148,110

Mechanical
$61,158 | $92,800 | $136,550

Petroleum
$86,524 | $156,370 | $250,000*

Subsea
$99,340 | $106,347 | $300,000*

81,410 jobs
in engineering and architecture in the Houston metro area in 2018
(Source: U.S. Bureau of Labor Statistics, May 2018)

[1] Figures from payscale.com, June 2019
[2, 3] Figures from National Occupational Employment and Wage Estimates, U.S. Department of Labor, 2018
* Figures from National Occupational Employment and Wage Estimates, U.S. Department of Labor, 2017

LEADING THE NATION IN INCLUSIVE EXCELLENCE

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

BY RASHDA KHAN

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

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

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

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

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

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

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

As of fall 2018, around 25 percent of the Cullen College's undergraduates are women; 23 percent of enrolled undergraduates identify as Hispanic; and 4 percent as black.

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

> "We have a well-established tradition of encouraging diversity and inclusion at the college and our goal is to keep building our successes."
>
> - DEAN JOSEPH W. TEDESCO

Women's share of degrees has only increased slightly at the bachelor's and master's level over the past two decades – 18 to 21 percent, and 18 to 25 percent, respectively, from 1997 to 2016. Although the number of women who received engineering doctoral degrees in 2016 is small (2,400), it represents a larger share: increasing from 12 percent to 24 percent from 1997 to 2016.

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

Located in the nation's fourth-largest city and one of the most ethnically and culturally diverse regions in the country, UH is a federally designated Hispanic- and Asian-American-serving institution with an enrollment of more than 46,000 students.

Omron Lab Helps UH Engineering Students Get

REAL-WORLD TECHNOLOGY EXPERIENCE

BY RASHDA KHAN

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

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

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

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

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

Having a dedicated state-of-the-art laboratory space makes a huge difference to the students, said **Len Trombetta,** associate department chair for ECE.

Dean Joseph Tedesco; Robb Black, president and CEO of Omron Automation Americas; and Badri Roysam

"If you walk into a laboratory, and there's equipment there for you and resources available to you, you're going to do a better job than if you have to fight for a bench or scrounge for equipment," he said. "It means a lot for the students to be able to come in and have a place they call their own, where they can work on their projects and have all the equipment and resources they need."

Senior design projects are one of the last major hurdles engineering undergraduates tackle before graduation. "They'll be taking other courses as well at the same time, but prospective employers will expect them to speak intelligently about what they worked on for their design project so the experience they gain at this stage is very important," Trombetta said. "This [lab] makes our graduates very marketable because these are skills companies want. We're grateful to Omron for making this possible."

Building the future in a changing world

Black, who earned a bachelor's degree in electrical engineering from Marquette University about 32 years ago, remarked that capstone projects have changed quite a bit.

"When I graduated in electrical engineering, you ... built a power supply [for your senior design project] or you built a power supply. Those were a lot of the choices back then," he said, after visiting with the students about their projects. "It's amazing how far the students have come in the past decade or so."

He was impressed and encouraged to see the variety of projects marrying together many different technologies and robotic functions and, he added, that's exactly what is needed for the dynamic marketplace.

"Manufacturing today is a different animal than when I graduated ... it was looked upon as this dark business of getting your hands dirty, working on a factory floor, there wasn't a lot of excitement," Black shared with the students. "Today you have robotics, artificial intelligence, big data ... things that are changing manufacturing faster than ever before. So the opportunities you have as graduate engineers is outstanding."

A game-changing gift

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

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

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

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

Black offered some parting advice to the Cullen College students:

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

Omron Automation is an industrial automation partner that creates, sells and services fully integrated automation solutions. The companies Omron works with include those in the automotive, food and beverage, infrastructure, semi-conductor and digital sectors among others. Established in 1933 and currently headed by President Yoshihito Yamada, Omron's 36,000 employees help businesses solve problems with creativity in more than 110 countries.

> "This [lab] makes our graduates very marketable because these are skills companies want. We're grateful to Omron for making this possible." - LEN TROMBETTA

UH Engineering Alumni Association Kicks Off

NATIONAL ENGINEERS WEEK

BY INEZ HUTCHINSON

For one week in February, engineers around the country are celebrated as part of National Engineers Week (eWeek). It's a time to raise awareness of the critical contributions made by engineers and engineering.

During eWeek, the UH Cullen College of Engineering honors its outstanding students at an annual program and reception hosted by the Engineering Alumni Association. This year's reception was held Feb. 19 at the UH Alumni Center.

Over 150 engineering students, alumni, faculty, staff and sponsors attended the gathering, which is now in its 15th year.

Approximately $40,000 was generously donated by engineering companies, professional organizations and alumni to 58 high-achieving Cullen College students in recognition of their excellence in academics and leadership.

Since its inception, the EAA has raised more than $500,000 in scholarships.

Two groups tied for the events top sponsor: The UH Petroleum Advisory Board & Ryder Scott Company Friends of UHPE with a total donation of $19,745. Several other companies, organizations and individuals contributed to the scholarship and award fund, including Phillips 66, Shell Oil Company, Fluor Corporation, UH Engineering Alumni Association, ConocoPhillips, Women Cougar Engineers, Black Cougar Engineers, Civil Engineering Cougars, CobbFendley and Associates, Friends of Cougar Biomedical Engineering, American Society of Indian Engineers and TechnipFMC.

The program kicked off with the announcement of the winner of the Engineering Challenge. This year's winning organization was the UH chapter of the Society of Hispanic Professional Engineers, while the UH chapter of the Society of Mexican American Engineers and Scientists (MAES) won the runner-up prize.

BIOMEDICAL ENGINEERING LEADERS UNITE

at UH for Annual Event Celebrating Innovation and Entrepreneurship

BY INEZ HUTCHINSON

The Cullen College of Engineering's Department of Biomedical Engineering welcomed leaders and innovators in biomedical engineering to the University of Houston in April for the 6th Annual BME Day, co-sponsored by BioHouston.

BME Day is one of the largest events at UH celebrating the research and industrial achievements in the ever-growing field of bioengineering.

This year's event took place on April 26 at the UH Health and Biomedical Sciences Center, attracting renowned speakers from academia and industry. The 2019 moderator was Dr. Ann Tanabe, CEO of BioHouston. Event speakers included Dr. Colin Brenan, founder and COO for HiFiBio BV; Elizabeth Hoff, managing director, Fannin Innovation Studio; and Rajitha Aluru, senior manager of technology development, JNJ Center for Device Innovation at the Texas Medical Center.

The daylong event provided senior BME undergraduates the opportunity to present their capstone projects and network with industry professionals, faculty and BME graduate students.

Metin Akay, founding chair of the UH Biomedical Engineering Department, said the purpose of BME Day is to "support, promote and strengthen the biomedical and healthcare engineering research and educational programs at UH." The event also advances innovation in healthcare in Houston and around the world by bringing together the greatest minds in the medical industry.

UH Civil Engineering

ONLINE MASTER'S PROGRAM RANKS ON TWO LISTS

BY RASHDA KHAN

The online master's program in civil engineering at the UH Cullen College of Engineering made two different lists highlighting the best programs for students interested in growing their careers in the field.

The program was No. 12 on the "Best Online Master's in Civil Engineering Programs of 2019" list recently published by BestColleges and No. 21 on the "24 Best Online Master's in Civil Engineering" list published by Online Schools Report (OSR). Both BestColleges and OSR provide independent college rankings, college planning resources and field-specific research.

According to the U.S. Bureau of Labor Statistics, the demand for civil engineers – who work on everything from buildings and roads to bridges and dams – is growing. Between now and 2026, an 11 percent jump is projected in the civil engineering job market. Earning potential ranges from a median salary of $83,540 per year to about $138,000 for the top 10 percent in the field.

The BestColleges ranking methodology focuses on academics and learner support, affordability and online programming. Information is collected from the Integrated Postsecondary Education Data System (IPEDS) and College Navigator, both of which are hosted by the National Center for Education Statistics.

OSR aims to provide students with information on quality programs that are accountable to students. Areas considered for rankings include program quality, student satisfaction, online presence, affordability and earning potential, as well as acceptance and retention rates. It pulls data from U.S. News and World Report, the National Center for Education Statistics and PayScale.

"I am proud that the work of the Civil Engineering Program is being recognized," said **Paula Myrick Short**, UH senior vice president for academic affairs and provost.

"Reputational awareness helps further not only our Tier One academic mission, but also the resources available to our students, especially in the form of notable faculty and top-notch research," she said. "By offering this degree as an online option, we expand the type of students who can apply for and complete this degree, and further awareness of our university and its programs."

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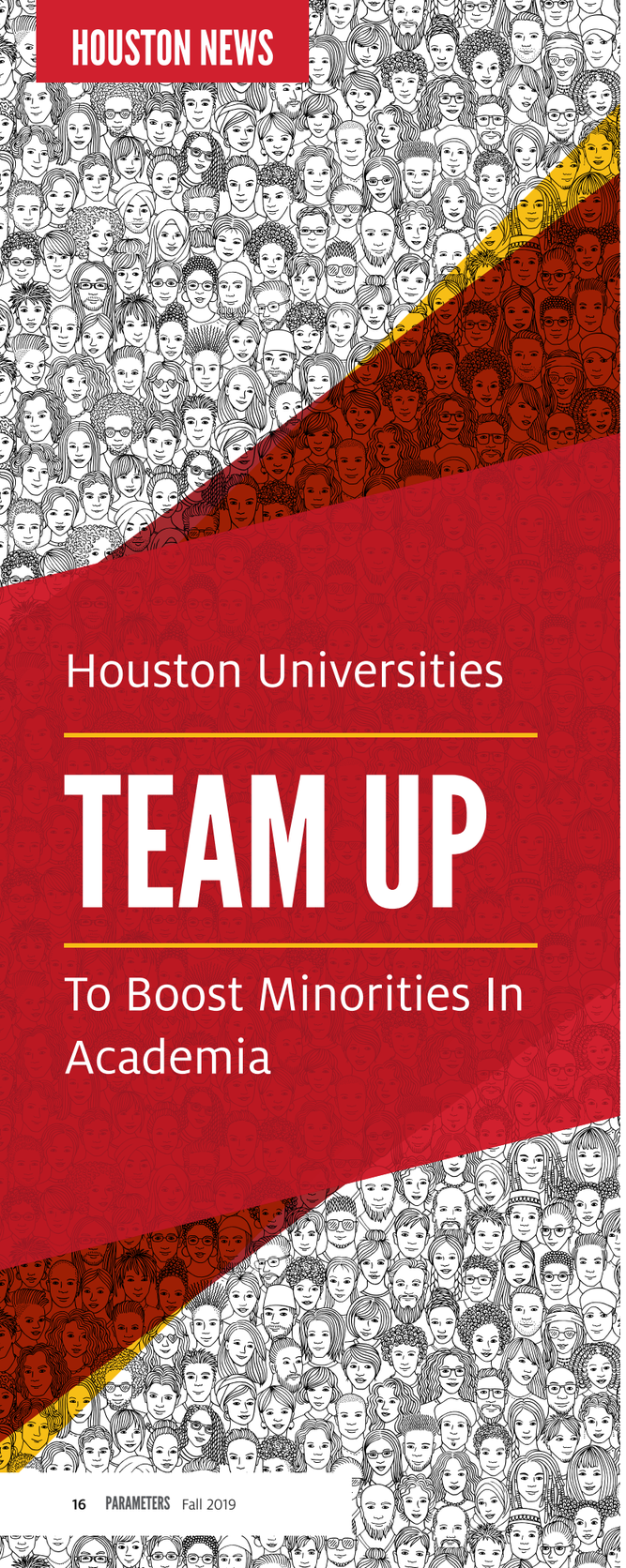
>
> - PAULA MYRICK SHORT, UH SENIOR VICE PRESIDENT FOR ACADEMIC AFFAIRS AND PROVOST



Houston Universities TEAM UP To Boost Minorities In Academia

Rice University, Texas Southern University (TSU) and the University of Houston (UH) have won a multimillion-dollar grant to help increase the number of underrepresented minorities pursuing academic careers in engineering and science.

The National Science Foundation (NSF) grant for $2.66 million over five years is part of its Alliances for Graduate Education and the Professoriate (AGEP) program, which seeks to "advance knowledge about models to improve pathways to the professoriate and success" for historically underrepresented minorities in science, technology, engineering and math (STEM) disciplines.

The award is specifically for those in data engineering and data science disciplines. It will fund a project called AGEP STRIDES (Strengthening Training and Resources for Inclusion in Data Engineering and Sciences).

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

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

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

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

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

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

From left: Wei Wayne Li of Texas Southern University; Pradeep Sharma and Hanadi Rifai of the University of Houston; Yvette Pearson, Reginald DesRoches and Canek Phillips of Rice

"We know diversity matters, so my collaborators and I are focusing on how to make academic ranks in engineering more diverse," said **Pradeep Sharma,** the M.D. Anderson Professor and chairman of the mechanical engineering department at UH. "The questions we are trying to answer are: How can we best support people from underrepresented groups to enter and thrive in academia? What tools and resources can we provide for them to make the most of their own potential and the opportunities out there?"

"What's most exciting is that our efforts will extend far beyond scholar development," said Yvette Pearson, associate dean for accreditation, assessment and strategic initiatives at the Brown School and co-investigator with Rifai, Li, Sharma and Rice postdoctoral researcher Canek Phillips. "Will we equip scholars with the tools they'll need to succeed in academia? Absolutely! Beyond that, our primary focus is learning about systemic barriers that impede their success and developing, implementing, studying and propagating solutions to overcome those barriers."

Pearson said the project will create opportunities for researchers to engage with each other across campuses, provide existing faculty with guidance on mentoring inclusive research teams and hold quarterly training programs to prepare future faculty members to lead research teams and centers and to further the impacts of their research through entrepreneurship.

"We are also going to provide future faculty members with affinity mentors who can advise them about their careers and also about life," Rifai said. "Because there's more to life than just the career, and we want them to have all the support they need to succeed."

A major component of the project is a research investigation to identify factors that help and hinder underrepresented minorities as they apply for faculty positions.

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

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

"We have a sizeable team of committed people at our institutions and at others nationwide who are working to make this project a success," Pearson said. "Some get the sense that diversity, equity and inclusion are the responsibility of certain subsets of people.

"And that is not true," she said. "It's all of our responsibility. I want this to become business as usual, and this AGEP award will enable us to make great strides in that direction."

Researchers Report

HIGH PERFORMANCE SOLID-STATE SODIUM-ION BATTERY

BY JEANNIE KEVER

Solid-state sodium-ion batteries are far safer than conventional lithium-ion batteries, which pose a risk of fire and explosions, but their performance has been too weak to offset the safety advantages. Researchers recently reported developing an organic cathode that dramatically improves both stability and energy density.

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

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

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

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

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

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

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

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

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

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

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

ENERGY

UH Engineer's Battery Research

GETS NEW CHARGE WITH ADDITIONAL DOE FUNDING

BY RASHDA KHAN

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

Yao, associate professor of electrical and computer engineering at the UH Cullen College of Engineering, was one of 15 principal investigators whose seedling projects – focused on cutting-edge battery research – were funded through the DOE's Battery500 Consortium. Each seedling awardee received $400,000 in 2017.

After an 18-month initial phase, the 10 most promising projects were selected to move into the second round of research time – another two years – and received additional funding. This brings the total funding for the project to $1.2 million.

A new battery for the future

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

During the first phase, the team introduced a class of high-energy quinone materials – which can be synthesized from plants and food like maize or soybean – to pursue the 500-Wh/kg specific energy target set by the Battery500 Consortium. They achieved a highly reversible specific capacity of 400 mAh/g and recorded a 1000 charging cycles, while most solid-state batteries diminish rapidly after 100 charging cycles.

"The results confirm the moderate potential and soft nature of quinones are invaluable enablers of high-energy solid-state batteries," Yao said.

