

UNIVERSITY of HOUSTON | ENGINEERING

# PARAMETERS

Cullen College of Engineering Magazine • Fall 2020



*THE STORY OF UH'S*

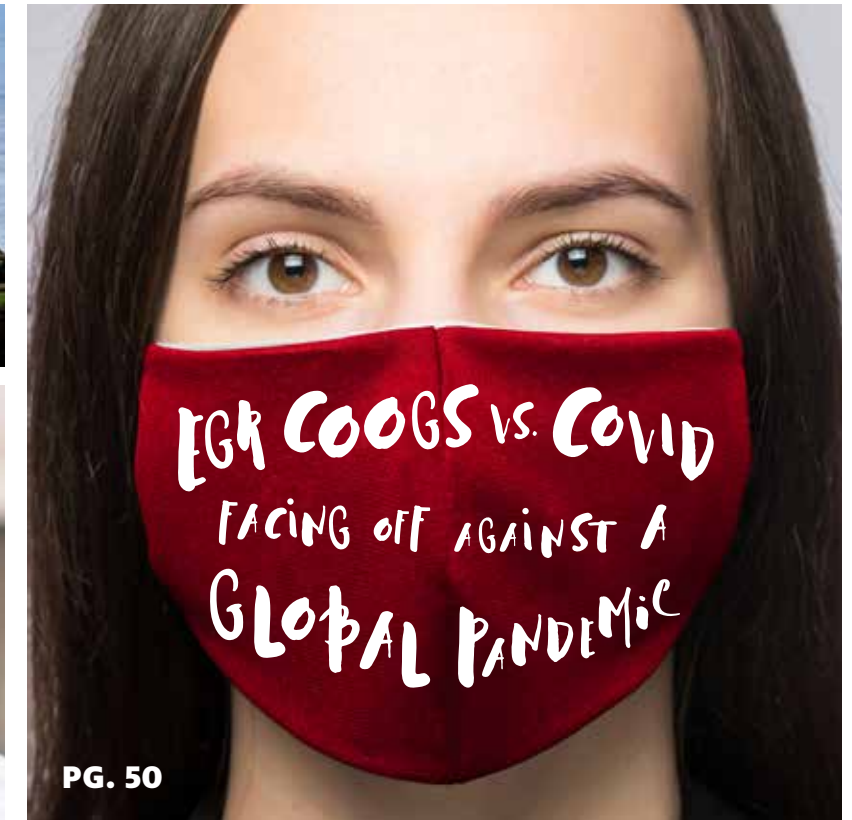
# **FIRST**

*BLACK WOMAN CHEMICAL ENGINEER*

# ENGINEERING EXCELLENCE

## TOP 25% NATIONWIDE GRADUATION RATES

Here at the **CULLEN COLLEGE OF ENGINEERING**, student success is our top priority. Our robust first-year experience, which **FOCUSES ON PROBLEM SOLVING**, has been lauded by national engineering accreditors as a model for other engineering schools to follow. Students receive a well-rounded, **TIER ONE EDUCATION FOCUSED ON INDUSTRY-RELEVANT, PROJECT-BASED LEARNING**, and are graduating in greater numbers than ever before.



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Cullen College of Engineering

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Hanadi Rifai

Associate Dean for Graduate Programs & Computing Facilities  
Suresh K. Khator

Director of the Division of Undergraduate Programs & Student Success  
Fritz Claydon

PARAMETERS

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UNIVERSITY of  
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CULLEN COLLEGE of ENGINEERING



## DEAN'S LETTER

So much has changed over the last year, the world is barely recognizable to what it was last February. In mid-March, as the novel coronavirus began to rip through Harris County, the University of Houston made an unprecedented move to transition all instruction and services online – a difficult but necessary decision. In the weeks that followed, the world around us seemingly came to a halt while we braced ourselves for what will likely be the greatest natural disaster of our lifetime.

Times such as these are what test the strength and resiliency of the Cougar spirit. Our community was forced to quickly adjust to a new normal while coping with the loss of plans made and long-celebrated traditions. But rather than being deterred by these new barriers, the Cougar Engineering community found new ways to adapt and thrive. Classes moved online, meetings went virtual, and we improvised ways to connect and celebrate our successes. In the midst of all this change, we have learned many important lessons while realizing our capacity for resilience and strength.

The lessons imparted in 2020 were not just about facing new threats, but also confronting those that have been long ingrained in our society. On May 25, an innocent Black man lost his life at the hands of police brutality. Out of that horrible atrocity came a sweeping movement calling for reform and change. Ending systemic racism will not come easily but we must persist and incite meaningful change where we can. Let us pledge to not shy away from combatting what we know is wrong while also taking the time to celebrate our trailblazers who helped shape the Cullen College into what it is today, an institution which thrives on the success of

its students, regardless of race or gender.

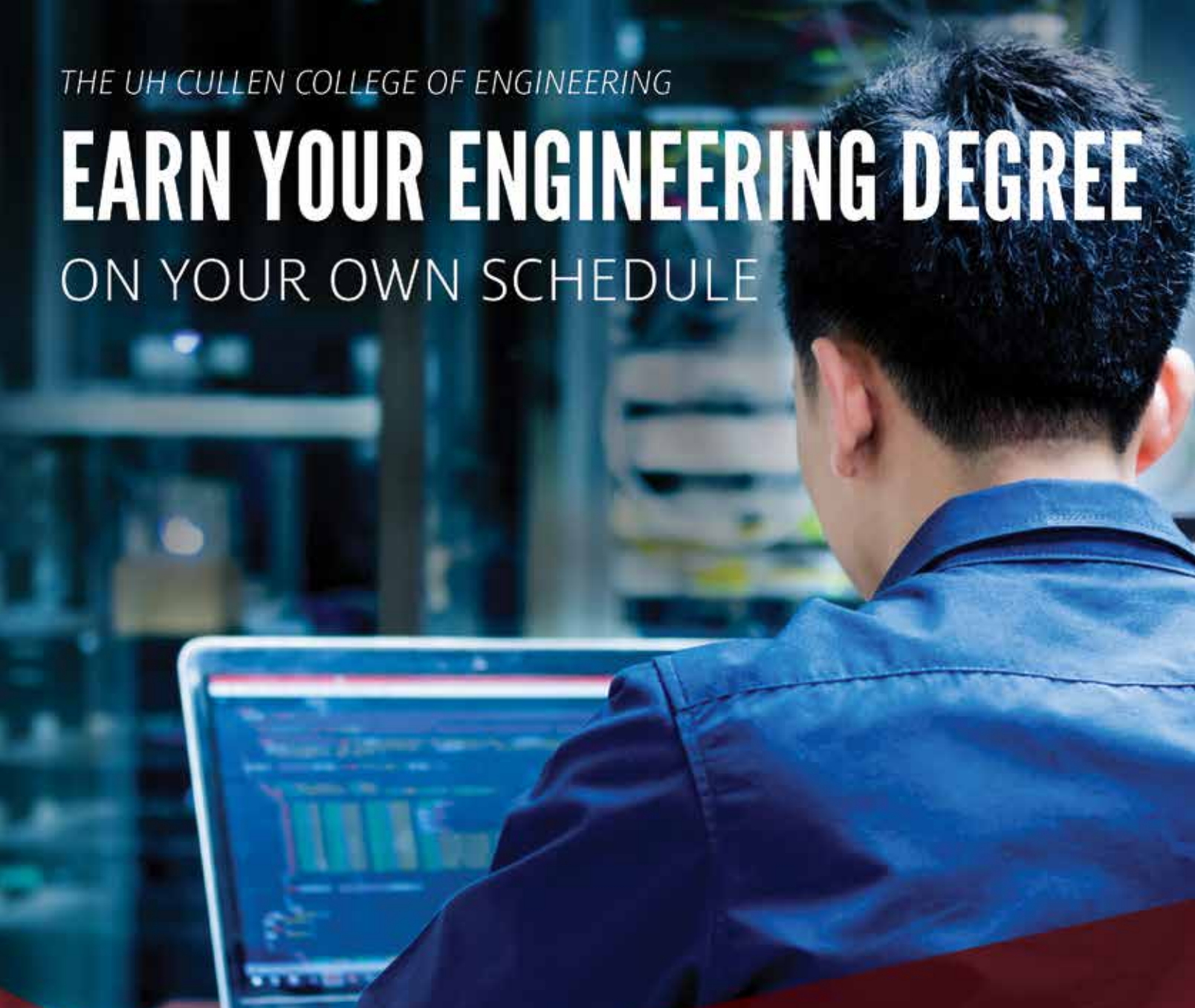
There is still much that we do not know about the road ahead and how life will continue to change as we learn to live with the virus. Let us not focus on what we cannot control, but rather, on how we choose to carry on from this point forward. As with all things, this too shall pass, and when it does, what will be our story? What will we say about our response and successes? What new perspectives did we gain? How did we support our students? How did we help the community? What research did we contribute? But perhaps most importantly, what did we learn? It is my hope that the answers to these questions are ones we can look back on with pride and that our stories will help pave the way for a better future.

Warm regards,

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

THE UH CULLEN COLLEGE OF ENGINEERING

# EARN YOUR ENGINEERING DEGREE ON YOUR OWN SCHEDULE



### ARE YOU LOOKING FOR A WAY TO FURTHER YOUR EDUCATION REMOTELY?

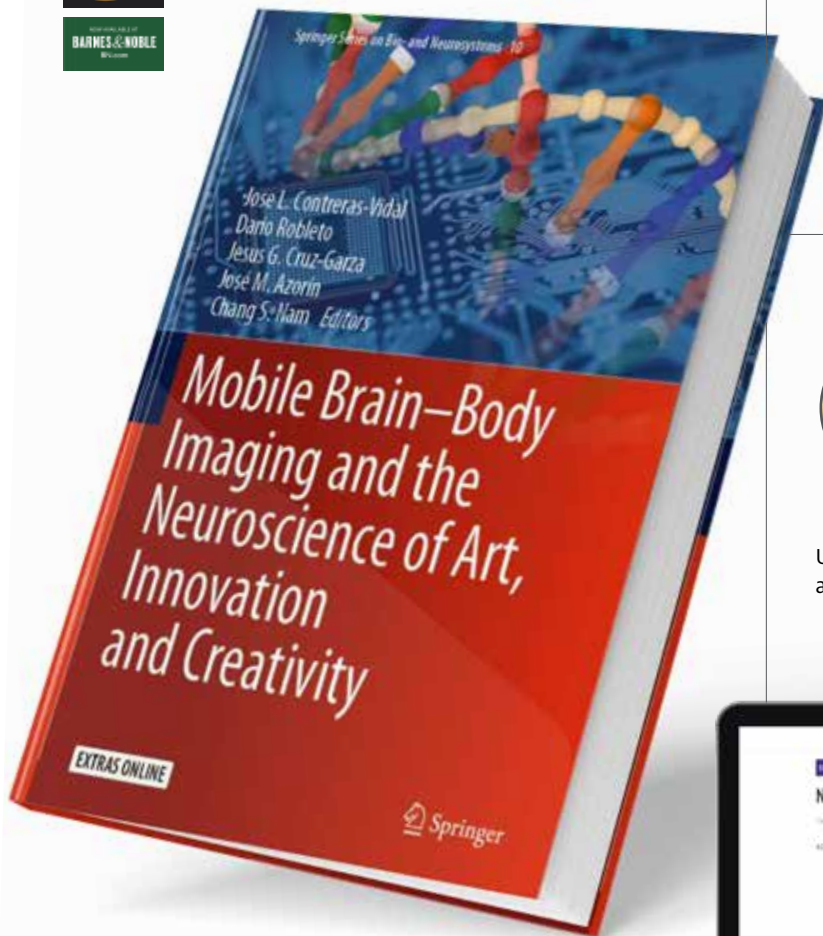
UH Engineering offers a wide range of online learning options, from **EARNING YOUR ENGINEERING DEGREE** to getting an **INDUSTRY-RELEVANT CERTIFICATION** to advance your career. Whether you are a **FULL-TIME STUDENT** or a **WORKING PROFESSIONAL**, we invite you to see what we have to offer. Learn how to engineer your future online today! Come see why we have been **ENGINEERING EXCELLENCE SINCE 1941**.

IN THE MEDIA **SPOTLIGHT**    



**JOSE LUIS CONTRERAS-VIDAL** RELEASES NEW BOOK

UH Engineering researcher **Jose Luis Contreras-Vidal** was a collaborator on a recently released book titled "Mobile Brain-Body Imaging and the Neuroscience of Art, Innovation and Creativity." The book describes itself as a "trans-disciplinary, collective, multimedia collaboration that critically uncovers the challenges and opportunities for transformational and innovative research and performance at the nexus of art, science and engineering."



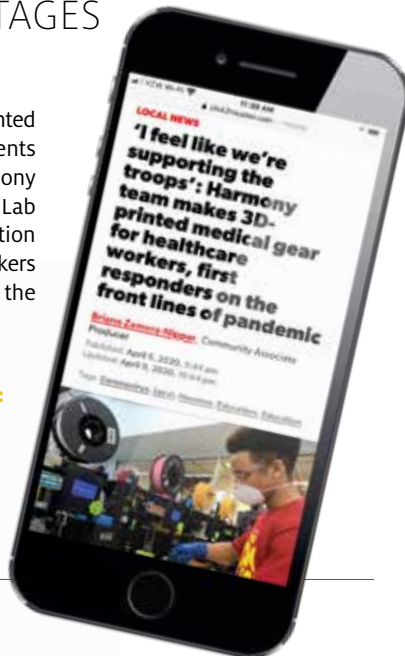
**BOOK AVAILABLE FOR PURCHASE AT:**  
[www.amazon.com](http://www.amazon.com) @ [www.barnesandnoble.com](http://www.barnesandnoble.com)



**ENGINEERING COUGARS** HELP COMBAT PPE SHORTAGES

Click2Houston recently spotlighted several UH Engineering students who partnered with the Harmony Public Schools Innovation Lab to 3D print personal protection equipment for health care workers and first responders during the COVID-19 crisis.

**SEE THE FULL STORY AT:**  
[www.Click2Houston.com](http://www.Click2Houston.com)



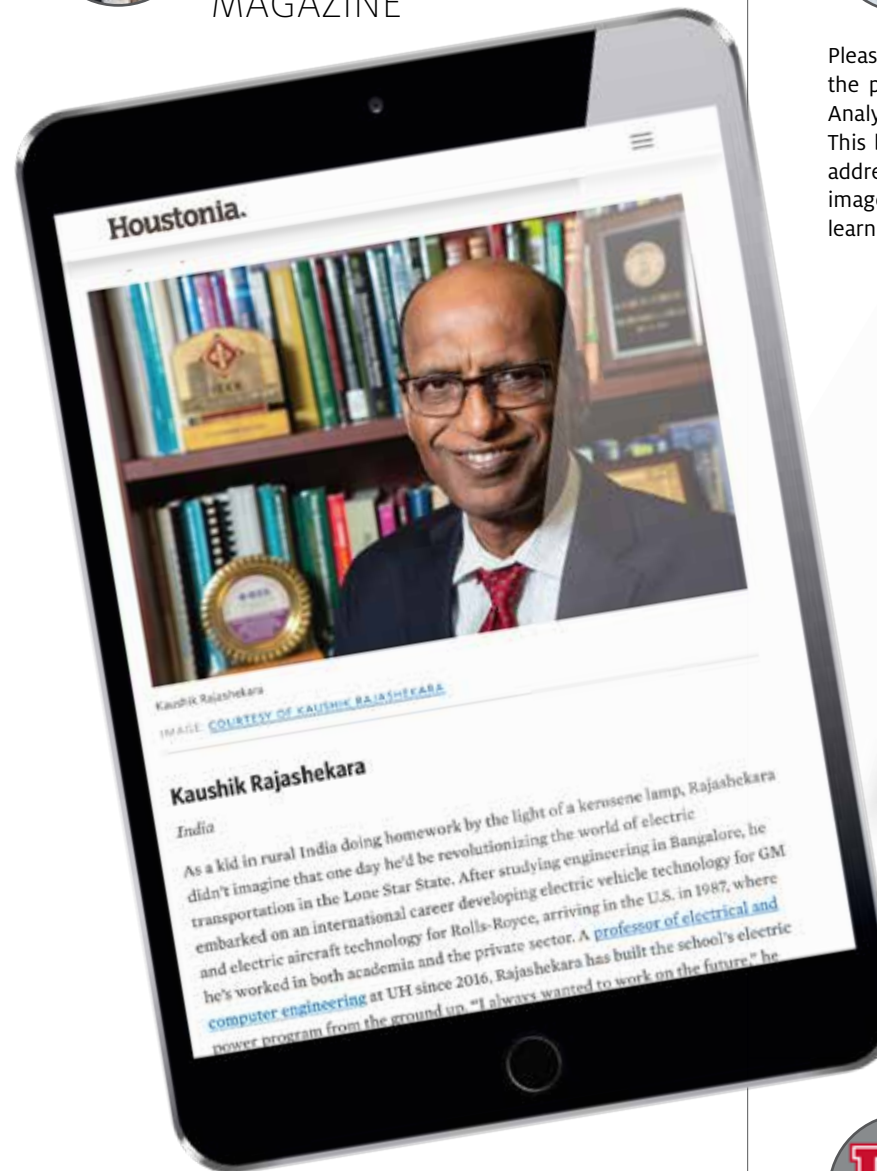
**UH ENGINEERS** HELP CELEBRATE NATIONAL ENGINEERS DAY

UH Engineering students recently volunteered their time to help local area kids learn about STEM fun at the Houston Children's Museum.

**SEE THE FULL STORY AT:**  
[www.houstonchronicle.com](http://www.houstonchronicle.com)



**KAUSHIK RAJASHEKARA** FEATURED IN HOUSTONIA MAGAZINE



Houstonia magazine recently featured 40 Houston immigrants from around the globe in their "Houston: The American Dream" issue.

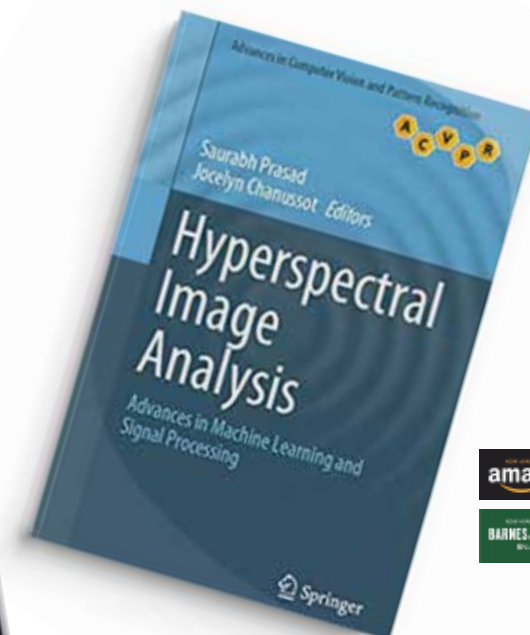
Among these stories were individuals who have made Houston their home and become an integral part of the city's successes. UH Engineering's own **Kaushik Rajashekara** was featured in the section "Finding Home a World Away: Asia."

**SEE THE FULL STORY AT:**  
<https://www.houstoniamag.com/news-and-city-life/2020/03/city-of-dreams-9-asian-immigrants-houston>



**SAURABH PRASAD** PUBLISHES NEW BOOK

Please join UH Engineering in congratulating **Saurabh Prasad** on the publication of his newest book titled "Hyperspectral Image Analysis: Advances in Machine Learning and Signal Processing." This book reviews the state of the art in algorithmic approaches addressing the practical challenges that arise with hyperspectral image analysis tasks, with a focus on emerging trends in machine learning, and image processing and understanding.



**BOOK AVAILABLE FOR PURCHASE AT:**  
[www.amazon.com](http://www.amazon.com) @ [www.barnesandnoble.com](http://www.barnesandnoble.com)



CHECK OUT OUR LATEST VIDEOS ON **YOUTUBE**

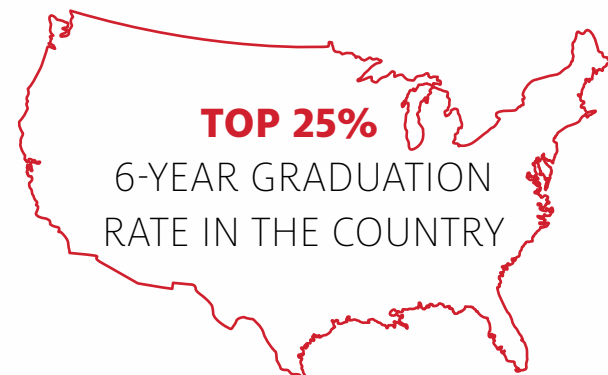


Check out the 2020 Virtual Engineering Alumni Awards Gala as well as videos about STEM engagement, community outreach and more!