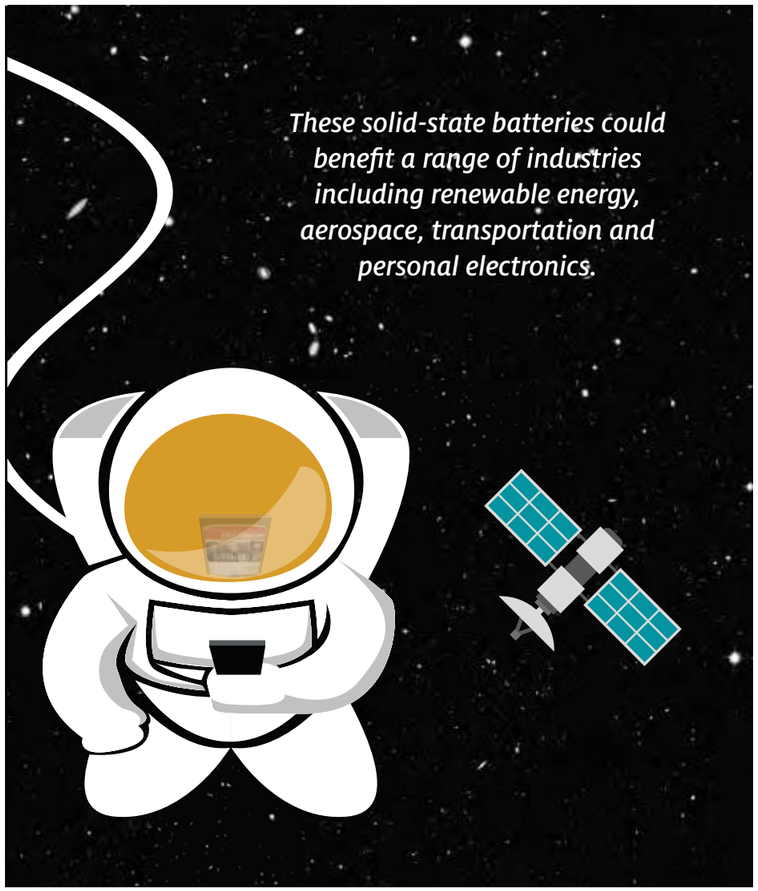
In the second phase, the research team will explore approaches to increase the active material ratio and translate high material-level specific energy to the cell level.

"This is necessary to make these innovative batteries practical for real-world applications," Yao said. "In addition, new organic materials with higher specific capacity and potential will be developed."

Yao's team will collaborate with Rice University on this project. "They have the tool to visualize the complicated microstructure of composite electrodes in 3D," he said. "It will allow us to better understand the properties and create a better interconnected network in the electrode."

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

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



ENVIRONMENT

SOLVING A SCIENTIFIC MYSTERY

and Finding a Solution for Industry

BY JEANNIE KEVER

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

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

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

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

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

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

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

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

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

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

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

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

In addition to offering an explanation for strontium-rich barite formation in marine environments, the researchers said the work offers new insights for understanding and manipulating solid solution nucleation and growth, which could lead to new methods for removing toxins from water and other liquids. That includes the possibility of a more efficient way to remove strontium from the produced water resulting from hydraulic fracturing, Hu said.

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

This work was supported by the U.S. Department of Energy, Office of Science, Office of Basic Energy Sciences, Chemical Sciences, Geosciences, and Biosciences Division.

Researchers Report New

LIGHT-ACTIVATED MICRO PUMP

BY JEANNIE KEVER

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

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

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

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

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

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

The latest work involved fabricating a quartz substrate implanted with 1016 gold atoms, or ten thousand trillion atoms, per square centimeter and testing whether a laser pulse could generate an ultrasonic wave capable of creating a liquid stream. The quartz plate – about the size of a fingernail – was implanted with gold nanoparticles; when a pulsed laser hits the plate, the gold nanoparticles generate an ultrasonic wave, which then drives the fluid via acoustic streaming.

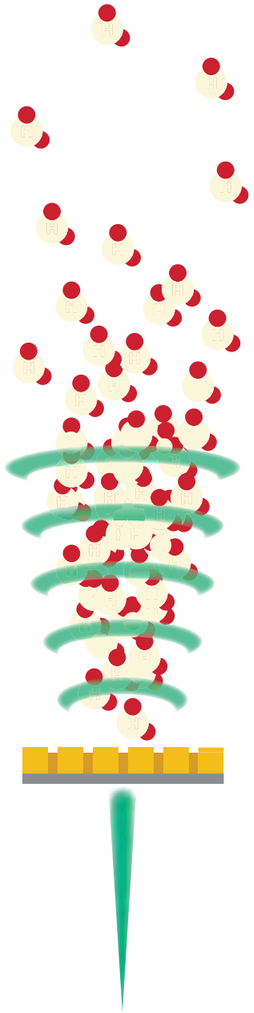
"This new micropump is based on a newly discovered principle of photoacoustic laser streaming and is simply made of an Au [gold] implanted plasmonic quartz plate," the researchers wrote. "Under a pulsed laser excitation, any point on the plate can generate a directional long-lasting ultrasound wave which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

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

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

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

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



Under a pulsed laser excitation, any point on the plate can generate a directional long-lasting ultrasound wave which drives the fluid via acoustic streaming.

CULLEN COLLEGE PROFESSORS WIN WELCH AWARDS

to Explore Fundamental Chemical Ideas

BY RASHDA KHAN

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

Jiming Bao, professor of electrical and computer engineering, earned a $240,000 award – his fourth Welch award – to continue studying cobalt oxides as viable catalysts for energy generation.

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

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

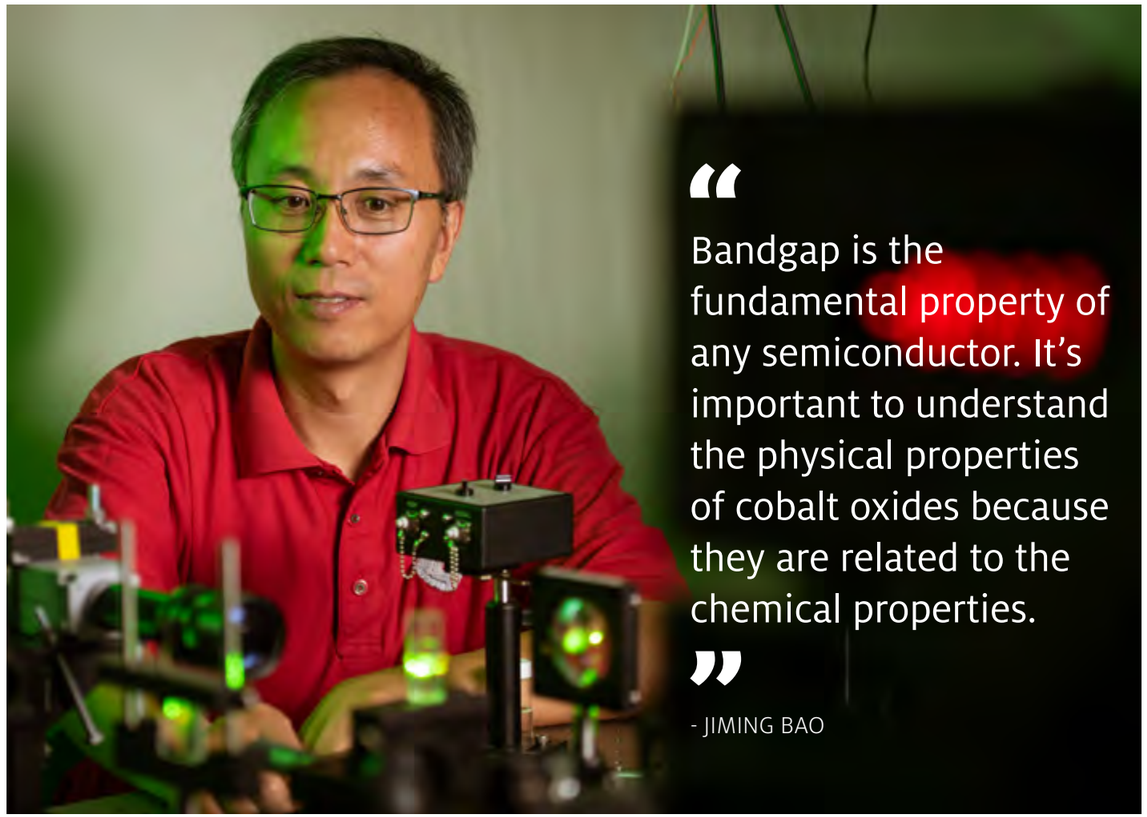
"New advances can only come from a better understanding of how the world works," said Carin Marcy Barth, chairwoman of the Welch Foundation. "Our mission as a Foundation is to support that critical basic research. It has been so rewarding to work with UH faculty – as well as scientists across the state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

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

Jiming Bao

Professor
Project Title: **Correlating Photocatalytic and Photoelectrochemical Activity of Cobalt Oxides with Dynamics of Photo-excited Electrons and Holes.**
Amount: **$240,000**

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



electron and free it up to participate in conduction, is essential in determining whether a material will be useful in making solar cells or light-emitting diodes (LEDs), or for generating useable fuel.

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

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

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

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

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

Bao appreciates the Welch Foundation for supporting his research. "Initially I thought this would be a short project, but it has turned out to be a long-term one," he said. "Continued support is important because along the way we have discovered new properties and fundamental truths and clarified many questions."

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

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

Debora Rodrigues

Associate Professor
Project Title: **Plant-based Antibiotic Nanocarriers Investigation in the Simultaneous Reduction of Pathogen Mutation Rates and Intestinal Infections in Humans.**
Amount: **$195,000**

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

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

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

The idea of using nanoparticles as antibiotic delivery systems has been proposed to develop more effective antibiotic therapies and reduce the emergence of antibiotic resistance. It's thought that nanoparticles can target microorganisms at the site of the infection and so can be used at infected areas for a fast remedy thereby reducing chances of antibiotic resistance to develop. In addition, because drugs delivered by nanoparticles are more targeted and can be released slowly over long periods of time, this delivery method could potentially decrease the amount of oral drugs a patient has to ingest as well as reduce the length of time a patient must continue taking those drugs.

Aside from these benefits, at present little is known about the effects of nanoparticles to either reduce or exacerbate the development of antibiotic resistance. Since antibiotics are typically delivered orally, the characteristics of nanoparticles as they travel through the human digestive system must be understood to ensure that the nanomaterials behave as intended.

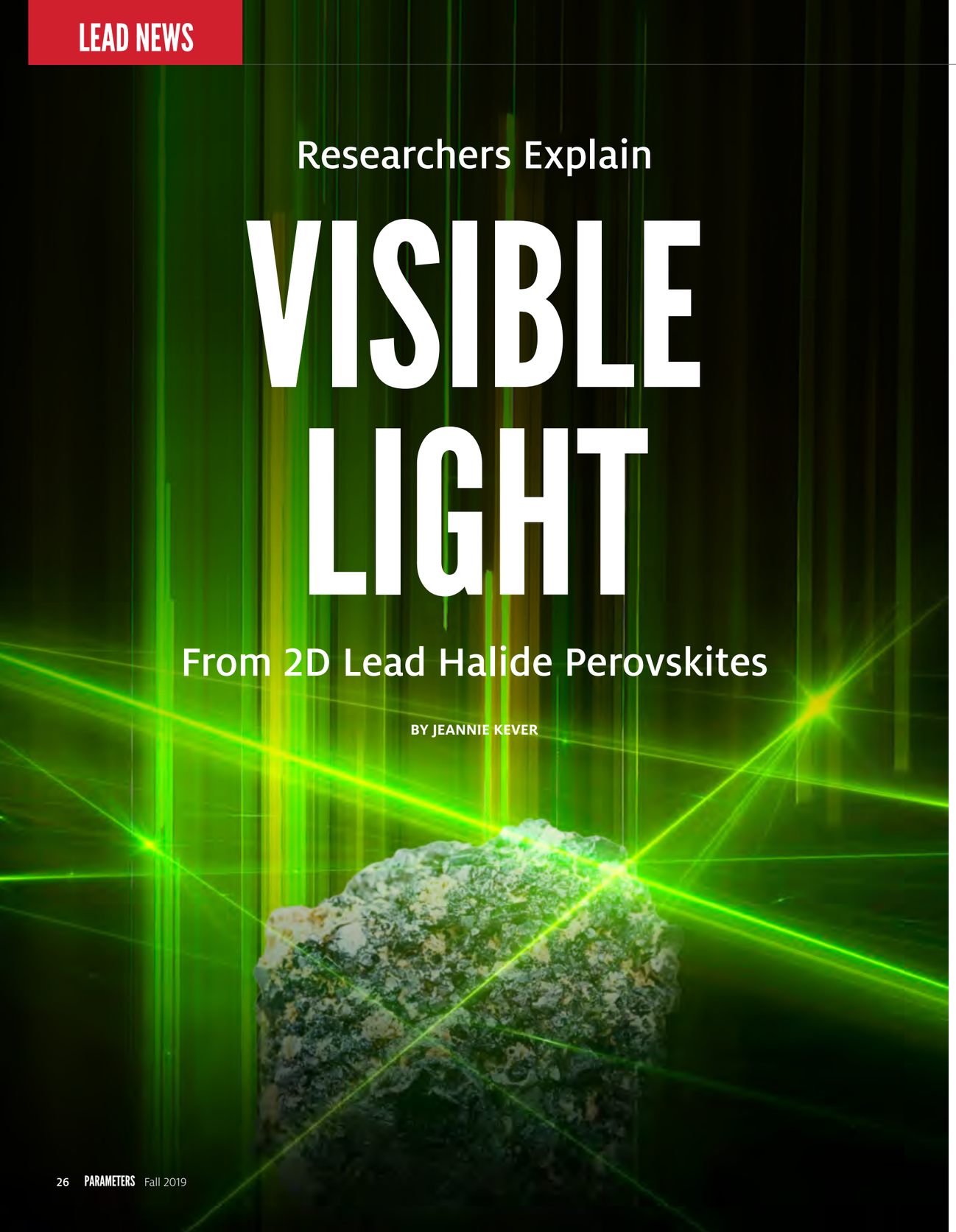
Rodrigues plans to use novel plant-based carbohydrates (lignin) and poly(lactic-co-glycolic) acid nanoparticles loaded with ciprofloxacin antibiotics in a simulated human digestive system bioreactor.

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

"We want to determine whether slow released drugs can induce or reduce the emergence of antibiotic-resistant bacteria," Rodrigues said. "The idea is to reduce the use of antibiotics over time and reduce the emergence of antibiotic-resistant bacteria."

WHO links antibiotic resistance to longer hospital stays, higher medical costs and increased mortality.

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



Researchers Explain

VISIBLE LIGHT

From 2D Lead Halide Perovskites

BY JEANNIE KEVER

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

But there was no agreement about how the crystal, CsPB2Br5, produced the green photoluminescence. Several theories emerged, without a definitive answer.

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

They initially synthesized CsPB2Br5 from a related material known as CsPbBr3 and found that the root cause of the light emission is a small overgrowth of nanocrystals composed of that original material, growing along the edge of the CsPB2Br5 crystals. While CsPbBr3, the base crystal, is three-dimensional and appears green under ultraviolet light, the new material, CsPB2Br5, has a layered structure and is optically inactive.

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

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

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

Crystals that produce light on the green spectrum are desirable because green light, while valuable in itself, can also be relatively easily converted to other forms that emit blue or red light, making it especially important for optical applications ranging from light-emitting devices to sensitive diagnostic tools.

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

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

They relied on Raman spectroscopy – an optical technique that uses information about how light interacts with a material to determine the material's lattice properties – to identify nanocrystals of the original source material, CsPbBr3, along the edges of the crystal as the source of the light.