**VIEW OUR NEWEST VIDEOS AT:**  
[www.youtube.com/UHCullenCollege](http://www.youtube.com/UHCullenCollege)

 | View Cullen College videos online at [youtube.com/UHCullenCollege](http://youtube.com/UHCullenCollege)  **YouTube**

# UH ENGINEERING BY THE NUMBERS



**30+** ACTIVE LABORATORIES

**14** NATIONAL ACADEMY OF  
ENGINEERING MEMBERS

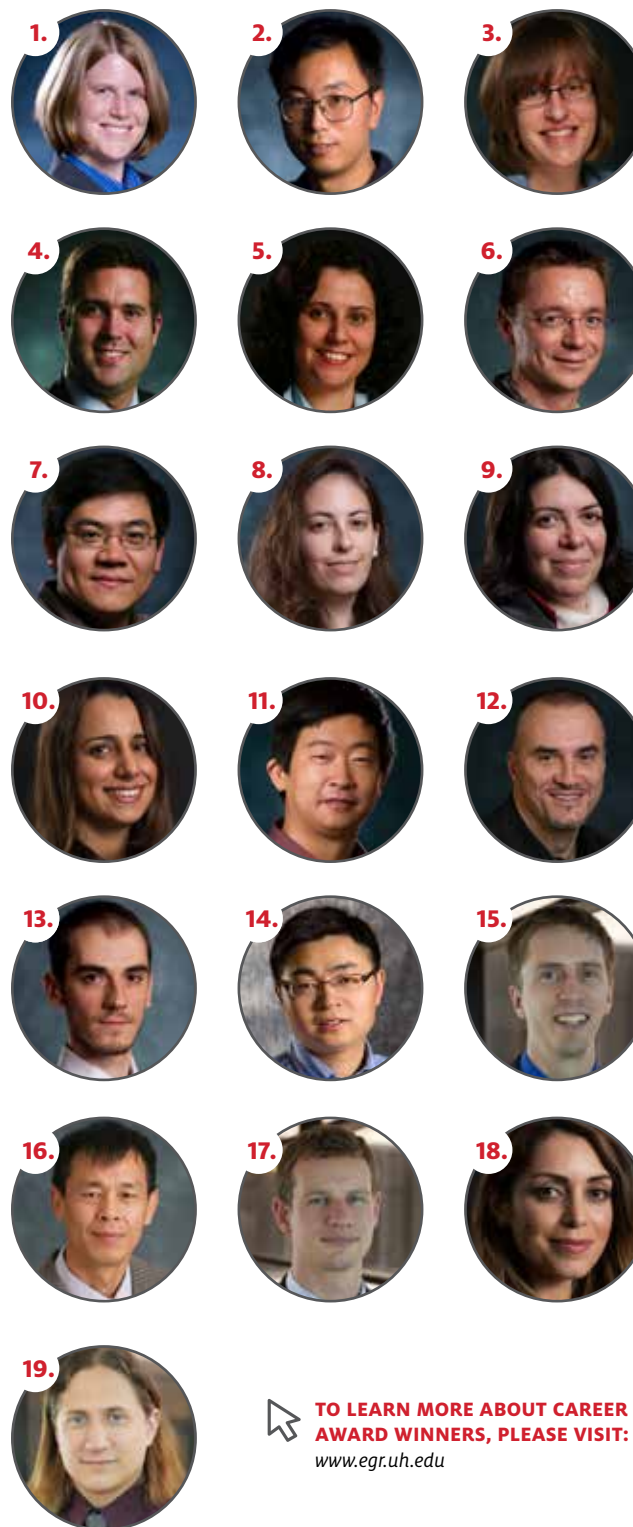
1. DAN LUSS; 2. JEROME SCHULTZ; 3. JAMES M. SYMONS; 4. BENTON F. BAUGH;  
5. CHARLES D. CUTLER; 6. JOHN H. LIENHARD; 7. CHRISTINE A. EHLIG-ECONOMIDES;  
8. KASPAR WILLAM; 9. JAMAL J. AZAR; 10. S.M. FAROUQ ALI; 11. ANDREA PROSPERETTI;  
12. KAUSHIK RAJASHEKARA; 13. GANESH THAKUR; 14. BIROL DINDORUK

**TO LEARN MORE ABOUT NAE MEMBERS, PLEASE VISIT:**  
<https://www.egr.uh.edu/people/nae-members>



**19** TOTAL FACULTY WITH  
CAREER AWARDS

1. MEGAN ROBERTSON (CHBE); 2. JIMING BAO (ECE); 3. JACINTA CONRAD (CHBE);  
4. JEFFREY RIMER (CHBE); 5. DEBORA RODRIGUES (CEE); 6. LARS GRABOW (CHBE);  
7. WEI-CHUAN SHIH (ECE); 8. GILA STEIN (CHBE); 9. HALEH ARDEBILI (ME); 10. ROSE  
FAGHIH (ECE); 11. ZHU HAN (ECE); 12. STANKO BRANKOVIC (ECE); 13. BORA GENCTURK  
(CEE); 14. CUNJIANG YU (ME); 15. AARON BECKER (ECE); 16. ZHENG CHEN (ME);  
17. JEREMY PALMER (CHBE); 18. SHEEREEN MAJD (BME); 19. DAVID MAYERICH (ECE)



**TO LEARN MORE ABOUT CAREER  
AWARD WINNERS, PLEASE VISIT:**  
[www.egr.uh.edu](http://www.egr.uh.edu)

**1376** AVERAGE

$\square S \square \square A \square \square T \square$   
**SCORE OF ENTERING FRESHMEN**

\*FALL 2019

**139** TOTAL FACULTY

**#67** BEST ENGINEERING  
SCHOOL IN THE NATION

\*(SOURCE: U.S. NEWS @ WORLD REPORT)

**TOP 100** ENGINEERING  
PROGRAMS IN THE US

\*(SOURCE: U.S. NEWS @ WORLD REPORT)

**80%** OF UH ENGINEERING  
UNDERGRADUATES ARE  
EMPLOYED IN TEXAS WITHIN  
ONE YEAR OF GRADUATION

**55** RESEARCH LABS,  
CENTERS, INSTITUTES &  
INDUSTRY CONSORTIUMS

**\$35M+** IN RESEARCH  
EXPENDITURES

**959** TOTAL DEGREES  
AWARDED IN FY2020

\*Degree Totals are from Fall 2019 & Spring 2020

**621** BACHELOR  
DEGREES

**252** MASTER  
DEGREES

**86** DOCTORAL  
DEGREES





## Cullen College Listed Among BEST ENGINEERING GRADUATE SCHOOLS OF 2021

In March, *U.S. News & World Report* released its updated 2021 rankings of best graduate engineering programs in the country. The UH Cullen College of Engineering's ranking increased once again and is now rated No. 67.

The Cullen College's ranking has increased dramatically over the years. By comparison, the college was ranked No. 78 in 2013. Most recently the college was ranked No. 69 in 2018.

Several UH Engineering programs were also named "Best Engineering Programs of 2021":

- Biomedical Engineering – No. 80
- Chemical Engineering – No. 36
- Civil Engineering – No. 64
- Electrical Engineering – No. 75
- Environmental Engineering - No. 68
- Industrial Engineering - No. 49
- Materials Engineering - No. 81
- Mechanical Engineering - No. 76
- Petroleum Engineering - No. 11

"The UH Cullen College of Engineering is experiencing and celebrating the most significant transformation in its history. These most recent rankings are a testament to the remarkable quality of our students and faculty," said **Joseph W. Tedesco**, Elizabeth D. Rockwell Dean of the UH Cullen College. "Our goal of being named a top 50 institution is well on its way to becoming a reality. Soon we will be known as a premier destination for engineering education and research."

Over 3,900 students are enrolled in engineering courses – 3,086 undergraduates as well as 861 master's and doctoral students in biomedical, chemical, civil, computer, electrical, environmental, geosensing systems, industrial, mechanical and petroleum engineering. The college also offers interdisciplinary graduate programs in subsea, aerospace, space architecture, materials and computer and systems engineering. With the recent expansion to UH at Katy, those numbers are expected to grow in the coming years.

The University of Houston is a Carnegie-designated Tier One public research university recognized by The Princeton Review as one of the nation's best colleges for undergraduate education. UH serves the globally competitive Houston and Gulf Coast Region by providing world-class faculty, project-based learning, high impact research and strategic industry partnerships. Located in the nation's fourth-largest city, UH serves more than 45,000 students in the most ethnically and culturally diverse region in the country.

For the full list of rankings from U.S. News and World Report, please visit: <https://www.usnews.com/best-graduate-schools>. ⚙️



## Six-Year Graduation Rate SOARS INTO TOP 25% NATIONWIDE

BY STEPHEN GREENWELL

The Cullen College of Engineering has set a record for its six-year graduation rate, hitting a mark of 71.4 percent for students that began in Fall 2014, according to latest information released by the department's Division of Undergraduate Programs and Student Success.

This is the fourth year in a row that the graduation rate has gone up, this time from 67 percent the previous year for students starting in Fall 2013. **Dr. Fritz Claydon**, the Director of the Division of Undergraduate Programs and Student Success, said the rate has increased from 43 percent for students starting in Fall 2010.

When it came to the factors behind the increased six-year graduation rate, Claydon noted that better matching admission standards to students' capability to complete the program, offering required courses two to three times a year, and using course grade indicators for curricula to warn and assist students with academic difficulties, were all major factors.

During the accreditation process, Claydon said the college's "robust, common first year experience that focused on problem solving" was "lauded by the Accreditation Board for Engineering and Technology as a model for other engineering schools to follow."

According to national data from the American Society of Engineering Education's 2018 "Engineering by the Numbers" report, the graduation rate for all engineering programs is 60 percent, with the rate dropping to 50 percent for public schools. The current rate of 71.4 percent would put the University of Houston in the top 20 to 25 percent nationally for all schools.

**Joseph W. Tedesco**, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering, thanked the faculty and the student body for their hard work.

"The need for engineering graduates is greater now than it has ever been," he said. "The Cullen College of Engineering is proud to be doing its best to meet that need, by producing high-quality graduates ready to lead in professional and academic settings."

UH Provost **Paula Myrick Short** praised the college for its graduation rate.

"I am proud of the Cullen College of Engineering faculty and leadership for this outstanding trajectory of student success," Short said. "Engineering students are receiving a Tier One education and are graduating in greater numbers than ever, ready to move forward to successful careers and continued achievements as UH alumni." ⚙️

# Class of 2020 HONORED WITH VIRTUAL GRADUATION CELEBRATION

BY STEPHEN GREENWELL



The fortitude of the Cullen College of Engineering's Class of 2020 was proudly celebrated by the university community on May 7, with a 90-minute virtual graduation celebration, featuring remarks from University of Houston leadership, a commencement speaker and most importantly, the graduating students.

*The celebration can be viewed in its entirety on YouTube.*

*Dean Joseph Tedesco started the celebration by praising the graduating class for dealing with the real-world conditions beyond its control.*



"I am especially proud of the graduating class of 2020," he said. "You are certainly the strongest engineering graduates ever at the Cullen College of Engineering. Unlike those who have come before you, you have had to keep up with your studies through an unprecedented global pandemic, and you have done so with grace, integrity and perseverance, and you have achieved your goal – the receipt of an engineering degree."



Tedesco added that the celebration was also an opportunity to herald the work done by the college's professors.

"In addition to being excellent scholars, they are devoted to our students and commit their best talents and energies to the teaching and learning processes, especially in today's rapidly changing world of virtual and remote learning," he said.

The faculty of the Cullen College of Engineering provided graduates with shout-outs and celebratory messages at several points during the virtual presentation. The celebration featured more



than 30 minutes of messages from current students, faculty and alumni. University of Houston President **Renu Khator**, Ph.D., also offered her congratulations via a recorded video.

*"We are so proud of you," she said. "Proud of all of your accomplishments, proud of your journey here."*

CenterPoint Senior Vice President of Electric Operations **Kenny Mercado**, a member of the class of 1985 with an electrical engineering degree and the class of 1991 with an industrial engineering management degree, served as graduation speaker.

Mercado stressed that while the pandemic had significantly altered the world, the skills the graduates gained at UH would provide them with the ability to make an impact.

"The jobs of tomorrow will have a little different taste to them than there was in the past, and engineering jobs are going to be prosperous and plenty as you move into your future," he said. "This is now your opportunity and I really want you to think about this, this is your opportunity to have genuine purpose, and to establish your career and develop your skills, and to make a real difference in our world for you, your family and your friends."

As with any graduation, the celebration culminated with a reading of the graduates. However, before the Bachelor of Science degree recipients were read, there was one final test to pass – a call and response of, "Who's house? Coogs House!" The ceremony concluded with a rendition of the UH alma mater.

As of August, more than 2,500 people watched the celebration between YouTube and UH platforms. The official commencement ceremony has been postponed and will be rescheduled for a later date when it is deemed safe to gather again. Please check the university's official commencement website for updates. 🚩



VIEW THE CELEBRATION ONLINE AT:  
[www.youtube.com/UHCullenCollege](https://www.youtube.com/UHCullenCollege)



# Can a New Kind of POWER PLANT IMPROVE AIR QUALITY, RESILIENCE?



BY JEANNIE KEVER

Researchers from the University of Houston, backed by \$4 million in funding from the Texas Commission on Environmental Quality, have joined a pilot project testing the use of supercritical CO<sub>2</sub>, or pressurized carbon dioxide, to produce low-cost, low-emission electric power.

The project, funded by the U.S. Department of Energy and located at the Southwest Research Institute in San Antonio, will demonstrate a new technology, known as Supercritical Transformatonal Electric Power, which can operate

so efficiently that a desk-sized turbine is able to power about 10,000 homes.

Researchers from UH, led by principal investigator **Hanadi Rifai**, John and Rebecca Moores Professor of environmental engineering and director of the environmental engineering graduate program, will train graduate students on the technology to address three main goals:

- 1) Determine whether the technology can use waste heat produced by petrochemical and other industrial facilities to generate electricity
- 2) Assess the best opportunities for integrating the technology
- 3) Study deployment of the technology across the electric grid, focusing on emissions, water usage and how best to match plant scale to grid requirements

Rifai said some of the TCEQ funding will be used for specific components of the technology at the pilot facility in San Antonio, as well as to support data collection to gauge the technology's efficiency.

The technology's small footprint has important implications for the resiliency of the grid, Rifai said, especially in parts of the state – like Houston – where hurricanes and other major storms can cause serious disruptions.

Developing technologies that can improve resiliency for the electric grid and other infrastructure is a major focus for the Hurricane Resilience Research Institute (HuRRI), a multi-institution research center based at UH and led by Rifai.

*The technology also has the potential to improve air quality by capturing and converting waste heat or other forms of carbon to electricity.*

Rifai said UH students working on their master's degree or Ph.D. in environmental engineering will work with the technology.

**Pradeep Sharma**, M.D. Anderson Chair Professor of mechanical engineering, is co-principal

investigator, focused on understanding and assessing how efficiently the technology can generate electricity.

He said a variety of disciplines will be brought to bear on key aspects of the technology. "The idea of using computational materials science, big data and machine learning in deploying the technology broadly, including the conversion of waste heat into energy, is very exciting," he said.

Because the turbine used in the technology is so small and has the ability to power up to 10,000 homes, Rifai said it has great potential to improve the resiliency of the grid in storm-prone regions. "It could make the grid not just resilient but capable of operating independently," she said. "Resiliency is so important for the Houston area."

She predicted that power companies will be interested in the technology if researchers can demonstrate that it operates efficiently and cleanly. That makes training graduate students to understand the technology even more important, as the companies will need workers who can scale up the projects. ⚙️



## Louie, Berté Awarded GRANT FOR WATER CONTAMINANT RESEARCH

BY STEPHEN GREENWELL

**Dr. Stacey Louie**, an assistant professor of civil and environmental engineering, received a \$12,000 grant to support a project centering on how contaminants interact with water.

The funding comes from the Texas Hazardous Waste Research Center at Lamar University. The main objective of the research will be developing size exclusion chromatography (SEC) methods to investigate organic contaminant interactions with dissolved organic matter (DOM). Louie said the student working with her will be **Tchemongo Berté**.

"She's a master's thesis student in her first year and has already gotten a great start in processing soil samples, setting up the instruments and collecting the preliminary data showing the feasibility of the project," Louie said.

The project ties into Louie's research on issues of water quality, and how pollutants affect it.

"The award and research focus on water quality, specifically the runoff of chemical pollutants like pesticides and herbicides into natural water bodies and their fate in the environment," she said.

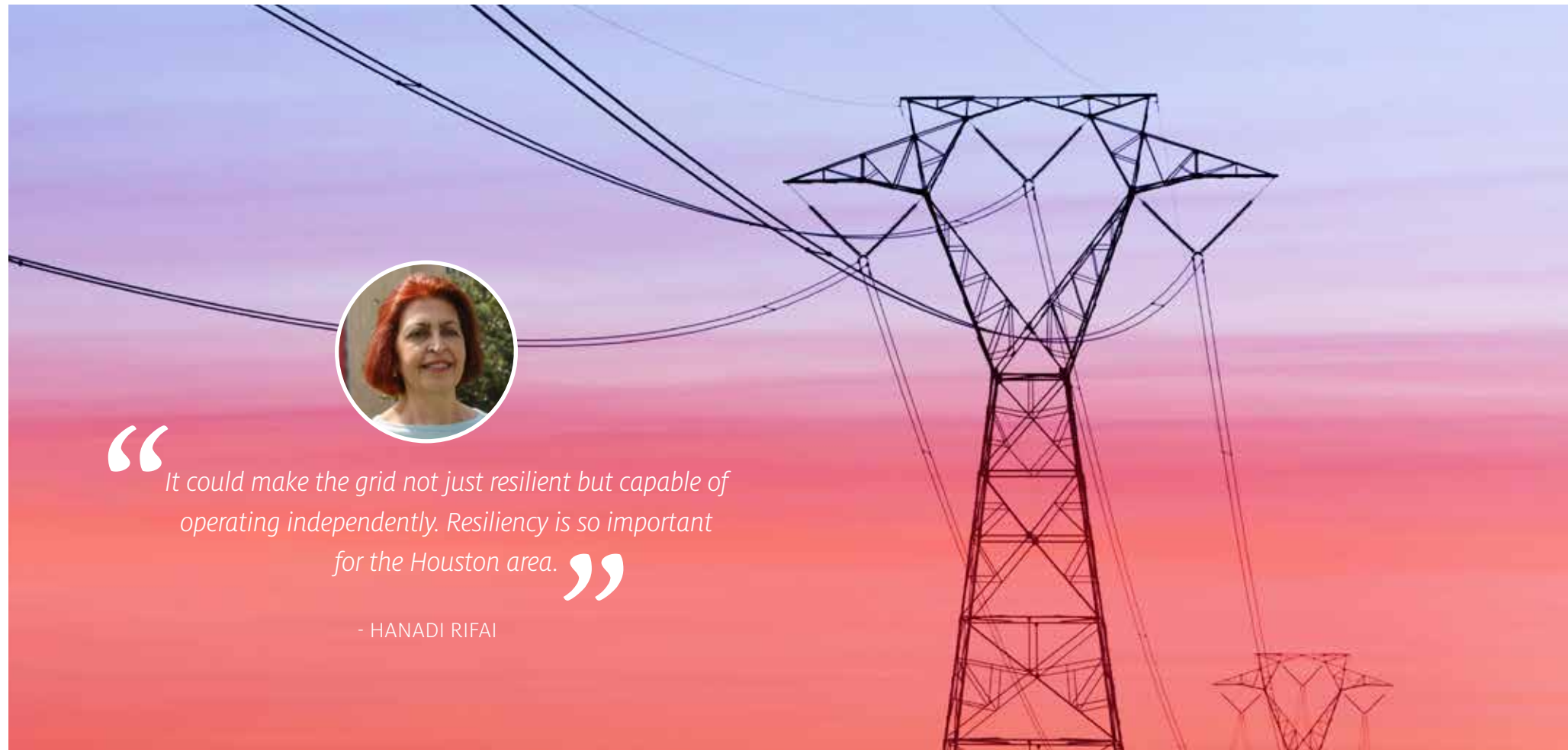
Using SEC methods will ideally allow Louie and Berté to identify contaminant interactions with dissolved organic material, especially as it relates to water quality.

"The new knowledge on contaminant interactions with dissolved organic matter will help us understand how they move around the environment, how resistant they are to degradation, and how easily they can be removed in various drinking water treatment processes," Louie said. "Therefore, the research has practical applications to better predict the concentrations of pollutants in our drinking water sources and identify more effective methods to treat each contaminant."

*Louie said that ideally, their method could provide quicker and cheaper results.*

"A major hurdle in this type of research is that existing methods to measure the contaminant-organic matter interactions are either extremely time-consuming or expensive," she said. "Our research also has practical benefits in that we are developing methods that are much faster than existing methods. There are a huge number of different chemical pollutants that could be present in water. Our method will allow us to potentially screen many pollutants within a short time."

The funding period for the grant is April 1, 2020 through June 30, 2021. ⚙️



“It could make the grid not just resilient but capable of operating independently. Resiliency is so important for the Houston area.”

- HANADI RIFAI



# LEE RECEIVES GRANT FOR SOUTH KOREAN WATER, SATELLITE PROJECT

BY STEPHEN GREENWELL

**Dr. Hyongki Lee**, an associate professor in the Department of Civil and Environmental Engineering at the Cullen College of Engineering, has been awarded a grant from the K-Water Institute of South Korea to study flood monitoring and management via the development of algorithms for satellite data. The study will look specifically at regions in South Korea.

The \$93,000 grant is for the project titled “Application of C-band SAR Data for Flood Monitoring and Management.” Lee is the principal investigator for the project, which covers work done from July 2019 to December 2021. Satellite observations can complement existing in-situ gauge network with additional spatio-temporal coverages, and is the only available option for poorly or ungauged basins.

The K-Water Institute was originally formed in 1988, reorganized from earlier efforts in 1974 and 1967. It oversees the construction, management and operation of water resources in South Korea. The goal of the organization is to provide safe, usable water to the people while protecting the environment and public interests.

According to Lee, the institute is one of the leaders when it comes to developing a C-band Synthetic Aperture Radar (SAR) satellite mission, which is funded by the Korean Ministry of Environment. The mission is planned for 2025 for the purpose of water resources management in Korea and around the globe.

“My expertise is developing innovative applications of satellite remote sensing data for water resources management, and my role for this project is to develop and enhance applications of C-band SAR data for flood monitoring and forecasting,” Lee said. “We will use currently operating C-band SAR data available from the Sentinel-1 mission of European Space Agency [ESA] to demonstrate the applicability of future C-band SAR missions in South Korea.”

Lee outlined two primary goals for the grant.

“Our first objective is to develop an algorithm of flood inundation forecasting using SAR images and other remote sensing data sets, including

“My expertise is developing innovative applications of satellite remote sensing data for water resources management, and my role for this project is to develop and enhance applications of C-band SAR data for flood monitoring and forecasting.”

- HYONGKI LEE

satellite radar altimetry, that provides surface water elevation,” he said. “Since the SAR sensor uses microwave bands, it can penetrate through clouds and obtain the image of the earth’s surface beneath, which makes it valuable for mapping flooded areas while cloud cover exists which optical sensors cannot provide.”