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

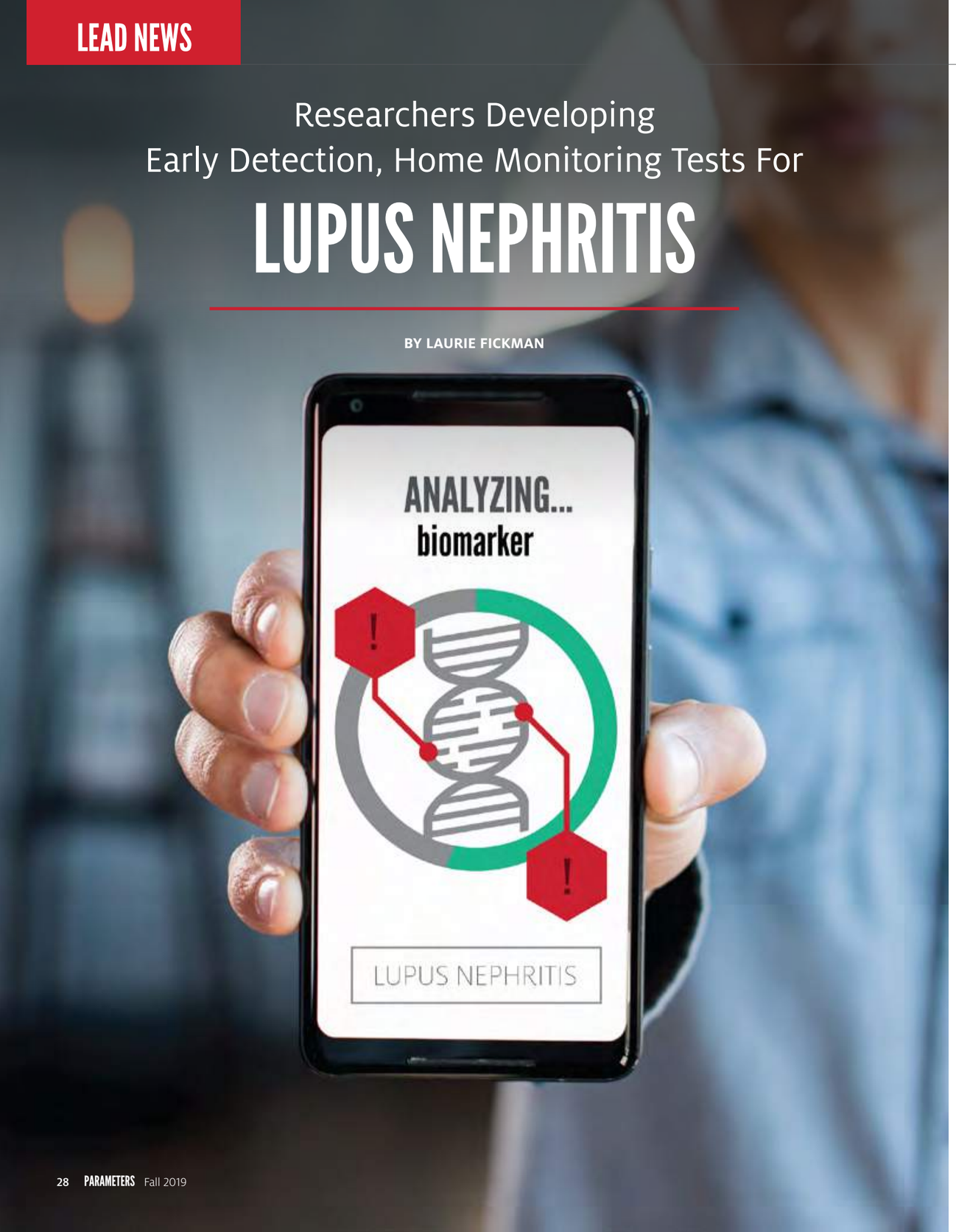
The researchers said the new understanding of the light emission will yield new opportunities to design and fabricate novel optoelectronic devices. The techniques used to understand the cesium-lead-halide compound can also be applied to other optical materials to learn more about how they emit light,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

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

Researchers Developing
Early Detection, Home Monitoring Tests For

LUPUS NEPHRITIS

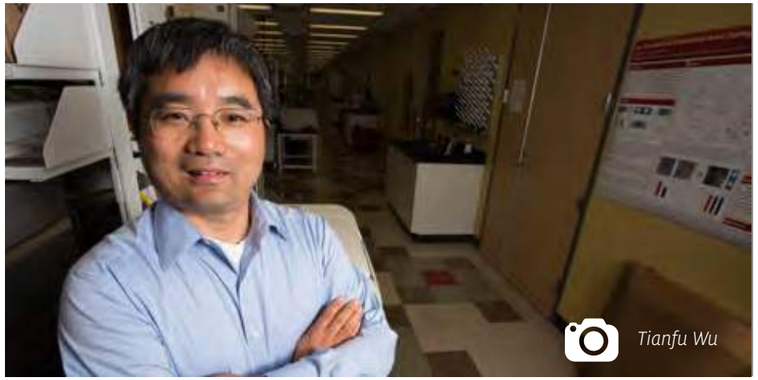
BY LAURIE FICKMAN



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

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


Chandra Mohan


Tianfu Wu

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

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

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

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

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

At home monitoring

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

"We are developing a technology allowing us to measure multiple biomarkers at one time, and this is a first," said Wu. The app-based program would allow patients to read their own diagnosis, which could be particularly helpful for elderly patients who often cannot be transported to an office for a test.

The home tests may not only be able to predict flares but to guide individualized treatment.

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

Imaging Technology Will Offer
NEW CLUES TO EMBRYONIC DEVELOPMENT

BY JEANNIE KEVER

David Mayerich

Soon after conception, an embryo's circulatory system connects to that of its mother. Complications that occur at this critical time can result in miscarriage or birth defects with long-term chronic conditions. Unfortunately, limitations in imaging technologies prevent researchers from fully understanding the cellular-level events leading up to this crucial point.

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

David Mayerich, assistant professor of electrical and computer engineering at UH, is leading the $3.7 million project funded by the National Heart, Lung and Blood Institute, with **Kirill Larin,** professor of biomedical engineering at UH; Mary Dickinson, professor of molecular physiology and biophysics at Baylor; and Joshua Wythe, assistant professor of molecular physiology at Baylor.

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

Current studies require multiple imaging methods: optical coherence tomography (OCT), a non-invasive imaging method typically used to study the eye, to collect high-resolution images of structural growth and changes, and three-dimensional fluorescence imaging such as light sheet microscopy to observe cellular changes.

Even a short time lag between images taken with OCT and microscopy can make it impossible to synchronize the structural and chemical changes, said Mayerich, whose work involves the application of data science to microscopy, allowing for high resolution imaging at massive scales. This new system will merge both imaging methods and align them in 3D, he said, using specially designed software to synchronize the data collection.

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

Mayerich and his lab will also determine how to interpret the resulting aligned images, identifying and measuring components including blood vessels, blood flow and individual cells as they change over time.

Ultimately, they hope to identify biomarkers correlated with certain birth defects, improving early detection.

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

GETTING CLOSER:
Finding Out Why The Immune System Attacks Itself

BY LAURIE FICKMAN

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

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

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

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

B Cells, good and bad

For every new pathogen encountered, a small subset of B cells activates to make an antibody that specifically recognizes that particular pathogenic protein. Every person has between 10-100 million unique B cells, each capable of making its own antibody. While antibodies are the natural way the body fights infections, in the autoimmune RA, these antibodies – that are supposed to fight foreign invaders – attack the body's own proteins and are thus called autoantibodies.

"We wanted to understand if there's anything special about this class of white bloods cells, the autoreactive B cells that make autoantibodies, that would make them fight against healthy proteins," said Varadarajan.

Fewer than one in 1,000 B cells are autoreactive, so to find which one is the culprit, Varadarajan's postdoctoral researcher Ankit Mahendra designed a method to reliably identify and isolate the population, then used RNA sequencing to study all of the RNA being made by each cell.

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

Autoreactive B cells, and they alone, have the protein IL-15Rα.

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

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

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

The team includes **Chandra Mohan,** Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering at UH; S. Louis Bridges, Anna Lois Waters Endowed Chair of clinical immunology and rheumatology at the University of Alabama School of Medicine; Sandeep Agarwal, associate professor and section chief of Medicine - Immunology, Allergy & Rheumatology at Baylor College of Medicine; Amita Aggarwal, Sanjay Gandhi Postgraduate Institute of Medical Sciences, Lucknow, India.

UH Engineers APPLY THEIR SKILLS TO HEALTH CARE

BY JEANNIE KEVER

Poria Dorali

Industrial engineers work to improve system performance, whether that system is in an oil refinery or an automobile production line or, as in this case, in hospitals.

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

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

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

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

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

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

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

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

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

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

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

"We're not Google or Microsoft programmers, where you go in your cubicle and write code," he said. Engineers solve problems, and that generally requires working with a group of people.

Dorali sees another benefit.

"We've experienced it firsthand," he said. "We see patients waiting. This is an opportunity to help the community and make a difference."

Research Moves Closer to BRAIN-MACHINE INTERFACE AUTONOMY

BY LAURIE FICKMAN

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

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

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

"This will help prosthetics work the way the user wants them to," said Francis. "The BCI quickly interprets what you're going to do and what you expect as far as whether the outcome will be good or bad." Francis said that information drives scientists' abilities to predict reward outcome to 97%, up from the mid-70s.

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

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

"This is important because we are going to have to extract this information and brain activity out of people who cannot actually move, so this is our way of showing we can still get the information even if there is no movement," said Francis. This process utilizes mirror neurons, which fire when action is taken and action is observed.

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

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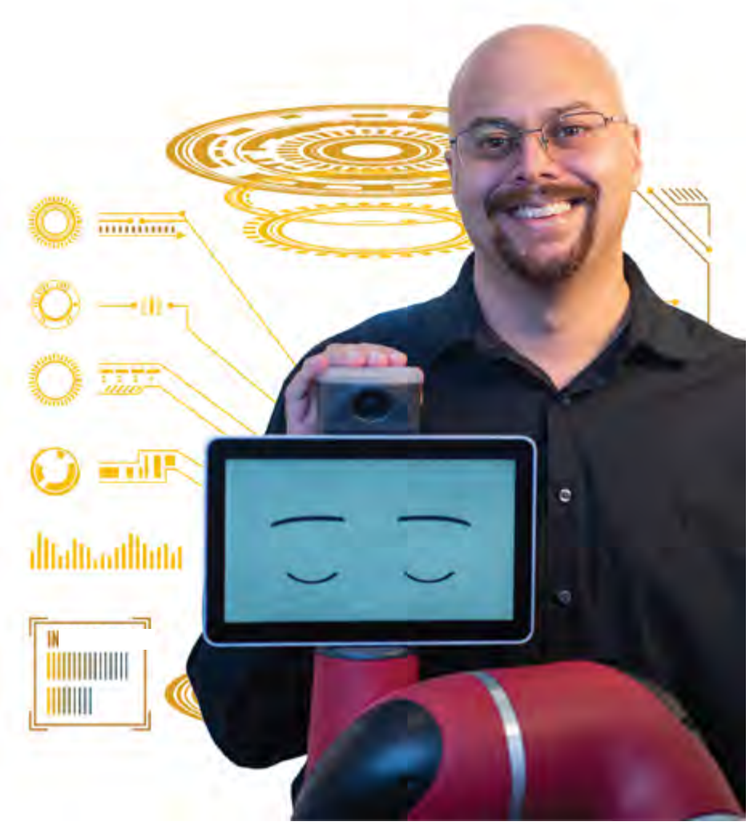


HOUSTON, WE HAVE AN EXPERIMENT:

UH Engineer Sends Cancer Research to the International Space Station

BY LAURIE FICKMAN

Precious Cargo

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

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

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

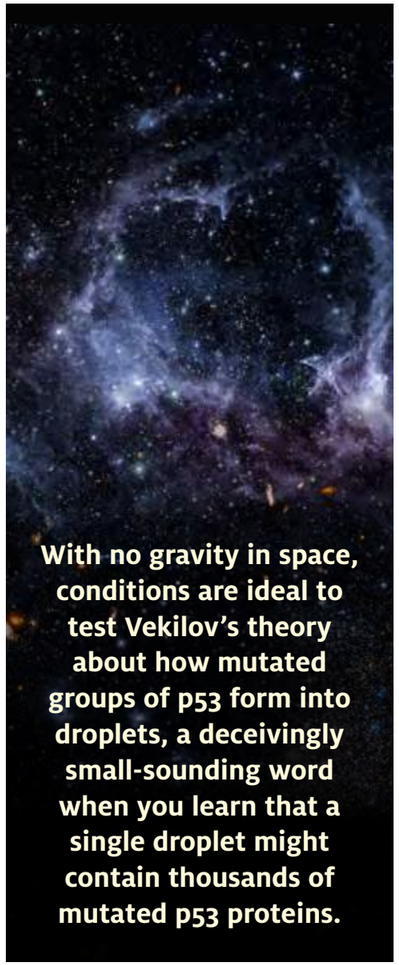
Into Space, But Why?

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

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

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

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



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The Astronaut And Her Work

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

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

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

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

A Meaningful Dedication

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

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

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

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

TARGETING NEW TREATMENTS FOR CONCUSSIONS

by Transforming Brain Pathology

BY LAURIE FICKMAN

Badri Roysam, chairman of the Department of Electrical and Computer Engineering at the UH Cullen College of Engineering, is leading a $3.19 million project to create new technology that could provide an unprecedented look at the injured brain. The technology is a marriage, as Roysam calls it, between a new generation of “super microscopes,” that deliver detailed multi-spectral images of brain tissue, and the UH supercomputer at the HPE Data Science Institute, which interprets the data.

“By allowing us to see the effects of the injury, treatments and the body’s own healing processes at once, the combination offers unprecedented potential to accelerate investigation and development of next-generation treatments for brain pathologies,” said Roysam, co-principal investigator with John Redell, assistant professor at UTHealth McGovern Medical School. Funded by the National Institute of Neurological Disorders and Stroke (NINDS), the project also includes Associate Professor **Saurabh Prasad** and Assistant Professor **Hien Van Nguyen,** both of the Cullen College of Electrical Engineering, and NINDS scientist Dragan Maric.

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

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

The impact is immediate

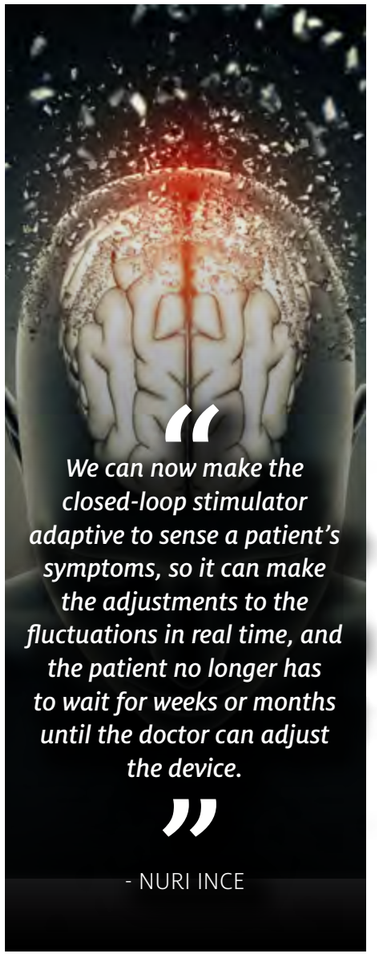
Injury to the brain causes immediate changes among all brain cells, severing some connections and potentially causing blood to leak into the brain — where blood is never supposed to be — by breaching the blood/brain barrier. After a concussion, the brain tissue becomes a complex “battleground,” said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

“We will present a carefully validated and broadly applicable toolkit with unprecedented potential to accelerate investigation and develop next-generation treatments for brain pathologies,” said Roysam.

Once validated, the new technology can also be applied to strokes, brain cancer and other degenerative diseases of the brain.

Smart Brain Stimulators: NEXT-GEN PARKINSON’S DISEASE THERAPY

BY LAURIE FICKMAN



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

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

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

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

Redefining coupling

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

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

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

Other investigators include David Francis, University of Houston Department of Psychology; Aviva Abosch, University of Colorado Denver School of Medicine, Neurosurgery; Jian-Ping Wu, Medtronic Inc. Restorative Therapies Group Implantables Research and Core Technology; and, Joohi Jimenez-Shahed, Baylor College of Medicine Department of Neurology.

UH, MIT Thermal Research

PUBLISHED IN NATURE COMMUNICATIONS

BY RASHDA KHAN

Polymers, also known as plastics, can be found in almost every kind of modern technological products – from soft robotics and organic electronics to 3D printing and artificial skin. The unique characteristics of polymers, which are cost-effective, lightweight and corrosion-resistant, make them ideal components in general.

However, more expensive materials continue to be used in manufacturing. For example, cases for cellular phones and computers are made of metal rather than inexpensive materials with lower thermal conductivity because the metal is necessary to dissipate generated internal heat.

"In these devices, heat dissipation by materials plays a critical role and is a bottleneck for boosting computation and performance capacity of these systems," said **Hadi Ghasemi**, Bill D. Cook associate professor of mechanical engineering at the UH Cullen College of Engineering. "Low thermal conductivity of polymers impede their use in these applications."

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

New game-changing polymers

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

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

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

In addition to Ghasemi, contributing authors on the paper are: Yanfei Xu (lead author), Daniel Kraemer, Bai Song, Jiawei Zhou, James Loomis, Jianjian Wang, Mingda Li, Xiopeng Huang, Xiaobo Li and Gang Chen – all with the Massachusetts Institute of Technology (MIT), as well as Zhang Jiang with the Argonne National Laboratory.

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

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

UH STARTUP SURFELLENT WINS BIG

at the 2019 Texas A&M New Ventures Competition

BY RASHDA KHAN

SurfEllent, a startup which brings innovative durable anti-icing coating technologies to the market, competed in the Texas A&M New Ventures Competition (TNVC) for the first time this year and performed extremely well. It won the second place award and its accompanying $35,000 check and walked away with the Texas A&M Engineering Extension (TEEX) Product Development Center Prize of $10,000.

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

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

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

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

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

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

SurfEllent's products, available as aerosol sprays and paints, are available through the company's online shopping platform at surfellent.com. Besides being useful on airplane wings and transmission lines, the products also have more everyday applications such as de-icing vehicles and porches.

TNVC, an annual pitch competition designed to promote the commercialization of emerging technologies, recognizes companies with high-growth potential and provides seed funding to help advance them. The competition is hosted by the Texas A&M Engineering Experiment Station (TEES).

With more than $500,000 in cash and in-kind services, the prize pool for this year's competition was the largest yet. Since 2015, the TNVC has awarded more than $1.5 million in prizes to Texas-based startups.

GOING PLACES:

UH PROMES is Tackling Global Challenges

BY RASHDA KHAN

While many people dream of seeing the world one day, a group of UH Cullen College of Engineering students recently returned from Brazil as part of the first engineering faculty-led study abroad experience through the Program for Mastery in Engineering Studies (PROMES).