“The second objective is to estimate stream flows in poorly gauged or non-gauged basins using satellite-observed river widths and water elevation changes. Conventional methods of river discharge estimation using satellite observations require a historic in-situ discharge data for training. In this project, we will use an approximate guesstimate of discharges that can be derived from a priori information as a basis with a machine learning technique to generate historic discharges over basins where little or no in-situ observations are available.”

Lee said the proposed products are expected to enhance flood risk reduction and to improve water availability prediction. ⚙️

Shaffer, Reed Awarded

# GRANT TO STUDY HOUSTON WATER CONSERVATION

BY STEPHEN GREENWELL

 DEVIN SHAFFER AND DANA REED

Two researchers from the University of Houston have received a grant to study the potential water conservation savings for different types of land uses in the City of Houston.

**Dr. Devin Shaffer**, an assistant professor in the UH Civil and Environmental Engineering Department, will oversee the work done by his doctoral student, **Dana Reed**, in developing a model for water use and conservation based on land use. In a competitive grant process, their proposal was selected by the Harris-Galveston Subsidence District (HGSD). The grant is for \$24,228.

"This is the first year of the water conservation grant program from the HGSD," Shaffer said. "We learned about it from the district and Houston Public Works, and we thought it was really

a good opportunity for us to build on ideas that we had heard and discussed at the One Water Summit." The summit focuses on using tools like conservation and reuse to manage water resources in an integrated way.

*"We're really just trying to inspire people to see water as valuable every step of the way," Reed said.*

The model developed by the pair will combine land and water use data to understand how water is used by various properties in the area. They will be working closely with the City of Houston to gather data about residential water use per parcel. They also chose a study area that overlaps with the wastewater collection area for

one of the city's wastewater treatment plants.

This area of study allows them to use flow data from the wastewater collection system to understand how much water is used outdoors for activities like watering the lawn compared to how much is used indoors. Water used indoors ultimately drains into the wastewater collection system and can be estimated from wastewater flow data.

"We're trying to model who's living and working in this area, and how they are using water," Reed said. "If we can understand how water is being used in the area, we can target conservation practices that will save as much water as possible."

For Dr. Tina Petersen, the deputy general manag-

er of the HGSD, the model is a way to learn more about best practices for water management.

"The Subsidence District is interested in this project because it will provide verification of potential water savings based on different water conservation scenarios," she said in a statement about the grant. "We also were intrigued by the innovative use of wastewater flow measurements to calibrate the land-use based water model. We are looking forward to learning more about the type of water conservation best management practices from this study."

The Houston area has unique water issues, Reed and Shaffer said. While it rains frequently, and there are numerous lakes and rivers in the region, groundwater still needs to be drawn from underground aquifers to help meet the

city's water needs. This groundwater withdrawal can cause the aquifers to compact over time, Shaffer said.

"Land subsidence from aquifer compaction can cause problems with flooding from rainstorms and hurricanes," he said. "Water that we can save from conservation can help reduce subsidence because it's water that's not drawn from the aquifer."

Reed noted that the lack of zoning regulations in Houston made it tougher to accurately estimate water usage.

"A lot of cities will have zoning that influences how water is used on a property, which we don't have here, so it's challenging to get a picture of how water is being used," she said. "An

additional challenge is motivating people to conserve water. There is a lot of water in Houston. We get a lot of rain and flooding here, so it can be challenging to get people to understand the benefits of water conservation."


Shaffer said his professional background, before getting into academia, was working in the water and wastewater industries.

*"Before I started my academic career, I worked as an engineer with municipal clients," he said. "I think it's exciting and motivating to work on these water resource problems in our local area. There are both challenges and opportunities."*

Likewise, Reed stressed that they hoped their model would discover implementable water conservation strategies.

"I have a background in industry also, and that experience has emphasized for me the importance of conducting research that is practical and applicable," Reed said. "I think it's exciting to take a look at the real problems here in Houston, so that our solutions can be practical."

*The ultimate goal, Shaffer said, is to develop a model that can be used by the City of Houston to get the best return on investment when it comes to water conservation practices.*

"For us, this is hopefully the start of a long-term collaboration between UH, the city and the district on regional and local water challenges," he said. 

## Mónico's Work Pulls ORDER FROM CHAOS

BY STEPHEN GREENWELL



For **Dr. Rodolfo Ostilla Mónico**, an assistant professor of mechanical engineering since Fall 2017, much of his work the past decade on turbulence has centered around a big question – can we find order in the chaos?

*“It’s an idea I find very intellectually stimulating,” he said. “Even if you can’t find the exact way turbulence is created and behaves, you can find general pictures which get increasingly better, and that’s very interesting. It’s been keeping me going for several years, and possibly several more.”*

Mónico was second author and did much of the simulation running and post-processing work for a paper published in February’s *Science Advances*, titled “Turbulence generation through an iterative cascade of the elliptical instability.” Ryan McKeown, a graduate student at Harvard’s John A. Paulson School of Engineering and Applied Sciences (SEAS), is the paper’s first author, and experiments were done at that facility.

According to an article by SEAS, for the experiments the researchers synchronized a scanning laser with a high-speed camera to rapidly scan a collision with vortex colliders in real-time. Each vortex was dyed with different colors, so researchers could observe how they reacted during a violent collision in a 75-gallon aquarium.

Mónico first started on the project in September 2015, when he was a postdoc at Harvard. The subject of turbulence has always fascinated him though. “It was what I had my expertise in and it was really interesting to me,” he said. “The question of ‘Can we find order in this chaos?’ forces you to think hard about many things.”

Mónico said their examinations of the collisions revealed surprises. With the high-speed camera, you can track how counter-rotation vortices lead to turbu-

*“We had some ideas of how to control turbulent flows, which show a lot of promise in the simulations, and we want to see if we can get this to work with a real, non-wetting surface.”*

- RODOLFO OSTILLA MÓNICO

lence and isolate individual events.

“The big idea was that you have big vortices and they break up into smaller vortices,” he said. “You think of big round vortices with smaller vortices within, but it’s something completely different ... It’s more that you have a criss-cross array of tubes of all sizes.”

Turbulence is also the main area of study for a \$386,241 grant that Mónico secured from the National Science Foundation (NSF) last October for his project, “Controlling secondary flows by the use of non-wetting surfaces.” He crafted the proposal with **Dr. Kamran Alba**, an assistant professor in the Department of Engineering Technology.

This project will involve physical experiments at the university, as opposed to just simulation and statistical analysis.

“We had some ideas of how to control turbulent flows, which show a lot of promise in the simulations, and we want to see if we can get this to work with a real, non-wetting surface,” Mónico said.

Mónico pointed to the lotus leaf as an example of a non-wetting surface in nature, with its microscopic bumps and ridges leading to contact angles greater than 90 degrees, and water “slipping” off.

*“The goal of this project is to investigate the use of non-wetting surfaces to induce, affect, and control secondary flows through selectively patterning the solid boundaries,” Mónico wrote in his abstract. “By using a combination of direct numerical simulations and laboratory experiments, questions on which types and patterns of treatments are most effective for this task will be answered.”*

The project will last three years, between September 2019 and August 2022. ⚙️



## UH Researchers Solve A SCIENTIFIC MYSTERY ABOUT EVAPORATION

BY JEANNIE KEVER

*Evaporation can explain why water levels drop in a full swimming pool, but it also plays an important role in industrial processes ranging from cooling electronics to power generation. Much of the global electricity supply is generated by steam plants, which are driven by evaporation.*

But determining when and how quickly a liquid will convert to a vapor has been stymied by questions about how – and how much – the temperature changes at the point where the liquid meets the vapor, a concept known as temperature discontinuity. Those questions have made it more difficult to create more efficient processes using evaporation, but now researchers from the University of Houston have reported answers to what happens at that interface, addressing 20 years of conflicting findings. The work was reported in the *Journal of Physical Chemistry*.

The temperature discontinuity was first reported in 1999 by Canadian researchers G. Fang and C.A. Ward, who noted that they were unable to explain the phenomenon through classical mechanics. The new work solves that mystery.

**Hadi Ghasemi**, Cullen College Associate Professor of Mechanical Engineering at UH, said the new understanding eliminates the “bottleneck” that has complicat-

ed predictions and simulations of processes involving evaporation.

“We demonstrated the physics of what happens within the space of a few molecules at the interface and accurately developed a theory on the evaporation rate,” Ghasemi said. “That allowed us to explain all of the conflicting findings that have been reported in the last 20 years and solve this mystery.”

In addition to Ghasemi, co-authors for the paper included first author **Parham Jafari**, a PhD student at UH, and **Amit Amritkar**, a research assistant professor at UH.

The researchers first approached the question in the lab, but Ghasemi said they were unable to get the needed spatial resolution for a definitive answer. They used a computational approach in order to find the properties of liquid and vapor within the length of a few molecules.

The explanation – developed using the Direct Simulation Monte Carlo method – will allow scientists to more accurately simulate the performance of all systems based on the theory of evaporation.

“With this understanding, we can more accurately develop simulations of performance and efficiency, as well as design and predict the behavior of advanced systems,” Ghasemi said.

That would have applications for energy, electronics, photonics and other fields. As just one example of the importance of evaporation, Ghasemi noted that 80% of electric power globally is generated through steam plants, which work based on evaporation phenomena. ⚙️

Rimer Receives

## NSF GRANT FOR ZEOLITE WORK

BY STEPHEN GREENWELL



The complexity and mystery of zeolites – porous aluminosilicate crystals – was what first attracted **Jeffrey Rimer**, the Abraham E. Dukler Professor of Chemical and Biomolecular Engineering at UH, to his current field of research.

“I was first introduced to zeolites during my Ph.D. studies, and I quickly became fascinated by these porous materials, partly because of their complexity, but more so by the fact that very little was known about the fundamental mechanisms governing zeolite crystallization,” he said. “This presented a challenge that to this day continues to motivate research in my group.”

*Rimer's research group will be aided in its search with a \$446,364 NSF grant for his proposed project, “Designing New Methods to Exploit Intercrystalline Transformations in Zeolite Synthesis.”*

According to a project summary provided by Rimer, zeolites are often used as catalysts and absorbents in commercial applications because of their unique properties. Despite their wide use in fields spanning from energy to medicine, their complexity makes it difficult to understand how these materials form and what methods can be developed to control and optimize their properties.

Rimer's project will use experiments and computer analysis to investigate a topic of growing interest – seed-assisted synthesis. The method involves introducing crystal seeds in growth mixtures to promote the formation of zeolite crystals with desirable sizes, shapes and compositions.

“The preliminary findings from our group reveal that seed-assisted synthesis has the potential to open new doors for the advancement of zeolite crystal engineering,” he said. “Given the importance of these materials in the petrochemical and chemical industries, advancements in the understanding of zeolite formation can lead to transformative outcomes, including innovative synthetic routes to tailor material properties for better performance in processes.”

Rimer said he has several collaborators for this work.

“The project will support two doctoral students, including one of my current students, **Rishabh Jain**, who helped gather preliminary data for this proposal,” he said. “As part of this project, we will also be collaborating with professor Javier Garcia Martinez at the University of Alicante in Spain for state-of-the-art characterization of our materials. We will also work with professor Rafael Gomez-Bombarelli, from the Massachusetts Institute of Technology, for machine learning to help guide experimental design.”