The students' learning adventure included leaping off a cliff to go hang-gliding, visiting the famous Museu Afro Brasil as well as a favela (a Brazilian shanty town), learning to speak Portuguese and presenting their research and creative solutions inspired by the National Academy of Engineering's Grand Challenges to the faculty and students of the University of Sao Paulo among other things.

The NAE's 14 "Grand Challenges," put together by a committee of global experts, are those that impact the world and need to be addressed. These include: making solar energy economical; providing energy from fusion; developing carbon sequestration methods; managing the nitrogen cycle; providing clean water; restoring and improving urban infrastructure; advancing health informatics; engineering better medicines; reverse-engineering the brain; preventing nuclear terror; securing cyberspace; enhancing virtual reality; advancing personalized learning; and engineering the tools of scientific discovery.

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

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

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

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

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

The aim of the PROMES study abroad trip was for students to understand the Grand Challenges that Brazil faces in the context of Brazilian culture, technological advances, economy, workforce and its K-12 population

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

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

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

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

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

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

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

"I am excited to see faculty incorporating initiatives from the Office of the Provost, such as the Global Citizens Credential, into their own programs," said Paula Myrick Short, UH senior vice president for academic affairs and provost. "Last year, PROMES won the Regent's Academic Excellence Award for uniting academic support with a sense of community for these students. It is heartening to see the progress they have made over the last year."

UH Researchers Forge Ahead With

LOW-COST, HIGH-EFFICIENCY SOLAR CELL DEVICE DEVELOPMENT

BY RASHDA KHAN

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

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

The article reports a 50 percent higher efficiency in gallium arsenide solar cells – also known as GaAs – on inexpensive metal substrate than a previous article on the project published in the journal *Progress in Photovoltaics: Research and Applications*.

"We achieved higher efficiency through improved materials growth and device fabrication," said **Venkat Selvamanickam**, M.D. Anderson Chair Professor of mechanical engineering, who leads the Selva Group. "The underlying template of germanium used in this new work was made by a different process – plasma enhanced chemical vapor deposition (PECVD) – that led to better gallium arsenide material quality and better solar cell performance."

The goal of the project is to develop methods to fabricate gallium arsenide solar cells at a low cost.

"Low-cost flexible GaAs solar cells can help us meet our future energy demands," said Devendra Khatiwada, a materials science and engineering doctoral student working with Selvamanickam. "In today's market, the majority solar cell technique is still based on silicon, but researchers are facing limitations of silicon's properties."

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

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

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

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

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

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

Energy & Environmental Science links all aspects of the chemical, physical and biotechnological sciences relating to energy conversion and storage, alternative fuel technologies and environmental science.

COULD ROBOTS MAKE A DOCUMENTARY

About A 5K Race?

BY JEANNIE KEVER

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

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

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

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

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

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

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

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

> *"Unlike the highlight reel in MarioKart™, real robots won't know ahead of time where the interesting parts will be, but they will know a lot of probability theory and will be able to calculate the odds of good video footage as a function of race status and robot position."*
>
> - AARON T. BECKER

A date for the first race has not been set, but the team is searching for partners.

The project will start with five robots, including a robotic car capable of moving up to 10 mph, currently being built by a senior design team made up of electrical engineering students Rhema Ike, Farah Luba, Henry Nguyen and Ramsey Daou.

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

A NEW ERA

OF ENGINEERING EXCELLENCE

BY RASHDA KHAN

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

Now as it sets its sights forward, UH Engineering hopes to continue setting the bar even higher. From the new facility in Katy, to advancements in innovation and entrepreneurship under the guidance of its new director, **Haleh Ardebili,** there are many promising developments on the horizon. Read on to see why we have been engineering excellence since 1941.

ENGINEERING KATY

UH Engineering Looks to the Future As It Expands to UH at Katy

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

- DEAN JOSEPH W. TEDESCO

Built at the confluence of I-10 and the Grand Parkway, the new 80,000-square-foot UH at Katy building stands tall against a backdrop of big Texas sky and a constant flow of traffic.

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

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

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

The Cullen College launched its bachelor's degree in petroleum engineering in the fall of 2009 to counteract the critical shortage of talent needed to replace the industry's aging workforce. Then, with support and input from Houston's booming energy industry, the Cullen College established a petroleum engineering doctoral program in 2015.

Since then, the petroleum engineering program is thriving and has been highlighted as a model partnership between industry and academia. Four of the 14 the prestigious National Academy of Engineering members at college are petroleum engineering faculty.

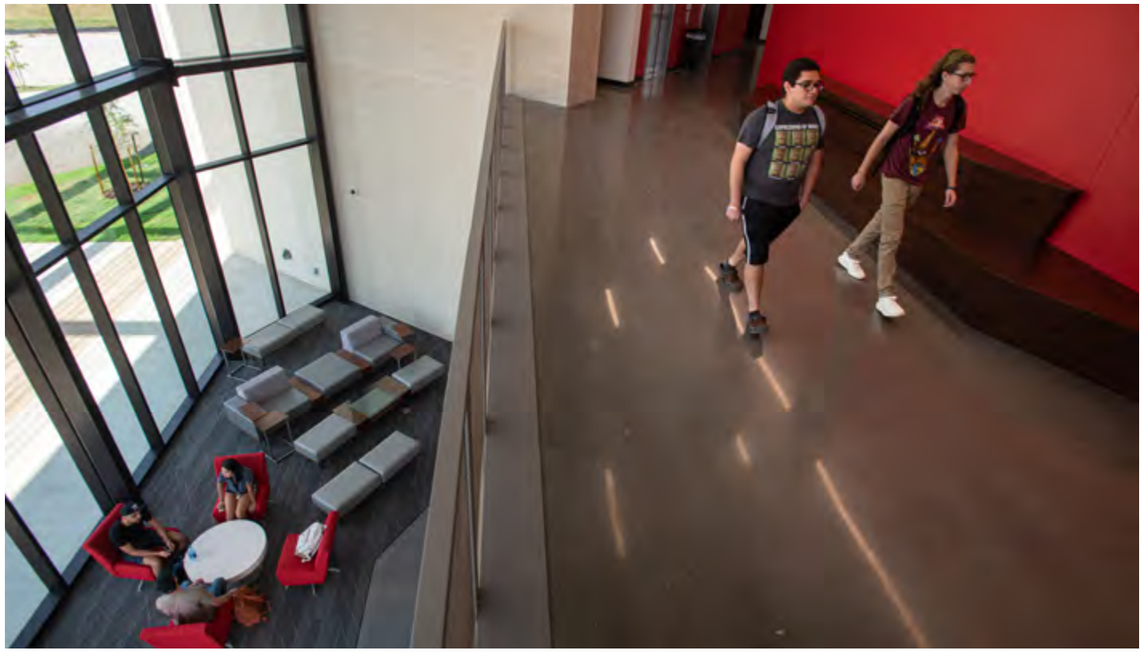
In 2011, the college established the first academic program in subsea engineering in the country and in 2012 offered the first master's degree in the discipline. In 2013, the Cullen College spearheaded the establishment of the Global Subsea University Alliance.

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

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

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

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



WHAT'S NEW

In addition to graduate and undergraduate course offerings, UH Engineering will also debut

3

New Undergraduate Majors

systems engineering

construction engineering

computer systems and analytics

and the new

UH/HCC Engineering Academy

featuring degrees in

civil engineering

computer engineering

electrical engineering

industrial engineering

mechanical engineering

in fall 2020

The beginnings of an idea

UH's expansion into Katy and other areas makes strategic sense.

"The way Houston is expanding in all different directions, we have to provide local centers where we can achieve not only financial growth, but also the educational growth that is required by the local community out there as well," said Ali Raza, chief digital officer of Apergy and a member of the UH Katy Engineering Advisory Board.

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

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

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

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

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

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

More courses are being planned for spring 2020.

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

"These new programs will have their upper division in Katy, itself – they start in Katy and finish in Katy," said J.R. Rao, who is the interim associate dean for engineering at UH Katy. "We're very excited about that."

Even though the wait has been long, the Katy community is happy to see the plans come to fruition.

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

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

Dean Tedesco agreed.

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

Future plans and promise

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

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

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

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

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

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

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

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

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

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

"Relevance in the global marketplace is key to the training we offer our students and we at the UH Cullen College take our mission very seriously," Tedesco said. "Engineers fix problems, and our new Engineering Academy will address student needs, community needs and state needs." ■

A NEW ERA OF INNOVATION

As breath is an integral part of life, innovation is an integral part of engineering.

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

Being innovative means being creative.

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

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

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

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

The college is filled with examples of faculty and students making a difference in the world.

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

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

"It's a warning material that gives feedback," Vipulanandan says.

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

Vipulanandan also developed the real-time monitoring system for smart cement users.

Smart cement has broad applicability and can be used in oil, gas and water wells; pipelines; highways; bridges; buildings; and more. The sensing ability lasts the lifetime of the structures.

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

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

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

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

Building a better future together

Located in Houston – the energy capital of the world, Space City and home to the world's largest medical center – the UH Cullen College is in a unique position to recognize opportunities and address needs involving the Greater Houston area and beyond. Faculty, researchers and students collaborate with partners from the Texas Medical Center, the Energy Corridor, NASA and more to engineer solutions to real world problems.

> "Innovation is the alarm that wakes me up. It is the daily motivation that keeps me going. It is the process of thinking, brainstorming, trying, failing and creating. Once in a while, I see what may be a game changer in real life. That is where entrepreneurship comes into play."
>
> - HADI GHASEMI

As a result, the college – established in 1941 – is a hive of innovative ideas and cutting-edge research. Work ranges from data science to robotics, from algorithm design to human-machine interfaces, from energy storage to smart cement.

Nuri Ince, associate professor of biomedical engineering and director of the Clinical Neural Engineering Lab at the college, believes collaboration is key to fighting diseases like Parkinson's, epilepsy or brain tumors.

"If you have collaborators who can spend time together, discuss, make their work environment available to each other ...then you have success," he says.

He takes advantage of the close proximity of the Texas Medical Center and its medical personnel and facilities to create an optimum learning environment for his students at UH and to further his research.

Collaborating with neurosurgeons, Ince's research team places electrodes on the cortical surface and deep inside the brain during surgeries, using the recorded brain activity to understand the pathological neural activity of the brain in Parkinson's disease and epilepsy.

In addition to determining neuromarkers associated with many cognitive and movement disorders, Ince's lab uses data collected during surgeries to develop neural decoding algorithms and visual interfaces for developing neuroprosthetics.

Ince is one of many Cullen College faculty making use of the partnership opportunities in Houston.

INNOVATOR SPOTLIGHT

HADI GHASEMI

Hadi Ghasemi, Bill D. Cook associate professor of mechanical engineering at the Cullen College, and his NanoTherm Research Group are world-renowned for their cutting-edge research involving surface physics, nanotechnology, biomimetic engineering and small-scale energy systems.

At the University of Houston, Ghasemi has launched a research program focused on icing and developing durable anti-icing coatings. His group was able to innovate a new bio-inspired durable anti-icing coating based on North American wood frogs that can tolerate freezing up to 65 percent of their total body water and still survive in the winter.

NASA chose Ghasemi's project from entries submitted by over 130 organizations across the U.S. for its potential to broadly impact human life on earth and the future of space travel.

Once Ghasemi had plenty proof of concept for his novel material, he partnered with students in his NanoTherm lab to launch the startup SurfEllent and begin marketing innovative durable anti-icing coating technologies to consumers.

Earlier this year, SurfEllent won the second place award and its accompanying $35,000 check at the Texas A&M New Ventures Competition (TNVC). It also won the Texas A&M Engineering Extension (TEEX) Product Development Center Prize of $10,000. Most recently, SurfEllent received a round of Seed Funding of $350,000 and two SBIR and STTR grants.

Ghasemi is actively involved in training the next generation of innovators. One of his doctoral students, Peyman Irajizad, received the best dissertation award among all the Ph.D. graduates in mechanical engineering and is the co-founder of SurfEllent. Furthermore, the students in NanoTherm research group under his supervision have filed a range of patents and received numerous awards.

Working on a larger scale

Another big advantage is the ability to work with national and state-level research centers. Such partnerships make greater funding and resources available, as well as allow collaborations on a much larger scale.

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

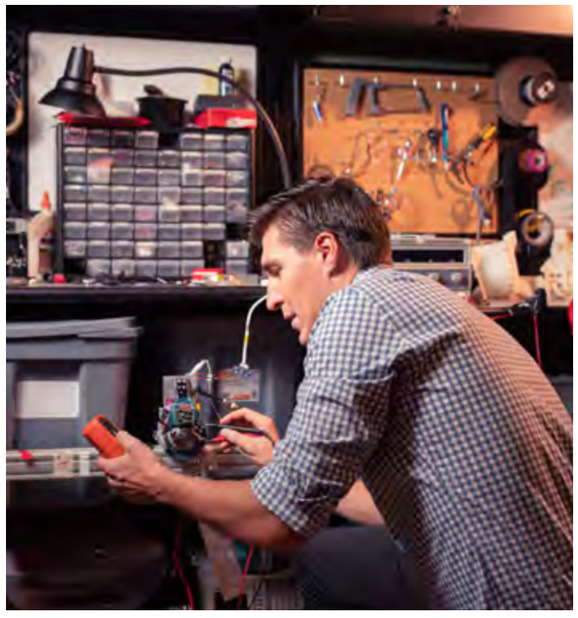
"It's a catalyzer for faculty, students and industry to come together and develop the next neurotechnologies to improve the human condition. We're thinking about the next 10, 20, 40 years from now," says **Jose Luis Contreras-Vidal**, Cullen distinguished professor of electrical and computer engineering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

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

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

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

Other centers affiliated with UH that regularly partner with the Cullen College include: the National Center for Airborne Laser Mapping (NCALM), the Hewlett Packard Enterprise Data Science Institute, Texas Hurricane Center for Innovative Technology (TCH-IT), the Hurricane Resilience Research Center and the Texas Center for Superconductivity.



Cumaraswamy "Vipu" Vipulanandan and Sai Anudeep Reddy Maddi

Leveraging UH resources

If innovation drives all of humanity's advances, then it's the entrepreneurial spirit that brings these advances to the people who can use it the most.

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

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

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

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

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

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

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

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

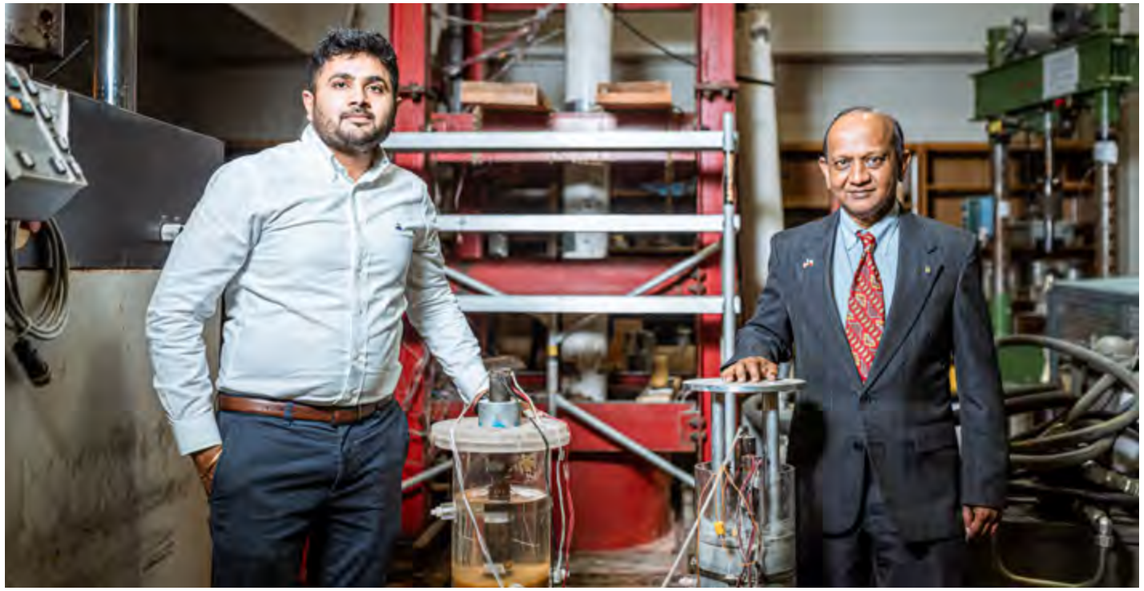
Earlier this year, the company was chosen as one of three local winners of the inaugural Houston MassChallenge program, won a $40,000 investment prize from the Houston Angel Network and was named one of 10 most promising companies by the Rice Alliance for Technology and Entrepreneurship.

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

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

"We are proud to be a part of a grand vision to push boundaries, impact the community and embrace innovation," says the Sensytec team.

> "I have been researching how to make materials with sensing properties for a long time, and it's evolved over more than 15 years. It's not a simple process. I tried things, learned, developed new things, published and kept on improving it until now, when it's a paradigm shift."
>
> - CUMARASWAMY "VIPU" VIPULANANDAN



Haleh Ardebili

Investing in a new era of innovation

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

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

Her goal over the next few years includes establishing an engineering technology incubator at the college to support increased student and faculty IP generation and start-ups, she says.

An accomplished researcher and inventor, Ardebili is no stranger to taking innovative ideas out of the laboratory and into the marketplace. Her research focuses on energy storage, with a variety of projects aimed at developing flexible, stretchable batteries capable of powering everything from spacesuits to submarines. Two patents are pending for her stretchable batteries, while her research has received funding from the National Science Foundation, Army Research Lab, the Office of Naval Research, the Air Force Office of Scientific Research, the Subsea Systems Institute and others.

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

Other new additions include the Research Computing Division at the college, created to encourage student engagement in design activities with data, computing and e-media; the recently hired industrial relations and intellectual property manager at the college; and the recent appointment of **Dan Burleson** as the UH Cullen College of Engineering’s first Director for Engineering Student Innovation and Design Experience (ESIDE).

Dan Burleson

Burleson will work to transform the Cullen College Engineering Design Experience for graduating juniors and seniors to encourage student innovation and success in developing unique multidisciplinary projects addressing critical societal challenges.

“Ultimately, I’d love for design and student innovation to be a culture piece of the entire undergraduate program at the Cullen College,” he says. “It’s a conversation and something students can engage in all the way from the freshman level to their senior year.”

To achieve this goal, Burleson will build engagement and relationships across Cullen College departments and faculty, as well with industry partners and professional organizations. He envisions leveraging existing resources and working with Ardebili, the HPE Data Science Institute and others for maximum benefit to Cullen College undergraduates.

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

INNOVATOR SPOTLIGHT

The Inaugural INNOVATOR AWARDS

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

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

Meet the recipients of the inaugural 2019 Innovator Awards:

VENKAT SELVAMANICKAM
Career Innovator Award
This award, which carries an honorarium of $4,000, recognizes full professors with a track record in innovation, entrepreneurship and mentorship during their career at UH.

WEI-CHUAN SHIH
Rising Innovator Award
This award recognizes efforts by a tenured associate professor in innovation and entrepreneurship at UH. The award comes with an honorarium of $3,000.

HADI GHASEMI
Early Innovator Award
This award, with an honorarium of $2,000, recognizes efforts by the tenure-track assistant professor in innovation at UH.

JAY ADOLACION
Young Innovator Award
This award, with a prize of $1,000, recognizes efforts by Cullen College students or postdocs in innovation and entrepreneurship at UH.

INNOVATOR SPOTLIGHT

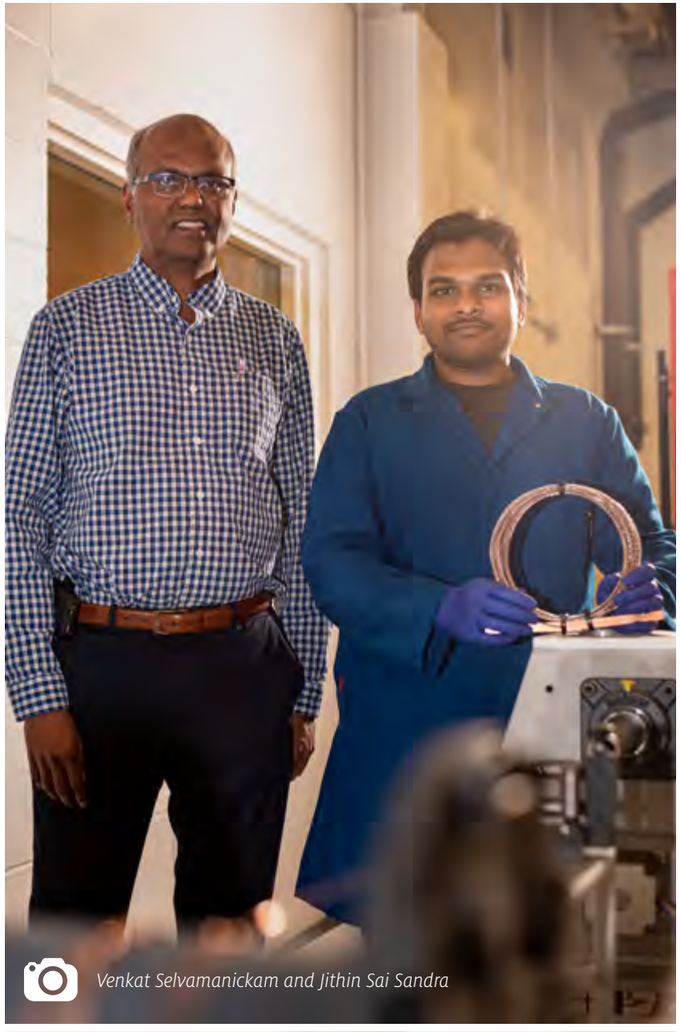
VENKAT SELVAMANICKAM

Venkat Selvamanickam, M.D. Anderson Chair and professor of mechanical engineering at the Cullen College, is one of the world's leading experts and pioneers of innovative manufacturing technologies related to superconductors. With a master's degree in mechanical engineering and a Ph.D. in materials engineering from the UH Cullen College of Engineering, Selvamanickam has compiled 32 years of research contributions in applied superconductivity, specifically the development and manufacturing of superconductor wires.

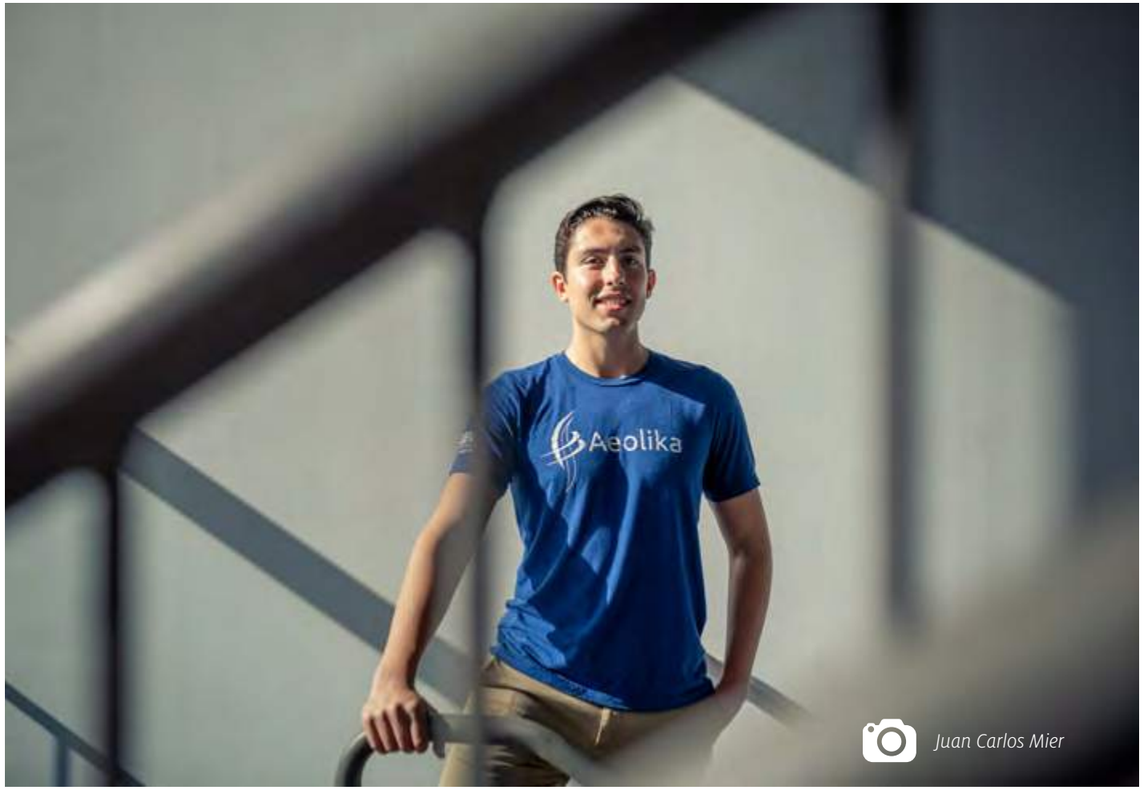
Selvamanickam established a startup company – AMPeers – in 2009 to scale up novel round superconductor wires developed at UH. AMPeers, which stands for Advanced Materials Pioneers, provides innovative solutions to material problems in a broad range of sectors – from defense to medicine and other industrial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

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

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



Venkat Selvamanickam and Jithin Sai Sandra



Juan Carlos Mier

Creating an impact

A robust culture of innovation, creativity and opportunity has a domino effect and leads to more ideas, projects and new frontiers.

Juan Carlos Mier, a senior majoring in chemical engineering and computer science, and his half-brother Mauricio Andrade started Aeolika, an urban wind turbine business in 2018. The technology – a magnet driven motor – was developed by John Harms, a HPE retiree, but the brothers saw an opportunity to take it further.

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

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

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

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

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

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

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

7 NEW FACULTY

BY RASHDA KHAN

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

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

Meet the talented newcomers:

Mario Romero-Ortega
Cullen Endowed Professor of Biomedical Engineering

Mario Romero-Ortega, an award-winning researcher in the field of neuroscience, will join the Cullen College on Jan. 1, 2020 , as the Cullen Endowed Professor of biomedical engineering.

He is the founder and chief scientific officer of NerveSolutions Inc., a company that commercializes the Biosynthetic Nerve Implant and NeuroBlock devices developed in his laboratory.

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

Prior to his UH appointment, he worked in several key roles — associate professor of bioengineering at the University of Texas at Dallas (UTD); as adjunct faculty in the surgery department at the University of Texas Southwestern Medical Center (UTSW) and at the University of Texas at Arlington Research Institute (UTARI); and as a partner researcher with the University of Wollogong in Australia.

Romero-Ortega has also served as director for the Regenerative Neurobiology Division at the Texas Scottish Rite Hospital and as assistant professor of neurology and plastic surgery at UTSW.

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

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

Marzia Cescon
David Zimmerman Assistant Professor of Mechanical Engineering

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

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

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

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

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

Mostafa Momen
Assistant Professor of Civil and Environmental Engineering

Mostafa Momen joins the Civil and Environmental Engineering Department at the Cullen College as an assistant professor. Previously, he served as an associate research scientist in the civil engineering and engineering mechanics department at Columbia University.

His research interests include studying hurricane boundary layers, urban canopies and resiliency, wind energy, reduced modeling and machine learning.

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

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

Gulin Aksu
Lecturer with the Division of Undergraduate Programs and Student Success

Gulin Aksu accepted a full-time lecturer position as part of the First Year Experience faculty with the Division of Undergraduate Programs and Student Success at the Cullen College. Previously, she served as a lecturer with the electrical and computer engineering department and won a 2015 Outstanding Lecturer Award.

Aksu earned a Ph.D. in electrical engineering from the University of Nebraska-Lincoln. Her bachelor's and master's degrees in electronics and communication engineering are from Yildiz Technical University in Turkey.

Marsha Kowal
Lecturer with the Division of Undergraduate Programs and Student Success

Marsha Kowal joins the Division of Undergraduate Programs and Student Success at the Cullen College as a lecturer. She is a freelance editor with BioScience Writers, a company providing writing and editorial services to scientists.

Previously, she worked as a scientist and a team leader at Base Pair Biotechnologies Inc.

Kowal has a Ph.D. in biomedical engineering from Cornell University and a bachelor's degree in bioengineering from Oregon State University.

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

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

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

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

Kristin Schaefer is now a lecturer with the Division of Undergraduate Programs and Student Success at the Cullen College. She is the owner and project engineer of Schaefer Engineering, established in 2013.

Prior to coming to UH, Schaefer also worked as a teacher with the Katy Independent School District. She taught project-based engineering and manufacturing courses with KISD's Career and Technology (CTE) Department.

Schaefer earned her bachelor's and master's degrees in mechanical engineering from Texas A&M University. She is the co-author on six U.S. patents.

Cullen College of Engineering's Wei-Chuan Shih

ELECTED TO FIRST CLASS OF NAI SENIOR MEMBERS

BY JEANNIE KEVER

Wei-Chuan Shih, associate professor of electrical and computer engineering, has been named a senior member of the National Academy of Inventors in recognition of his contributions to scientific and technological innovation. Shih was named to the inaugural class of NAI senior members, a new category created to recognize active faculty members, scientists and administrators who have had success in patents, licensing and commercialization. Mark Clarke, associate provost for faculty development and faculty affairs, was also named a senior member.

Senior members also are recognized for fostering a spirit of innovation within their institutions, while educating and mentoring the next generation of inventors.

Amr Elnashai, vice president of research and technology at UH, said the new category captures the range of innovation activities at the University.

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

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

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

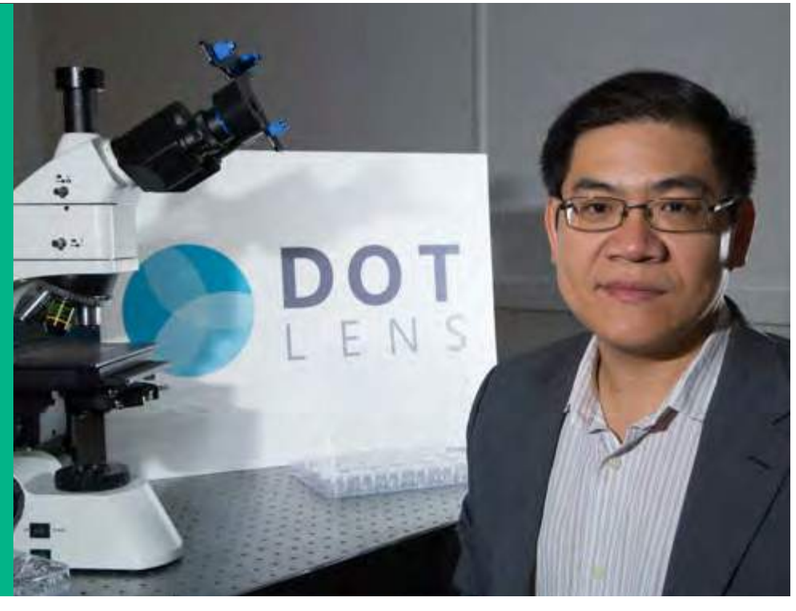
Shih, whose NanoBioPhotonics Group focuses on developing new sensing and imaging techniques, has been granted 11 U.S. patents. The group has developed a number of technologies and devices with applications in fields including biomedicine and environmental testing. He has a broad IP portfolio, including a non-invasive glucose sensor developed at MIT, an offshore oil spill sensor developed at Schlumberger and plasmonic nanophotonic sensors and materials developed at UH.

He and a group of students gained attention in 2015 with the creation of an optical lens that could be used to convert an inexpensive smartphone to a microscope for less than a nickel a lens. They started a company, DotLens, to produce and distribute the lenses, and their paper detailing the manufacturing process became the most downloaded paper of the year in the *Journal of Biomedical Optics*.

The researchers subsequently used funding from a NSF citizen science initiative to develop the technology into a test kit that consumers could use to test water for lead and other pathogens.

Shih, whose NanoBioPhotonics Group focuses on developing new sensing and imaging techniques, has been granted

11 U.S. PATENTS



ASCE RECOGNIZES UH CIVIL ENGINEERING RETIREE

With Service Award

BY RASHDA KHAN

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

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

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

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

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

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

Rogers created a similar legacy of service and dedication during his 43-year career at the UH Cullen College of Engineering. He taught from 1970 to 2013 and graduated four Ph.D. students and advised 21 MSCE thesis-track graduate students from 1974-2003, with several other MSCE and MCE students to 2012.

He was honored for his outstanding concurrent service as faculty advisor to four UH student organizations — ASCE, Omicron Delta Kappa, Tau Beta Pi and Theta Tau.

From 1971 to 2001, Rogers authored and co-authored 60 papers and publications, gave 49 research presentations from 1968 to 1991, and presented 26 invited seminar presentations.

Rogers also participated in UH research contracts from NASA, Harris County Flood Control District, City of Houston, City of Conroe, City of Pearland and U.S. Community Service.

Other accolades earned by Rogers include: the 1974 Texas Young Engineer of the Year Award from the Texas Society of Professional Engineers San Jacinto Chapter; the 1996 Engineer of the Year Award from the Texas Society of Professional Engineers and Engineers Council of Houston; the ASCE William H. Wisely American Civil Engineer Award in 1997; ASCE Texas Section Lifetime Service Award in 2008; ASCE Civil Engineering History and Heritage Award in 2010; and the 2011 Lifetime Achievement Award from the Environmental and Water Resources Institute of the ASCE. He received a Service to the Academy award from the AAWRE in 2018.