Rimer is the PI for the project. Funding from the grant runs from July 15, 2020 through June 30, 2023. ⚙️

Molecular Understanding of Drug Interactions  
Suggests Pathway to Better Understand



TREATMENTS

BY JEANNIE KEVER

The process of crystallization is central to drug development, petrochemical processing and other industrial actions, but scientists say they still are learning about the complex interactions involved in the building and dissolution of crystals.

Researchers from the University of Houston and the Université libre de Bruxelles reported in the journal *Nature* that they have for the first time demonstrated at the molecular level what happens when two compounds known to inhibit crystal growth – in this case, antimalarial drugs – were combined. The results were unexpected.

“You would expect using two drugs that attacked crystallization in two different ways would be synergistic, or at the very least additive,” said **Jeffrey Rimer**, Abraham E. Dukler Professor of Chemical and Biomolecular Engineering at UH and a co-author of the paper. “Instead, we found that they can work against each other.”

Working against each other, known as antagonistic cooperation, meant that the drugs were actually less effective in tandem than individually. **Peter Vekilov**, John and Rebecca Moores Professor of Chemical and Biomolecular Engineering and Chemistry at UH and another co-author, said the work will allow the design of more effective treatments for malaria, a mosquito-borne disease that killed 435,000 people in 2017, most of them children in Africa.

But more broadly, it suggests a new way to screen molecules for their potential in drug development, allowing new treatments to be developed more quickly.

“When you are using modifiers, a small change in the molecule’s structure can dramatically alter its performance,” Rimer said. Malaria is caused by a parasite, which consumes hemoglobin and leaves behind

a compound known as hemozoin, which the parasite sequesters inside a crystal. Antimalarial treatments work by inhibiting the crystal growth, freeing hemozoin to attack the parasite.

For this work, the researchers studied the growth of hemozoin crystals in the presence of four antimalarial drugs – chloroquine, quinine, mefloquine and amodiaquine – which work in one of two distinct ways.

Both computationally and experimentally, including through the use of atomic force microscopy, the researchers demonstrated how compounds which attack crystallization by two different mechanisms behave when combined. The resulting molecular-level understanding of that behavior suggests a new mechanism for materials science, Vekilov said.

“This mechanism may provide guidance in the search for suitable inhibitor combinations to control crystallization of pathological, biomimetic, and synthetic materials,” the researchers wrote. “In a broader context, our results highlight modifier interactions mediated by the dynamics and structures on the crystal interface as a prime element of the regulation of the shapes and patterns of crystalline structures in nature and industry.”

In addition to Vekilov and Rimer, researchers involved with the project include UH Ph.D. student **Wenchuan Ma** and collaborator Dr. James Lutsko of the Université libre de Bruxelles. ⚙️



UH Biomedical Engineering Lab  
**CREATES IMPROVED BRAIN  
CHIP FOR PRECISION MEDICINE**

BY LAURIE FICKMAN



The Akay Lab biomedical research team at the University of Houston is reporting an improvement on a microfluidic brain cancer chip previously developed in their lab. The new chip allows multiple-simultaneous drug administration, and a massive parallel testing of drug response for patients with glioblastoma (GBM), the most common malignant brain tumor, accounting for 50% of all cases. GBM patients have a five-year survival rate of only 5.6%.

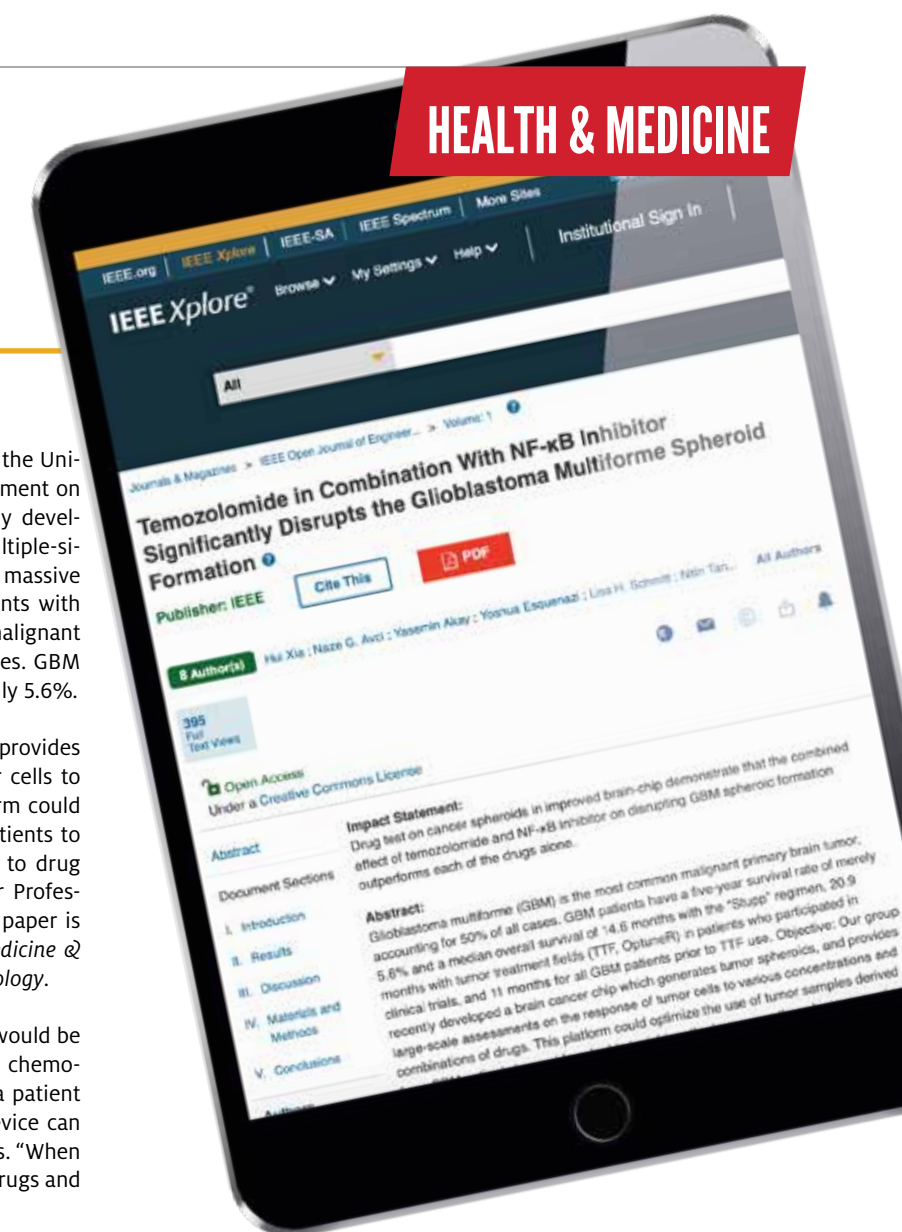
“The new chip generates tumor spheroids, or clusters, and provides large-scale assessments on the response of these GBM tumor cells to various concentrations and combinations of drugs. This platform could optimize the use of rare tumor samples derived from GBM patients to provide valuable insight on the tumor growth and responses to drug therapies,” reports **Metin Akay**, John S. Dunn Endowed Chair Professor of Biomedical Engineering and department chairman. The paper is published in the inaugural issue of the *IEEE Engineering in Medicine @ Biology Society’s Open Journal of Engineering in Medicine and Biology*.

The ability to quickly assess the effectiveness of a cancer drug would be a notable improvement over typical cancer protocols in which chemotherapy drugs are given, then tested for several months, and a patient switched to another drug if the first is ineffective. The new device can determine the optimal drug combination in as little as two weeks. “When we can tell the doctor that the patient needs a combination of drugs and the exact proportion of each, this is precision medicine.”

Akay’s team takes a piece of a tumor biopsy, cultures it and puts it in the chip. Then they add chemotherapy drugs to the chip’s microvalves to determine the best drug combination, and the specific proportion, that kills the most tumor cells.



NAZE GUL AVCI, YASMINE AKAY AND HUI XIA



HEALTH & MEDICINE

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The team cultured 3D tumor spheroids, or clusters, from GBM cell lines as well as patient-derived GBM cells in vitro and investigated the effect of the combination of Temozolomide and a nuclear factor-κB inhibitor on tumor growth.

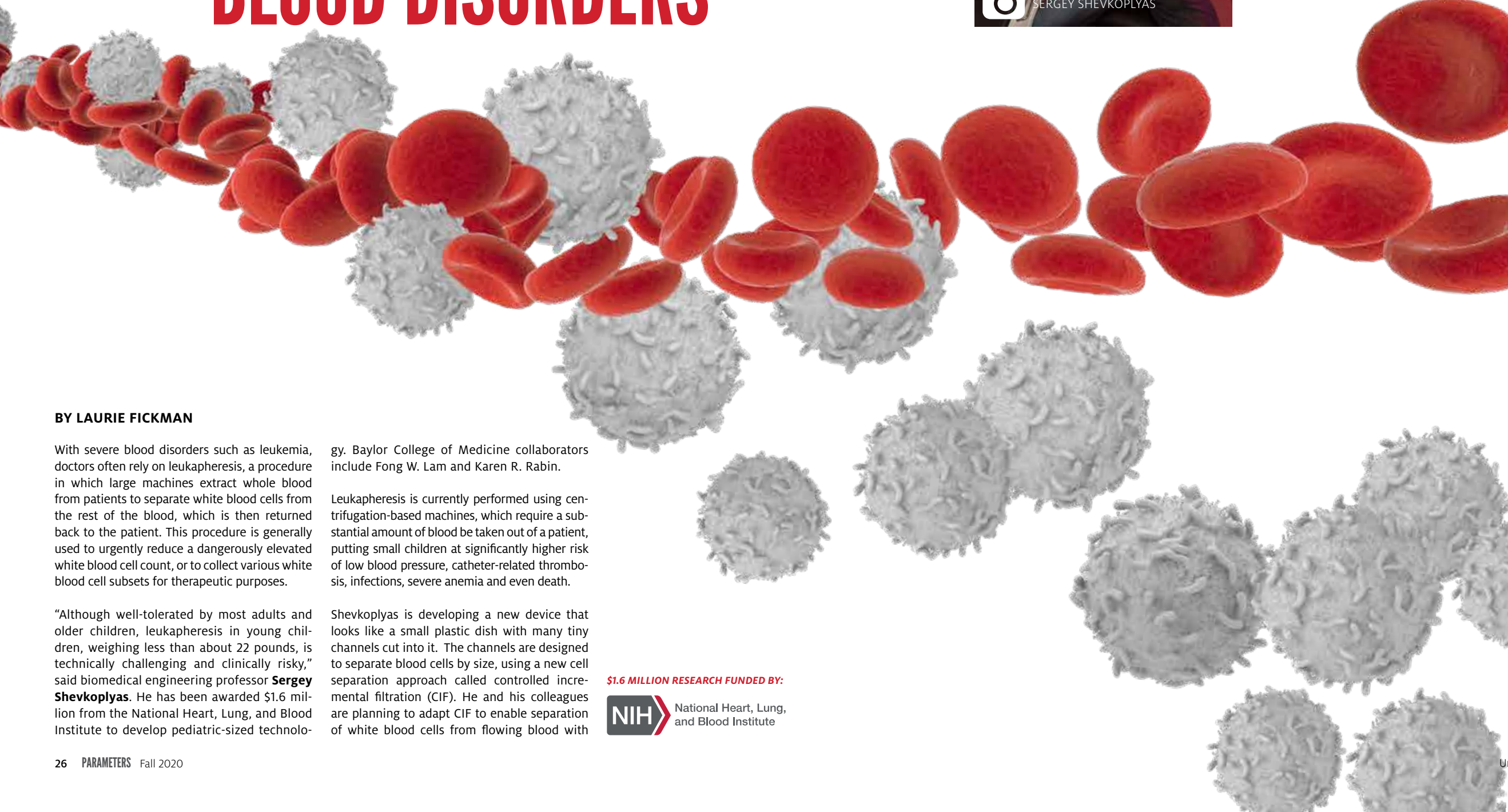
“Our study revealed that these drugs have synergistic effects in inhibiting spheroid formation when used in combination, and suggests that this brain cancer chip enables large-scale, inexpensive and sample-effective drug screening to 3D cancer tumors in vitro. Further, this platform could be applied to related tissue engineering drug screening studies,” said assistant professor **Yasmine Akay**. She is joined on the team by research assistant professor **Naze Gul Avci** and post-doctoral fellow **Hui Xia**. The tissue samples were provided by project collaborator Jay-jiguang Zhu, MD, director, Neuro Oncology, McGovern Medical School at UT Health.