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

- JERRY ROGERS

UH Chemical Engineering Chairman

WINS SWCS AWARD FOR APPLIED CATALYSIS

BY RASHDA KHAN

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

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

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

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

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

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

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

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

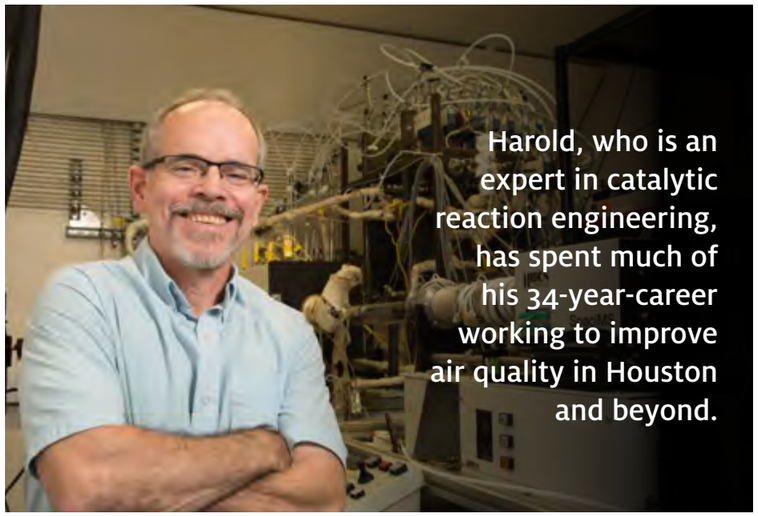
Harold added that being a professor in chemical engineering in Houston and the Gulf Coast where energy is king and the chemical industry is thriving has definite perks. "It really helps the students see how their work is making a difference by interacting with these collaborators from industry," he said.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

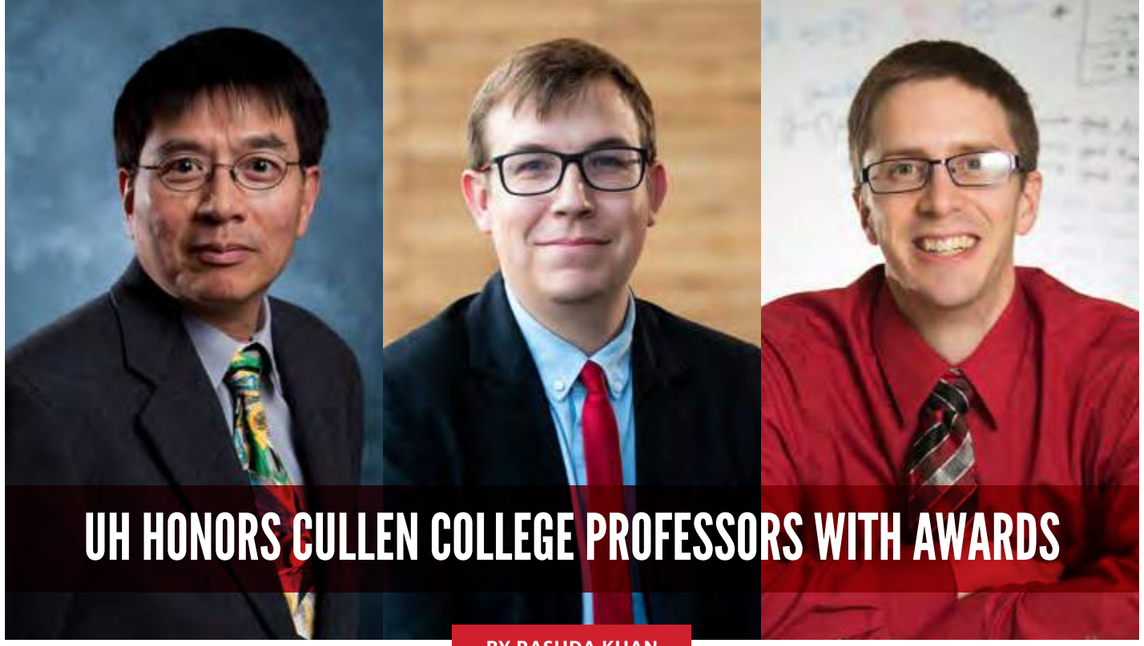
He earned his doctorate in chemical engineering from the Cullen College in 1985, studying under the guidance of his now-colleague Dan Luss. After graduating, Harold took a faculty position at the University of Massachusetts at Amherst, where he became a tenured associate professor. However, he wanted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

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

Past accolades include being elected a fellow of the American Institute of Chemical Engineers (AIChE) on 2014 as well as the University's most prestigious faculty honor – the Esther Farfel Award in 2013 among numerous other research and teaching awards.

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





UH HONORS CULLEN COLLEGE PROFESSORS WITH AWARDS

BY RASHDA KHAN

Each spring, the University of Houston recognizes the best and brightest faculty members, honoring them with teaching and research awards. This year three members of the Cullen College of Engineering community earned distinctions. Read more about them below:

Yi-Lung Mo, professor of civil and environmental engineering at the UH Cullen College of Engineering, won a prestigious 2019 John and Rebecca Moores Professorship.

The Moores Professorship is a University-level honor awarded annually to UH faculty members who have made outstanding contributions in research, teaching and service. Each Moores Professor receives a $10,000 annual stipend and the professorship is renewable every five years.

"I enjoy all my work – research, teaching and service on the international, national and local level. But research is my heartbeat," said Mo, who owns nine patents.

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

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

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

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

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

He also appreciates the diversity on campus.

"My students come from all over the world, from many different countries," Mo said. "I like to talk to my students and brainstorm with them. Everyone thinks in different ways and it helps broaden my mind and ideas."

Other Cullen College faculty honored by various University awards are:

Daniel Burleson, instructional assistant professor at Cullen College, won a Teaching Excellence Award in the Instructor/Clinical category. This award honors outstanding teaching effort.

Aaron Becker, professor of electrical and computer engineering, won an Undergraduate Research Mentoring Award. This award recognizes faculty – with at least five years mentorship involvement – making a significant impact in their field by supporting and mentoring undergraduate students in research and scholarship. Becker, a robotics expert, is known for his work with millirobots – millimeter-sized robots – and drones.

Cullen College Faculty

WIN UH RESEARCH AWARDS

Two Cullen College of Engineering faculty won the University of Houston's Awards for Excellence in Research, Scholarship and Creative Activity for the 2018-19 academic year. **Hadi Ghasemi** was recognized in the Assistant Professor category and **Peter Vekilov** was honored in the Professor category.

The awards, given each year by the UH Division of Research, recognizes faculty with a growing record of outstanding research, scholarship and creative contributions, who are emerging leaders in their fields.

Hadi Ghasemi, Bill D. Cook associate professor of mechanical engineering, is renowned for his work involving innovative materials and icephobicity. Earlier this year, he and his collaborators announced a research breakthrough where they created a durable silicone polymer coating capable of repelling ice from any surface based on a new theory in physics called stress localization.

The new material uses elastic energy localization where ice meets the material, triggering cracks at the interface that slough off the ice. The material, which is applied as a spray, can be used on any surface. Testing indicates it will last for more than 10 years, with no need to reapply.

Previously, Ghasemi created a biologically-inspired anti-icing material that can withstand critically low temperatures. The material – which is applied to surfaces as a coating – was one of three winners of the NASA iTech competition in 2017.

The anti-icing coating was inspired by the tiny North American wood frog, a creature that can freeze up to 65 percent of its total body water without dying. NASA chose Ghasemi's project from entries submitted by over 130 organizations across the U.S.


Hadi Ghasemi

for its potential to broadly impact human life on earth and the future of space travel.

Once Ghasemi had plenty proof of concept for his novel material, he partnered with students in his Nano Therm lab to launch the startup SurfEllent and began marketing the product to consumers.

Other materials created by Ghasemi and his research team include a new magnetic slippery surface (MAGSS), which can be applied to any surface – ceramic, polymers or metals. While pursuing postdoctoral work at the Massachusetts Institute of Technology (MIT), he is credited with creating a low-cost graphite "solar sponge" to convert sunlight into steam for potable water.

He runs the UH Nano Therm Lab that explores research in the field of thermodynamics, heat transfer, and nanotechnology.

Peter Vekilov, John and Rebecca Moores Professor of chemical and biomolecular engineering and chemistry, discovered the two-step nucleation mechanism – called the Vekilov mechanism – where crystal nuclei form inside pre-existing dense liquid droplets. The impact of this finding will allow biomedical researchers to gain a better understanding of how pathogenic crystals of proteins and small molecules form in the body.

His research in the pathological mechanism of malaria has an unmatched potential to break through in the fight against malaria. He identified the atomic structure of the hematin crystal surface sites that are available for interaction with different drugs, allowing for molecular-level modeling of the action drugs as well as screening for new candidate molecules. In a recent publication in the *Proceedings of the National Academy of Sciences*, Vekilov described three different pathways whereby antimalarial drugs suppress the crystallization of hematin and proposed the first molecular mechanisms for cooperativity between drug molecules. He also proposed, synthesized and tested a new drug possibility with the potential to treat strains of parasites that are resistant to current treatments. All of this work was enabled by Vekilov's foundational work on nucleation and crystal growth, and could impact the lives of billions of people.

In recent years, Vekilov has focused on the nucleation and growth of amyloid fibrils. Fibrils and certain oligomers have been implicated as the main carrier of neurotoxicity in Alzheimer's disease. Work by the Vekilov group, published in *iScience*, has identified a new phase of the protein p53, mesoscopic p53 rich oligomers, that serve as loci for the nucleation of the amyloid fibrils. Vekilov and his students characterized the transition state for growth of A beta fibrils that is crucial for the understanding of the action of potential drugs that suppress amyloid aggregation.

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

Both professors were honored at the Faculty Excellence Award Dinner at the Hilton University of Houston last April.


Peter Vekilov

2019 Cullen College Outstanding Service Awards

College Awards

Michael Nikolaou (ChBE)
Fluor Corporation Faculty Excellence Award

Kalyana Nakshatrala (CEE)
W.T. Kittinger Teaching Excellence Award

Fritz Claydon (ECE)
Career Teaching Award

Miguel Fleischer (ChBE)
William A. Brookshire Teaching Excellence Award

Daniel Burleson (Office of the Dean)
William A. Brookshire Teaching Excellence Award

Teaching Excellence Awards

Dong Liu (ME) — Associate professor

Farah Hammami (ME) — Instructional faculty

Kevin Ding (ECE) — Adjunct faculty/lecturer

Kosar Mozafarri (ME) — Teaching assistant

Amirhossein Najjarbashi (IE) — Teaching assistant

Research Excellence Awards

Jae-Hyun Ryou (ME)
Senior Faculty Research Award

UH Professor Invited to NAE's

U.S. FRONTIERS OF ENGINEERING SYMPOSIUM

BY RASHDA KHAN

Rose T. Faghih, assistant professor of electrical and computer engineering at the UH Cullen College of Engineering, received an invitation to attend the prestigious 2019 U.S. Frontiers of Engineering Symposium. The event was held Sept. 25-27 in Charleston, South Carolina.

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

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

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

Faghih expressed her excitement about attending the symposium.

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

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

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

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

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

"Not only will I be learning about a broad spectrum of pioneering technical works and advances, I will meet brilliant minds from various engineering fields and sectors," Faghih said. "I am enthusiastic about the possibility of starting new collaborations. This experience will enable me to formulate research problems that could change the world and improve the lives of individuals across the globe."

Faghih received an M.S. and Ph.D. in electrical engineering and computer science from the Massachusetts Institute of Technology (MIT) in 2010 and 2014, respectively. She joined the Cullen College faculty in 2017.

IEEE-USA and DiscoverE Foundation selected Faghih as one of the 2016 New Faces of Engineering, an award for engineers aged 30 years or younger.

Faghih was nominated by **Kaushik Rajashekara,** distinguished professor of electrical and computer engineering at the Cullen College and an NAE member. He is also the head of the Cullen College power and energy systems program and director of the Power Electronics, Microgrids and Subsea Electrical Systems (PEMSES) laboratory.

This is a unique opportunity to learn about new real-world technologies related to three topics highly related to my research: advanced manufacturing in the age of digital transformation, self-driving cars and genome engineering.

- ROSE FAGHIH

UH Civil and Environmental Engineering Chairman

WINS 2019 MINDLIN MEDAL

BY RASHDA KHAN

Roberto Ballarini, Thomas and Laura Hsu Professor and chairman of the department of civil and environmental engineering at the UH Cullen College of Engineering, is the recipient of the 2019 Raymond D. Mindlin Medal from the American Society of Civil Engineers (ASCE).

Established in 2008, the award recognizes outstanding research contributions to applied solid mechanics. The ASCE's Engineering Mechanics Institute (EMI) selected Ballarini for "the application of elasticity and fracture mechanics to problems in numerous disciplines and at multiple length scales, and for seminal contributions to experiments for measuring the mechanical properties of materials and structures at micro and nano length scales."

The medal is named for Raymond D. Mindlin, who was a professor at Columbia University and is best known for his pioneering contributions to applied mechanics.

"The Mindlin Medal is particularly special to me because Raymond Mindlin, one of the great mechanicians of the 20th century, was my academic great-grandfather. That is, he was the advisor of the advisor of my advisor," Ballarini said.

He added that he was surprised and humbled by the award because "past winners include leading scholars whose seminal contributions to mechanics have inspired my own research and teaching."

Ballarini earned his bachelor's degree in civil engineering from the City College of New York, and his master's and doctoral degrees – also in civil engineering – from Northwestern University.

Although his primary background is in the mechanics of materials and structures, Ballarini's research spans a wide range of topics, including advanced composites, microeletromechanical systems, natural and synthetic nanostructures, biological structures, aerostructures, applied mathematics and prosthetics.

"Early on in my career I decided not to work on one specific topic," Ballarini said. "Instead, I decided to adopt a multidisciplinary approach and to pursue interesting problems in many different fields."

Ballarini, who joined UH in 2014, said he most enjoys teaching and working with students.

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

Ballarini received the medal at the ASCE's EMI 2019 Conference in June in Pasadena, California.

Established in 2008, the award recognizes outstanding research contributions to applied solid mechanics.

UH Mechanical Engineering Chairman Honored With

ASME CHARLES RUSS RICHARDS MEMORIAL AWARD

BY RASHDA KHAN

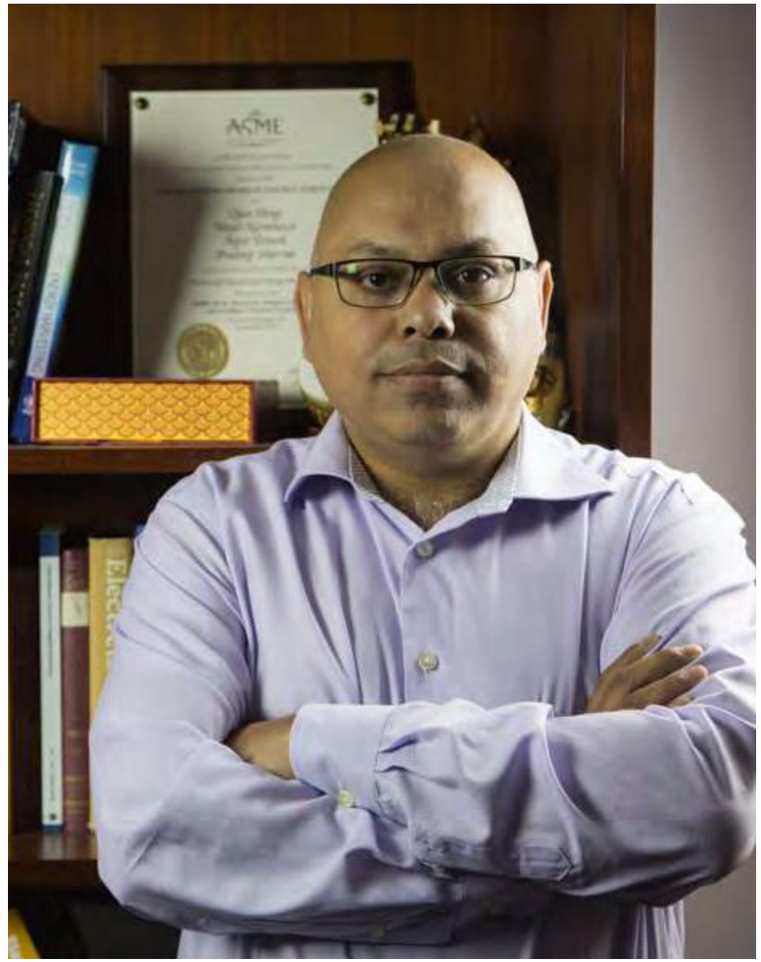
Pradeep Sharma, M.D. Anderson Professor and chairman of the mechanical engineering department at the UH Cullen College of Engineering, is having a good year. He received the 2019 James R. Rice Medal from the Society of Engineering Science (SES) earlier this year and was recently selected to receive the 2019 Charles Russ Richards Memorial Award from the American Society of Mechanical Engineers (ASME).

The prestigious award is presented to an engineering graduate who has demonstrated outstanding achievement in the mechanical engineering field 20 years or more after graduation. ASME is recognizing Sharma for pioneering achievements in using theoretical and computational methods to material behavior as well as leadership in the scientific community.

"This recognition is a singularly humbling experience and once again, I credit it to the wonderful students, post-docs and collaborators I have had," Sharma said.

His research group at the Cullen College uses theoretical and computational methods to understand physical phenomena across multiple disciplines – from materials science to biology. Recent research highlights include the designing of soft multifunctional materials, elucidating why some animals can detect magnetic fields, time-scaling in atomistic simulations and assessing the mechanical behavior of materials used for energy storage.

Sharma graduated with a B.S. in mechanical engineering in 1994 from the University of Baroda (India) and then earned his Ph.D. at the University of Maryland at College Park in 2000. Subsequently, he worked as a research scientist for General Electric Corporate R&D. He joined the department of mechanical engineering at the Cullen College in 2004 as a tenure-track assistant professor and has been the chair of the department since 2012.



In addition to several UH teaching and research awards, his past accolades include the 2015 Melville Medal from the ASME and a Fulbright Award in 2013.

Sharma appreciates the support of the Cullen College of Engineering and his department. "I was very fortunate to have been hired into what is arguably one of the most collegial and friendly department in the University. We often underestimate how much our colleagues contribute to our success," he said. "I am very appreciative of the college leadership who have been nothing but supportive in my research despite the administrative expectations, as well as my colleagues who are always willing to help in ways small and large."

The award comes with $1,000, a travel supplement and a commemorative certificate. Sharma will receive the award at the ASME's International Mechanical Engineering Congress and Exposition in November in Salt Lake City, Utah.

Phaneendra Kondapi

UH Engineering Faculty Earn
INTERNATIONAL RECOGNITION FROM SOCIETY OF PETROLEUM ENGINEERS

BY RASHDA KHAN

The Society of Petroleum Engineers (SPE) recognized two UH Cullen College of Engineering faculty members with major international awards.

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

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

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

Kondapi is an active member of SPE. He was a founding member and chairman of the SPE Flow Assurance technical session in 2015. That same year, he also chaired the SPE "Flow Assurance: Future State of the Art" global forum. He continues to serve on various SPE committees and has organized and chaired over 45 technical sessions at various conferences.

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

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

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

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

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

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

During a career with Chevron that spanned 37 years, Thakur served in various roles including vice president and global advisor and Fellow. Serving as the highest level technical professional across the entire corporation with over 50,000 employees, he led teams in the design of several key deep water offshore, shallow water offshore and onshore major capital projects involving billions of dollars of capital expenditures, which successfully created significant values for the company through hundreds of million barrels of reserves and hundreds of thousand barrels of production. He also served as chairman of the Corporate Reservoir Management Forum, focusing on the development of oil and gas projects and surveillance, analysis and optimization of projects, and sharing best practices and lessons learned from projects around the world. He actively participated in corporate reserves reviews of various oil and gas assets around the world for 15 years.

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

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

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

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

He offered some advice for Cullen College students:

- Develop a positive attitude and "can do" approach. Be persistent, stay focused, use your time effectively, respect others and embrace diversity.
- Our industry has seen many ups and downs and it has affected all of us in some ways. But the outlook for the future of the oil and gas industry and energy in general is bright and healthy. I see a robust oil and gas industry in the future. We should focus on describing the value of our profession to society, such as providing energy for light, heating, air conditioning, driving, running machines, airplanes, etc. It's important to continue exploring, drilling, producing, refining and transporting oil, gas and derivative products for a variety of usage, while taking care of the environment and focusing on safety and social responsibility. If we stop these activities, the whole world will come to its knees. What we do is an integral part of our society, and today's young engineers and scientists are going to play an even more important role than my generation played.
- I would encourage young professionals and college students to continue to stay active, take leadership roles and continue to develop themselves as this is a very important industry, and it is going to be here for many more years.

SPE is the largest not-for-profit professional association whose members are engaged in energy resources development and production. It serves more than 168,000 members in 144 countries worldwide. SPE is a key resource for technical knowledge related to the oil and gas exploration and production industry and provides services through its publications, events, training courses and online resources at www.spe.org.

National Academy of Engineering Member

WINS IEEE ACHIEVEMENT AWARD

BY RASHDA KHAN

Kaushik Rajashekara, distinguished professor of electrical and computer engineering at the Cullen College of Engineering and a member of the National Academy of Engineering (NAE), is the winner of the 2019 IEEE PELS Vehicle and Transportation Systems Achievement Award presented by the Institute of Electrical and Electronics Engineers (IEEE)'s Power Electronics Society (PELS).

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

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

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

Early in his career at General Motors/Delphi, Rajashekara was a member of the team that helped develop the General Motors EV1, the first mass-produced electric car from a major automaker. As chief scientist, he continued to develop and advocate for electric, hybrid and fuel cell vehicle propulsion systems. He then served as chief technologist at Rolls-Royce, where he worked on advanced architectures for more electric and hybrid electric aircrafts. During this time, Rajashekara also investigated strategies for electric taxiing of airplanes, flying trucks and powering drones.

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

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

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

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

UH Engineering Community

MOURNS PROFESSOR EMERITUS KAMEL SALAMA

BY RASHDA KHAN

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

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

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

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

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

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

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

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

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

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

UH Graduate Student Wins

ACS AWARD FOR ENVIRONMENTAL CHEMISTRY

BY RASHDA KHAN

Bo Cao, a doctoral candidate in environmental engineering at the UH Cullen College of Engineering, won a 2019 Graduate Student Award in Environmental Chemistry from the American Chemical Society (ACS). ACS makes up to 20 such awards annually.

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

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

His faculty advisor is **Yandi Hu,** associate professor of civil and environmental engineering. "I'm very grateful for her mentoring and support," Cao said. "Without her efforts in the past four years, I wouldn't have earned this award."

The awardees receive a cash prize and membership in the Environmental Division for one year. They are also publicized in the ACS newsletter, *EnvirofACS*, and the journal *Environmental Science and Technology.* More importantly, the award recognizes the students' "potential for future contributions as professionals in environmental chemistry."

Cao's research focuses on reducing the mineral scaling during the reverse osmosis filtration process, which is used in seawater desalination. Reduction of the scaling can improve the efficiency of the desalination and lower the cost of producing potable water from seawater.

"This is very important as it can help alleviate water scarcity in the world and help meet the increasing demand for drinking water around the globe," Cao said.

UH Students and Alumni Earn Prestigious

NSF GRADUATE RESEARCH FELLOWSHIPS

Seven current and former University of Houston students – two of whom represent the Cullen College of Engineering – have earned highly coveted National Science Foundation (NSF) graduate research fellowships.

The fellowships recognize outstanding graduate students in NSF-supported science, technology, engineering and mathematics (STEM) who are pursuing research-based masters and doctoral degrees at accredited U.S. institutions. Fellows benefit from a three-year annual stipend of $34,000 along with a $12,000 cost of education allowance for tuition and fees.

"Winning the most competitive graduate fellowship competition in the USA is a testament to the innovative thinking of our graduate students and the depth and breadth of their educational experience at UH," said Amr Elnashai, vice president for Research and Technology Transfer. "NSF graduate fellows contribute to shaping the new innovation ecosystem, and UH students will no doubt make their mark on their respective fields."

The NSF fellowship has been credited with inspiring recipients to become life-long influencers who contribute meaningfully to both scientific innovation and teaching. Many Nobel Laureates are past fellows as are Google Co-founder Sergey Brin and Freakonomics co-author Steven Levitt.

The Cullen College graduate recipients are:

Faheem Ershad

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

Audrey Wang

Wang graduated in May from UH with a bachelor of science in electrical engineering. Her research focused on using high performance computing to investigate structure-function relationships in solid-state electrolytes for applications in solid-state batteries. Wang has declined the NSF award and will join the automation company ABB, which operates in robotics, power, heavy electrical equipment and automation technology.

UH Engineering Student Wins

ASCE HAWLEY MEMORIAL FELLOWSHIP

BY RASHDA KHAN

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

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

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

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

Worldwide population growth has fueled industrialization and pollution, which in turn have caused a water crisis for 1.2 billion people and the situation is worsening, Ansari said. The number of affected peopled is projected to rise to 3.9 billion in the next decade according to the World Water Council, he pointed out.

"With a small amount of freshwater available, desalination is one of the most promising technologies to provide an infinite, uninterruptible and reliable source of clean water," Ansari said.

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

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

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

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

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

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

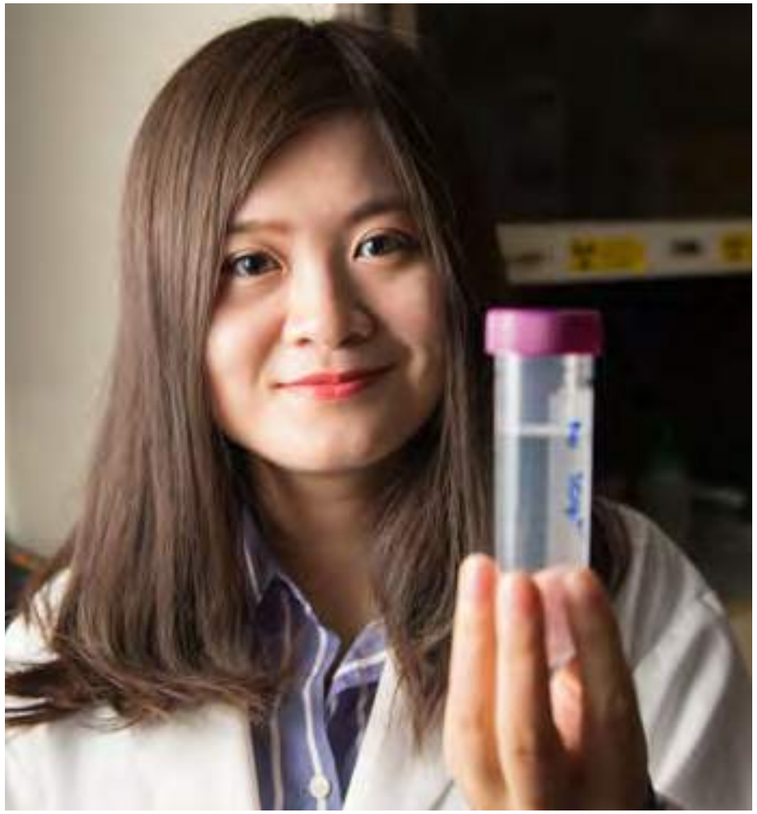
In addition to his research, Ansari has also led an undergraduate team in the 2017 Campus Rainworks Challenge, which is the U.S. Environmental Protection Agency's annual national competition to engage college students in the design of on-campus green infrastructures to address stormwater pollution. His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

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

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

"By understanding the fundamentals of the interaction between the biological and chemical components, I hope to pave the way to develop desalination systems with less fouling and more water recovery."

- ALI ANSARI



> *My research has enormous implications for the removal of heavy metals, scales formation control and well-controlled materials used in various industrial applications.*
>
> - CHONG DAI

Cullen College Alumna Scores
PRESTIGIOUS CHINESE GOVERNMENT AWARD

BY RASHDA KHAN

Chong Dai, who earned a Ph.D. in environmental engineering from the UH Cullen College of Engineering, was awarded a 2019 Chinese Government Award for Self-financed Students Abroad.

Given by the China Scholarship Council, this competitive award is presented to only 500 students worldwide each year. She will receive a $6,000 cash prize and a certificate.

"The growing global population and increasing personal energy consumption brings with them critical energy shortage and related environmental challenges," Dai said. "I would like to solve these problems."

Dai graduated from UH in May 2018 and her doctoral dissertation – titled "Heterogeneous Nucleation and Growth of Nanoparticles Under Environmentally Relevant Conditions"– won first place in the Department of Civil and Environmental Engineering's Best Dissertation Award.

"My research has enormous implications for the removal of heavy metals, scales formation control and well-controlled materials used in various industrial applications," Dai said. While at UH, she worked with **Yandi Hu,** associate professor of civil and environmental engineering.

"I would like to give special thanks to my advisor, Professor Yandi Hu," Dai said. "She offered great help and advice in regards to my research, award application, my Ph.D., life and my future career."

After earning her doctorate, Dai served at the National Science Foundation (NSF) as an entrepreneur lead for Team 1191 lead detection, part of the NSF Innovation Corps. The program prepares scientists and engineers with entrepreneurial training to move towards commercialization of scientific projects that emerge from academic research.

Currently, Dai works as a postdoctoral research associate at Rice University. She does barite and calcite inhibition testing and modeling under simulated oilfield conditions.

Established in 2003, this award aims to encourage research excellence and recognize the achievements of Chinese students abroad. Awardees are selected based on their research achievements and academic merit after several rounds of judging by invited experts in the field.

It is considered to be the highest honor awarded by the Chinese government to graduate students studying abroad.

CULLEN COLLEGE STUDENT WINS BIG
in Scholarships and Opportunities

BY RASHDA KHAN

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

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

She won scholarships from BP, the Society of Women Engineers (SWE), the National Society of Black Engineers (Houston chapter), AACE International (originally the American Association of Cost Engineers), the UH Cougar Athletic Alliance, the UH Urban Experience Program, the UH Honors College and from the University of Houston Foundation.

"These scholarships helped pay for my classes and allowed me to participate in more extracurricular activities," Akinwande said. "It's been a very exciting year for me."

Akinwande has been using her time to make the most of other opportunities and build a cache of experiences. She landed a spring co-op with Marathon Petroleum Corp. after attending the UH Engineering Career Fair last fall.

"It's been really exciting to apply some of the basic concepts I learned in my chemical engineering classes to actual processes," she said.

She also attended the SWE annual conference in Minneapolis in 2018 and is looking forward to starting her internship with Shell this summer.

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

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

What's next for Akinwande?

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

Meanwhile, she shared some advice for other students.

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

Akinwande, who is a UH Honors student and a regular on the dean's list, applied for several scholarships in 2018. As a result, she won

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Record Number of UH Engineering Students

HEADED TO GERMANY FOR RESEARCH AND ADVENTURE

BY RASHDA KHAN

Eight University of Houston students – all from the Cullen College of Engineering and the Honors College – won 2019 DAAD RISE research scholarships and an opportunity to work at top German universities and research institutions last summer.

Established in 2005, the highly competitive program is sponsored by the German Academic Exchange Service, Germany's publicly funded but independent organization of higher education institutions, known by its German initials as DAAD. RISE stands for Research Internships in Science and Engineering.

DAAD RISE summer internship opportunities are offered to undergraduates from the United States of America, Canada, United Kingdom and Ireland. About 300 scholarships are available each year. This year, the program received 1,901 applications and accepted 318 students.

"The DAAD RISE Program is an exciting, fully-funded opportunity for undergraduates to receive both research and international experience during the summer," said Ben Rayder, director of national fellowships and major awards at the UH Honors College. "In the last two years, UH has seen a spike in recipients – from three to eight, which has been made possible through the collaborative efforts of the Honors College and the Cullen College of Engineering."

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

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

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

Meet the University's 2019 DAAD-RISE scholars

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

Christopher Hixon, a mechanical engineering senior, worked at the Karlsruhe Institute for Technology. He chose his major because he wanted to build fast cars and he was excited to be working on optimizing leaf spring suspensions, which is a key part of the automotive industry's goal to reduce the weight on every component of vehicles while maintaining strength, performance and reliability.

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

Vincent Laroche
Research Project:
Recycling Processes of Fibrous Particles

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

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

Mary Olear
Research Project:
Blockchain Technology in Supply Chain Management

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

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

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

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

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

Jesus Silva Rodriguez
Research Project:
High Voltage Engineering in the Field of Future Energy Grids in Key Technology HVDC Transmission

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

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

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

Joshua Tran
Research project:
Cleaning Mechanisms in Food Processing Plants

Joshua Tran, a first-generation college student and chemical engineering major worked at the Technical University of Braunschweig on optimizing cleaning strategies for food processing plants.

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

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

UH Engineering Doctoral Student

PUBLISHES IN NANO ENERGY

BY RASHDA KHAN

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

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

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

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

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

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

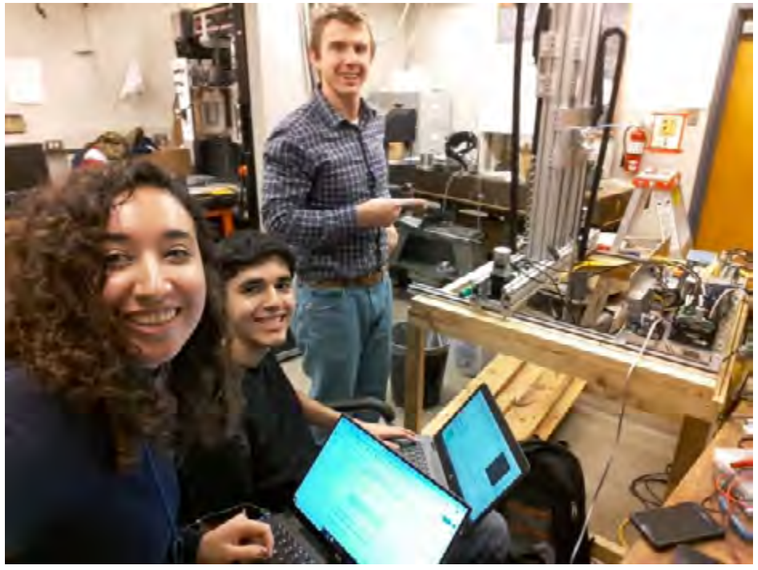
The article shares research that demonstrates the capability of harvesting biomechanical energy using a high-durable and biocompatible material, called III-nitride thin film, in flexible piezoelectric generators.