To minimize any sample loss in vitro, the team improved their existing brain cancer chip system by adding an additional laminar flow distribution layer, which reduces sample loss during cell seeding and prevents spheroids from escaping. This allows the spheroids to form uniformly throughout the chip for consistent drug testing between each spheroid. ⚙️



UH Researcher Developing New Device

# TO TREAT BABIES WITH BLOOD DISORDERS



BY LAURIE FICKMAN

With severe blood disorders such as leukemia, doctors often rely on leukapheresis, a procedure in which large machines extract whole blood from patients to separate white blood cells from the rest of the blood, which is then returned back to the patient. This procedure is generally used to urgently reduce a dangerously elevated white blood cell count, or to collect various white blood cell subsets for therapeutic purposes.

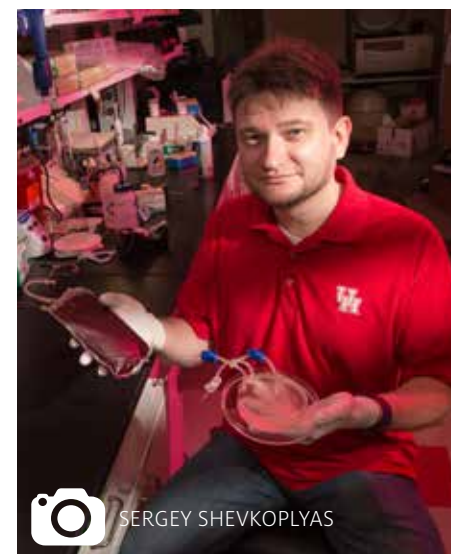
“Although well-tolerated by most adults and older children, leukapheresis in young children, weighing less than about 22 pounds, is technically challenging and clinically risky,” said biomedical engineering professor **Sergey Shevkoplyas**. He has been awarded \$1.6 million from the National Heart, Lung, and Blood Institute to develop pediatric-sized technolo-

gy. Baylor College of Medicine collaborators include Fong W. Lam and Karen R. Rabin.

Leukapheresis is currently performed using centrifugation-based machines, which require a substantial amount of blood be taken out of a patient, putting small children at significantly higher risk of low blood pressure, catheter-related thrombosis, infections, severe anemia and even death.

Shevkoplyas is developing a new device that looks like a small plastic dish with many tiny channels cut into it. The channels are designed to separate blood cells by size, using a new cell separation approach called controlled incremental filtration (CIF). He and his colleagues are planning to adapt CIF to enable separation of white blood cells from flowing blood with

\$1.6 MILLION RESEARCH FUNDED BY:



SERGEY SHEVKOPLYAS

high efficiency, minimal loss of red blood cells and platelets, and at flow rates on par with conventional leukapheresis.

“The ability to perform leukapheresis safely and effectively in these most vulnerable pediatric patients will significantly increase their access to a rapidly expanding range of highly effective cell-based therapies, thus having a potentially transformative impact on health and well-being of children worldwide.”

“Since all the existing machines were built for adults, we have to do something very special for babies, that’s what is inspiring us,” Shevkoplyas said. 🌟

## HEALTH & MEDICINE

### Race-Specific LUPUS NEPHRITIS BIOMARKERS



BY LAURIE FICKMAN



University of Houston Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering, **Chandra Mohan**, and his team have discovered a difference in urinary biomarker proteins of lupus nephritis (LN) in patients according to race. He is reported his findings in *Nature Communications*.

“Among African American patients, the most discriminatory biomarkers that distinguished active LN from inactive disease were urine ALCAM, PF-4, properdin, and VCAM-1,” reports Mohan. Mohan is already collaborating with a biotech partner targeting the ALCAM protein with new therapeutics that can potentially block it in patients with LN. Yet other urine proteins were noted to be discriminatory among Caucasian and Asian patients.

*“The best biomarkers lend themselves to be the best therapeutic targets because they tend to be disease drivers, and that is what is happening here with ALCAM,” said Mohan.*

Systemic Lupus Erythematosus (SLE), also called lupus, is an autoimmune disease that occurs when the body attacks its own tissues and organs. Inflammation from the disease can impact many different parts of the body including joints, skin, kidneys, blood cells, brain and heart. Lupus nephritis is one of the most frequent and severe clinical manifestations of SLE, representing a leading cause of morbidity and mortality.

“While patient demographics are widely known to affect SLE disease manifestations and ➤➤➤

outcomes, there are virtually no studies investigating this phenomenon in the context of disease biomarkers," reports Mohan. "Most SLE biomarker studies focus on one demographic group or all ethnic groups combined, which yield results that may not be equally predictive in all demographic groups of SLE patients."

Mohan's team used an aptamer-based screen with the power to simultaneously interrogate over 1,100 unique proteins, rather than traditional biomarker discovery study designs, which are either based on prior understanding of established pathways underlying LN or analysis of proteins.

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*"In this assay, streptavidin-coated beads labelled with 1,129 unique aptamers are added to each urine sample to allow them to bind to their designated protein targets," said Mohan. Aptamers are synthetic, single-stranded DNA-based molecular recognition elements, which selectively recognize and quantify a wide spectrum of proteins in body fluids or cells.*

"This is one of the largest, if not the largest, screening platforms currently available," said Mohan, who used the screening on 127 patients with inactive lupus, 107 patients with active lupus nephritis, 67 with active non-renal lupus and 74 healthy individuals.

Given the observed variation in urine biomarkers across ethnicities, Mohan's team is planning a longitudinal study which tracks patients for months or years, so that disease flares can be predicted before they actually happen.



Other collaborators on this study are Claudia Pedroza, UT Health; Chaim Putterman, Albert Einstein College of Medicine; Hemant Suryawanshi and Thomas Tuschl, The Rockefeller University; Jill Buyon, New York University; Chi-Chiu Mok, Tuen Mun Hospital Hong Kong; Michelle Petri, Johns Hopkins School of Medicine; and, Ramesh Saxena, University of Texas Southwestern Medical Center. ⚙️



Continuously Tracking Fear Response

# COULD IMPROVE MENTAL HEALTH TREATMENT

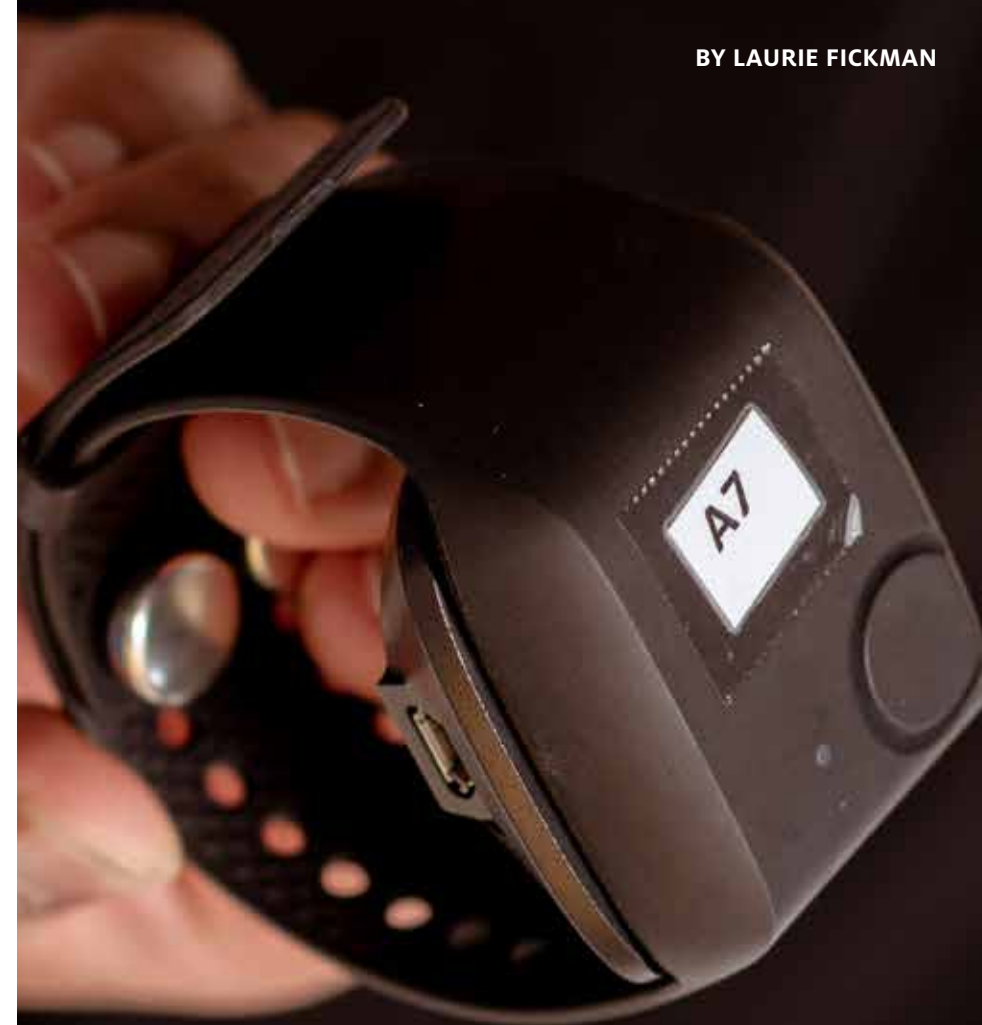
BY LAURIE FICKMAN

*Assistant professor of electrical and computer engineering **Rose Faghii** is not afraid of fear. If continuously monitored, she sees it as a tool to improve mental health treatment.*

So, she and doctoral student **Dilranjan Wickramasuriya** in the University of Houston Computational Medicine Lab (CML), who have previously tracked the fear response through sweat, or skin conductance, have now illustrated that the sympathetic nervous system's activation level can be tracked continuously.