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

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

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

> *"It would be really amazing if one day we could have electronics that work forever – without the need for charging or replacing the batteries. Energy harvesting from biomechanical energy is one of the promising approaches to make this a reality."*
>
> - JIE CHEN



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

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

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

Each year NASA and the National Institute of Aerospace sponsor RASC-AL – short for Revolutionary Aerospace Systems Concepts-Academic Linkage. This is the second year for the RASC-AL Special Edition: Moon to Mars challenge. The aim of the challenge is to spur technology innovations to facilitate human missions on the surface of the moon or Mars.

The other finalists include teams from: Carnegie Mellon University, Colorado School of Mines, Massachusetts Institute of Technology (MIT), Northeastern University, Stevens Institute of Technology, University of Tennessee Knoxville, University of the District of Columbia, Virginia Polytechnic Institute and State University and West Virginia University.

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

The importance of the mission

Water is a necessity for human survival – this is as true in deep space as it is on Earth.

"Follow the water" is a guiding principle of space exploration and an essential part of NASA's plan to send people back to the Moon by 2024 and then onto Mars.

"This project is working on a device that could play a critical role in the next major step in space exploration, focusing on Mars and the Moon," said Metcalfe, adding the presence of ice and/or water on both of these celestial bodies has been confirmed.

> "Water can be used to create liquid oxygen and liquid hydrogen, which are the most efficient rocket propellants known today. Thus, on trips to Mars or the moon, it wouldn't be necessary to bring along rocket fuel for the return trip, as the Apollo Lunar astronauts in the 1970's had to do at very great expense."
>
> - RALPH METCALFE

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

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

In addition to the $10,000 stipend from NASA, the team garnered several corporate sponsorships. Control Flow Inc., Cosine Additive and ANKO Products Inc. made extensive in-kind donations of materials and parts for the project.

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

Meet the team

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

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

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

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

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

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

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

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

"The team came with a strong sense of what would be needed to implement and execute their project in terms of resources, skills, and knowledge," she said. "How to actually realize their design was an integral part of their design and planning phase."

Chang was so impressed with the team's work that she had The Phoenix present a technical poster about the project earlier this year to the Engineering Leadership Board, an advisory body for the Cullen College comprising leaders from industry, education and other sectors.

"What excites me most about their project is how well they've been able to demonstrate the potential of our UH engineering students to excel and compete with other top engineering programs in the nation," Chang said. "They are a team of only four students (with families and jobs), the other national finalists are much larger teams and some are repeat competitors. My hope is that they will be able to inspire more UH students to take the step to compete on the national level."

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

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

The UH Phoenix team – Andrew Advani, Sharlyn Tijerina, Jacob Frady and Joseph Pauwels with the Planetary Ice Extractor (PIE). The team was a finalist in the NASA's 2019 Special Edition: Moon to Mars Ice & Prospecting Challenge.

PARTNERING WITH INDUSTRY

BY RASHDA KHAN

Chemicals Giant Ineos Visits With UH Engineering Students

The UH chapter of Tau Beta Pi – Texas Epsilon (TBP) recently hosted an information session with representatives of INEOS, a global manufacturer of petrochemicals, specialty chemicals and oil products. The INEOS presenters included Bob Sokol, chief financial officer of INEOS Oligomers and Oxide; Fred Rulander, chief operating officer of INEOS Oxide North America; Matt Abraham, university sponsor and

business development director; and Joel Roberts, lead recruiter.

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

The highlights of the presentation included the growth of the private company, hiring practices and professional growth opportunities within the company. "The INEOS engineers present described their ability to do anything they put their minds to in the company – from working in the plants to making important decisions in the financial sector," said **Pietro Antonio Cicalese,** a master's student in biomedical engineering at and spokesman for TBP.

> "We saw their business philosophy as a parallel to what we want to do at TBP (Tau Beta Pi): bring engineers to the forefront of the modern world, not just as the mighty problem solvers that we are, but as the strong and ambitious leaders we are meant to be. The company representatives explicitly expressed their interest in creating a program with TBP at UH."
>
> - PIETRO ANTONIO CICALESE

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

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

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

Cullen College Graduate Students Visit Tenaris

UH Cullen College of Engineering graduate students who took the SUBS 6349 Subsea Materials and Corrosion course wrapped up their spring 2019 semester with a field trip to Tenaris, a leading supplier of tubes and related services for the world's energy industry and certain other industrial applications.

The tour was an interactive way to learn about materials, corrosion and other topics covered in the course, said Cullen College lecturer **Yolanda De-Abreu**. The students got an in-depth introduction to coil tubing, which is widely used in the oil and gas industry. Cliff West, maintenance coordinator at Tenaris, explained basic concepts of coil tube fabrication, microstructure-property relationships and testing.

UH Cullen College of Engineering Helps

GROW A NEW GENERATION OF RESEARCHERS

BY RASHDA KHAN

STUDENTS

Undergraduates from all across the nation spent 10 weeks this summer at the Cullen College of Engineering and the BRAIN Center at the University of Houston gaining research experience, learning valuable lessons and building their academic careers.

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

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

"Entering the program, I was unsure if research was right for me or if I would enjoy industry more. Essentially, I was using this experience to determine the right path for me," said Jackson Levine, a senior at Tulane University double majoring in biomedical engineering and neuroscience with a minor in music.

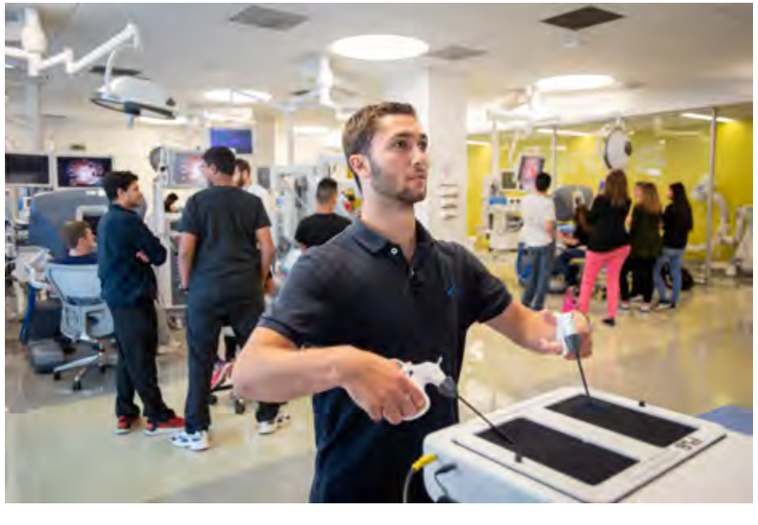
"I learned that research is my passion and I can confidently say that, after this REU, I plan to pursue a Ph.D. in the field of neurotechnology," said Levine, who worked on a research project investigating the use of vibrations to improve the gait of people suffering from Parkinson's disease, spinal cord injuries and other similar chronic conditions.

He was excited about contributing to his first research paper. "I actually got to click the button to submit the paper. This [is] the first of hopefully many papers, so I will remember that moment," Levine said.

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

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

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



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

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

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

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

Turcheck had the opportunity to work with **Jose Luis Contreras-Vidal,** who is a professor of electrical and computer engineering and the director of the Building Reliable Advancements in Neurotechnology (BRAIN) Center at UH. The BRAIN Center, a collaboration among Arizona State University, the University of Houston and industry members, was officially funded in 2017 with a $1.5 million grant from the National Science Foundation. Its mission is to develop safe, effective and affordable personalized neurotechnologies.

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

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

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

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

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

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

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

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

- Do your research. Find a lab investigating a subject that deeply interests you. But more importantly, love the research environment and the people around you. This is an opportunity to learn and make incredible connections.
- Stay open to new opportunities in research, even if they don't align with your current interests. Venturing into a new field can open you up to a new passion.
- Participate in an REU program even if you are not considering academic research as a career. It can help hone your technical skills in the field and your ability to be self-sufficient in a work setting.

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

UH Cullen College Alumnus

MIGUEL GONZALEZ

Leads UHCL’s College of Science And Engineering

BY RASHDA KHAN

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

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

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

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

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

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

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

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

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

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

But his driving force is student success.

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

He paused for a moment of reflection. “I lived it as a student within the UH System and I was mentored in such a way that we were able to do some very good things,” Gonzalez said. “I know this is going to be pretty much in that tenor.”

Cullen College Alumna Conducts

FULBRIGHT RESEARCH IN GERMANY

BY RASHDA KHAN

Megan Goh (BSBE '18), a 2018-2019 Fulbright grant recipient, is conducting research in Germany. She is studying how and when infantile brain disorders occur in animal models using photoacoustic imaging.

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

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

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

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

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

> "I have been blessed with a lot of opportunities and have nothing but good words for my UH experience."
>
> - MEGAN GOH

Additionally, Goh worked as a biomedical engineering undergraduate fellow in the Biomedical Imaging Optics Lab led by UH professor **Kirill Larin** and served as a Harris Methodist Hospital intern.

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

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

THE GIFT OF KNOWLEDGE

Alumnus Creates Endowed Scholarship For UH Electrical and Computer Engineering Students

BY RASHDA KHAN

Herbert David Hickman (BSEE '59) from Colorado gifted his home to the UH Cullen College of Engineering to establish an endowed scholarship, with preference for electrical and computer engineering students.

"Mr. Hickman was fond of his time at the University of Houston and felt that his engineering education provided him with a solid foundation for a successful career," said **Russell Dunlavy,** assistant vice president of University Development.

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

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

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

> Mr. Hickman was fond of his time at the University of Houston and felt that his engineering education provided him with a solid foundation for a successful career. His legacy will continue to live on through the students [at the Cullen College of Engineering].
>
> - RUSSELL DUNLAVY

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

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

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

"Herbert Hickman's story and generosity is an important part of the UH story – helping working students achieve their dreams," said **Badri Roysam,** Hugh and Lillie Cranz Cullen University Professor and department chairman of electrical and computer engineering.

"His support will allow us to provide scholarships to well-deserving UH students studying electrical engineering, which is a vital profession to help the United States succeed in the competitive global environment of today and the future."

LIENHARD'S LENS

BY JOHN LIENHARD

I offer my photo of a 4-4-0 locomotive: The four small idler wheels in front steer it around bends. The engine drives the four large wheels. And it has no idler wheels behind. Designer Henry Campbell of Philadelphia put it into production in 1839, and it dominated 19th century rail service all the way into the 20th century. People called it the American type of locomotive.

Now here's the zinger: Houston's Great City Seal proudly displays this engine. That seems to make sense. We're America's second largest port; and rail carries most of the freight. The catch is, we adopted that seal just one year after Philadelphia built the first 4-4-0. Rail was scarcely 10 years old in America. Rail had yet to reach Texas. And Houston was certainly no seaport.

Houston was then just four years old. The Allen brothers, John and Augustus, came to the new Republic of Texas in 1836. They bought up 10 square miles of land adjacent to Harrisburg, Texas. Then they set out to form a major city on Buffalo Bayou. We took Sam Houston's name the next year. For a while, we even served as temporary capital of the Republic of Texas.

The Allens proclaimed that Houston would be the region's "great commercial emporium." And Augustus Allen hired the riverboat Laura to make the trip up the Bayou from Galveston in 1837. Buffalo Bayou would now become the watercourse for Galveston's goods. But where to go from here? Rail had to be the answer, and rail was hardly invented

Yet today here sits Houston's seal with its remarkably modern locomotive! We finally did get a locomotive 12 years after the seal. The embryonic Buffalo Bayou, Brazos, and Colorado Railway bought a far more primitive, second-hand 4-2-0 engine, in 1852. They added a 4-4-0 two years later, and we finally had the locomotive that dreamers put on the city's seal 14 years before.

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

VIEW MORE PHOTOS AT
enginespics.smugmug.com

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

EAA AWARDS GALA - 6/6/19

The 2019 UH Cullen College of Engineering Alumni Awards Gala was held at the Bayou City Event Center on Thursday, June 6, 2019. The annual event, hosted by the Engineering Alumni Association (EAA), celebrates the professional achievements and contributions of college alumni and faculty. Honorees included Ryan J. Baird (BSEE '01), Charles N. Grichar, P.E. (BSChE '73), William A. Brookshire, Ph.D. (BSChE '57)†, Carol K. Schmidt, P.E. (BSChE '07), Debora Rodrigues, Ph.D., Heidi Alderman and The Honorable Dennis R. Paul, P.E. (BSCE '86, MSCE '91).

ENGINEERING CAREER FAIR - 9/12/19

Over 100 companies came to the University of Houston campus to recruit engineering students for internship, fellowship and full-time positions at the Engineering Career Fair in September. More than 1,800 UH engineering students attended the fair, many of whom conducted or scheduled interviews with company recruiters. This year's fair attracted sponsorships and recruiters from LyondellBasell, Shell, Schlumberger, ExxonMobil, P&G, Daikin, Ineos, Sulzer, Oxy, Phillips 66, Enterprise Products and many more top companies.

UH OFFSHORE INDUSTRY CRAWFISH BOIL - 5/5/19

UH Engineering kicked off the Offshore Technology Conference at the 31st annual UH Offshore Industry Crawfish Boil held on Sunday, May 5.

Alumni, faculty, students and industry leaders gathered to network and mingle as they enjoyed crawfish, barbecue and live music.

EAA ANNUAL MEETING & NETWORKING SOCIAL - 8/22/19

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

Attendees enjoyed free craft beer, tacos, raffle prizes and updates about the Cullen College throughout the evening.

G.R.A.D.E. CAMP 2019

G.R.A.D.E. Camp, offered twice each summer by the UH Cullen College of Engineering, introduces girls ages 13 to 17 to the wonders of engineering. The week-long camp (named for Girls Reaching and Demonstrating Excellence) starts young participants on a journey of recognizing their own potential and inspires many to pursue careers in science and technology.

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

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

UHEngineering @uhengineering University of Houston Cullen College of Engineering

View more photos online at

www.flickr.com/photos/cullencollege/albums

ENGINES OF OUR INGENUITY

Episode No. 471

Then and Now

Today, I ask if things have really changed in my lifetime. The University of Houston's Cullen College of Engineering presents this series about the machines that make our civilization run, and the people whose ingenuity created them.

We pass our days adapting to one new technology after another. No one seems to alter life radically. When the word processor entered my life, it was blessed relief. Yet I would not say that the earth moved on that day.

Last night I put myself to sleep by running a mental inventory of such change. It was a shock. My first memories are from the Depression years of the mid-thirties. I lived in a middle-class home with fairly modern parents.

It was a large 13-room house. We heated it with a coal furnace. Shoveling coal in, and taking clinkers out, were daily chores. There was no domestic air conditioning. We had one bathroom upstairs. A second commode in the basement was an unusual luxury.

We had an icebox — not a refrigerator. Every few days a horse-drawn wagon, filled with ice and straw, came by. A man with a rubber shoulder guard grabbed a 50-pound block of ice with tongs, slung it on his back and carried it to the icebox. We'd steal shards of ice to lick when he was gone.

Now and then a man with a handcart came down the street sharpening knives and scissors. We forget that kind of amenity. We forget the deliveries of milk, groceries and medicine. Doctors made house calls; yet the dentist, who began drilling my teeth when I was 6, never used any pain killer.

We looked to the sky more than we do now. It was full of interesting things -- DC-3s, biplanes, blimps, dirigibles and skywriting. Skywriting was difficult. The letters were hard to position and quickly windblown. Once in a while some skywriter, drunk and angry, would pen his four-letter curse in the heavens.

Our car had an automatic starter. Some neighbors still had to crank theirs. We traveled a great deal on foot and on the electric trolley. My mother never did learn to drive. We got our first bikes when we were 10. They had balloon tires and no gear shift. My father did his own photo finishing in the basement. During prohibition, up to 1933, he also made gin down there.

We had one radio in the house. We gathered around it for programs. The notion of individual radios was unheard of. We spent as much time around the piano. It was expected that you'd make your own music at social gatherings.

That life had its own texture — a good texture in many ways. But when I cut away the haze of childhood, I see it's not a life I'd want back. I realize the enormity of change. And I see that change itself is the shared element between life then and life now.

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

John Lienhard

The Engines of Our Ingenuity is a nationally recognized radio program authored and voiced by John Lienhard, professor emeritus of mechanical engineering and history at the University of Houston and a member of the National Academy of Engineering. The program first aired in 1988, and since then more than 2,800 episodes have been broadcast. For more information about the program, visit www.uh.edu/engines.

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