"We developed a mixed filter algorithm to continuously track a person's level of sympathetic nervous system activation using skin conductance and heart rate measurements," Faghii reported in the journal *PLOS One*. "This level of sympathetic activation is closely tied to >>>







ROSE FAGHIH & STUDENTS



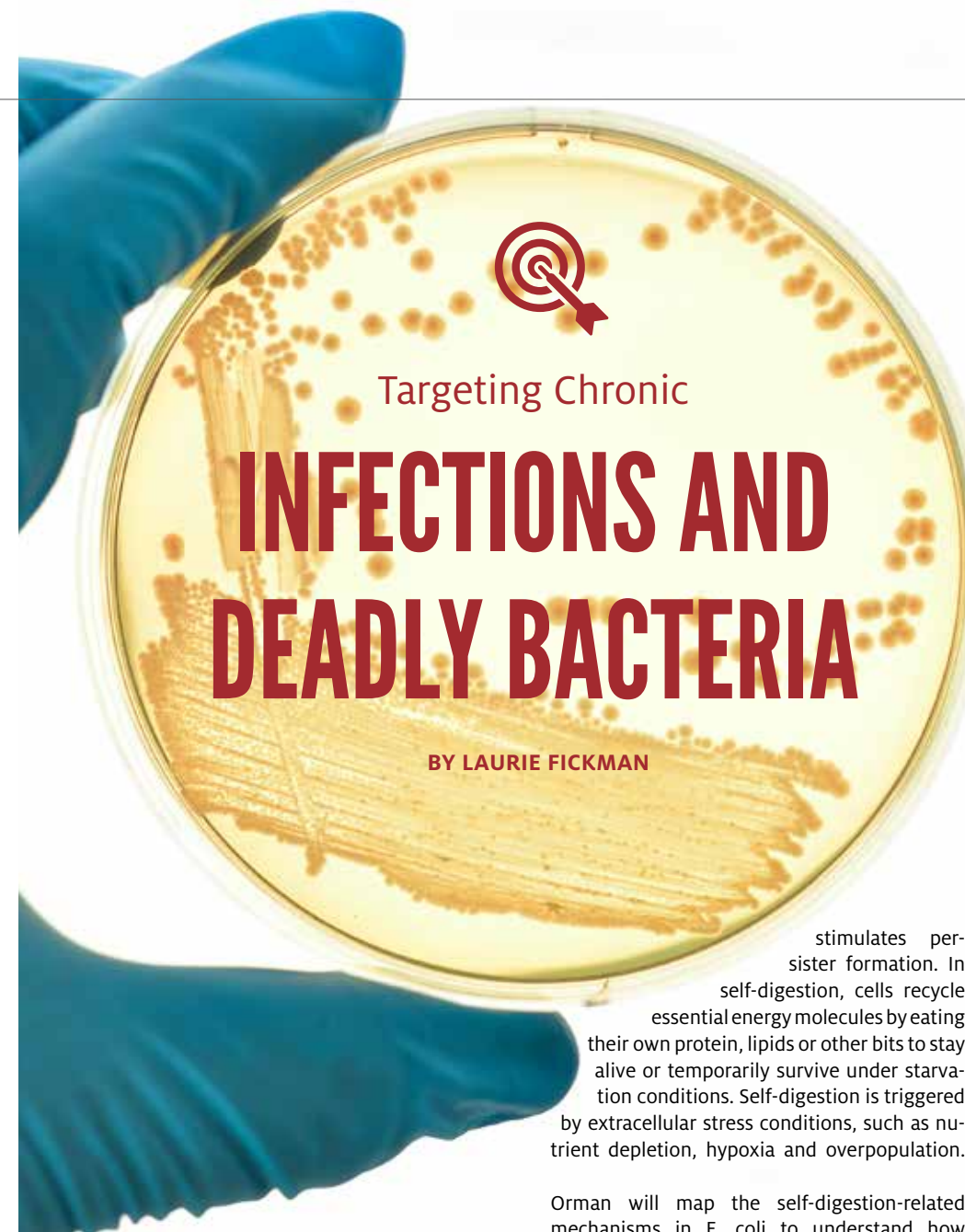
what is known as emotional arousal or sympathetic arousal.”

The sympathetic nervous system controls what is commonly known as the “fight or flight” response, activated when the body is confronted by fear. Sympathetic nerves are a primary part of the response, and their arousal propels a person to action. When the sympathetic nervous system is activated, the heart starts pumping blood faster to send more oxygen to muscles. Then, tiny bursts of sweat released by the body cause a cooling effect.

“Using measurements of the variations in the conductivity of the skin and the rate at which the heart beats, and by developing mathematical models that govern these relationships, CML researchers have illustrated that the sympathetic nervous system’s activation level can be tracked continuously,” Faghih reported.

The ability to track arousal from skin conductance and heart rate together is an important precursor to the development of wearable monitors that could aid in patient care. The algorithm could be embedded in a wearable electronic device to monitor a patient diagnosed with a fear or anxiety disorder.

*“Anxiety and trauma-related disorders are often accompanied by a heightened sympathetic tone and these methods could find clinical applications in remote monitoring for therapeutic purposes,” she said. ⚙️*



Targeting Chronic

# INFECTIONS AND DEADLY BACTERIA

BY LAURIE FICKMAN

stimulates persister formation. In self-digestion, cells recycle essential energy molecules by eating their own protein, lipids or other bits to stay alive or temporarily survive under starvation conditions. Self-digestion is triggered by extracellular stress conditions, such as nutrient depletion, hypoxia and overpopulation.

Orman will map the self-digestion-related mechanisms in *E. coli* to understand how self-digestion is linked to persister cell formation. Then, he will therapeutically explore these mechanisms to identify chemical compounds that can eliminate persister cells.

“Mapping of this comprehensive bacterial pathway from its initial exogenous trigger, through its signal transduction, to the source of antibiotic tolerance, will enable us to develop affective anti-persister therapeutics,” said Orman.

Self-digestion inflicts damage on the cells and can make the cells dormant, putting them in a sleeping mode, and these dormant cells are not effected by antibiotics. The bacterium is less fit to produce protein and resume growth upon exposure to fresh nutrients, providing temporary protection against antibiotics until the self-inflicted damage is repaired.

From an evolutionary perspective, self-diges-

tion is an important survival mechanism. This complex process, which is orchestrated by many regulatory proteins and enzymes, has been well documented in mammalian cells, but largely ignored in bacteria.

“By integrating our expertise in bacterial cell biology with advanced current technologies, we aim to decipher the key components of this pathway to provide a clear and much-needed picture of bacterial self-digestion mechanisms,” said Orman.

Orman, himself, is persistent. Previously he developed methods to directly measure the metabolism of persister cells. He has also discovered that persisters are mostly derived from stationary-phase cells with high metabolic activities maintained by self-digestion. ⚙️

“*If we know how persister cells are formed, we can target their formation mechanisms to eliminate these dangerous cell types.*”

- MEHMET ORMAN





Does Cannabis Use

# AMPLIFY THE EFFECT OF PRENATAL ALCOHOL EXPOSURE & VICE VERSA?

BY LAURIE FICKMAN

An unforeseen consequence of normalization of marijuana use is that adolescents and adults of childbearing age are increasingly engaged in a practice of Simultaneous Alcohol and Cannabinoid (SAC) use, or co-ingestion. A recent U.S. hospital-based assessment revealed that at the time of birth, about 22 percent of assessed umbilical cords were positive for marijuana.

"It is likely, given the documented synergy between ethanol and cannabinoids, that their combined ingestion will, as hypothesized, result in increased neurogenic and neurovascular deficits in exposed offspring," said **Kirill Larin**, University of Houston professor of biomedical engineering.

Larin and collaborator Rajesh Miranda of Texas A&M University received a \$2.5 million grant from the National Institutes of Health to acquire ev-

idence to guide studies on SAC birth outcomes, and to assess the effectiveness of new pharmacological interventions targeted to cannabinoid receptors to prevent or reverse effects of prenatal alcohol exposure (PAE).

PAE is an established cause of brain-based disability and cannabinoids are known contributors to newborn birth defects. "SAC use is motivated and maintained by a phenomenon termed 'cross-fading,' where the combined use amplifies each drug's psychological effects," said Larin. "Cross-fading also appears to contribute to increased craving for both alcohol and marijuana and may contribute to the emergence of poly-substance use."

Larin approaches the research with two questions in mind: Is SAC more dam-

“

*Using alcohol and marijuana together has become an unforeseen consequence of normalization of marijuana, and it can be damaging to unborn children when pregnant mothers ingest both.*”

- KIRILL LARIN

aging to fetal development than either alcohol or cannabinoids alone? And can an anti-cannabinoid drug protect against the effects of PAE and SAC?

"Our studies will focus on the effects of SAC on the formation of nerve tissue and blood vessels, the complementary growth that supports fetal brain development," said Larin. He will use state-of-the-art optical imaging (optical coherence tomography and light-sheet microscopy) and high-resolution ultrasound imaging to assess the effects of SAC on brain and behavior, nerve growth and cerebrovascular blood flow.

"With the increased potency of today's marijuana, as well as the street availability of potent synthetic cannabinoids, a re-evaluation of potential developmental harm is imperative," Larin said. 🧠



Shevkoplyas's Research

# SEEKS NEW WAY TO SEPARATE T-CELLS

BY SARA STRONG

*Doors could soon open wider for cell-based therapies, thanks to research underway in the University of Houston lab of Dr. Sergey Shevkoplyas, associate professor of biomedical engineering.*

With funding from a Cancer Prevention & Research Institute of Texas (CPRIT) grant, Shevkoplyas and his research team are seeking to revolutionize the first step in a patient's individualized cell-based treatment: the harvesting of T-cells from the patient's blood.

Shevkoplyas envisions a new device – simpler and more accessible than existing technology – that can serve many patients who cannot be reached today.

"No one has done this before, but I'm optimistic," Shevkoplyas said.

Over recent years, cell-based therapies have grabbed headlines for their potential to convince a body's natural immune system to launch a search-and-destroy mission against some types of disease agents. Cancer is the usual target, including some kinds of stubborn tumors that tend to defy traditional chemotherapy and radiation treatments. A few non-cancer applications, including Crohn's disease and other autoimmune disorders, can also be treated with cell-based therapies.

Although the science is still in its early stages, positive reports inspire the general public to regard cellular therapies as almost a miracle. The development is indeed a landmark in medical history, but it's not an instant or certain cure.

## The trouble with T's

Challenges begin with the very first step, which is collecting T-cells from a patient's blood. T-cells, a critical part of a healthy immune system, travel through the bloodstream ready to attack invaders or bad cells that might threaten the health of the body.

In some cases though, the T-cells don't know how to recognize the target. That is where the art and science of cellular therapies steps in.

For many of those situations, T-cells can be custom altered so they can attach to a very specific part of a defective cell, then they can do their job of destroying the pathogen. Once altered, they are known as CAR T-cells (for chimeric antigen receptor-modified T-cells).

*But first, they must be collected from the patient, or sometimes a donor.*

The current method of T-cell collection, called leukapheresis, involves passing a large volume of patient's blood continuously through a special machine, which separates T-cells via cen-

trifugation and returns the rest of the blood back to the patient. The system does the job but is slow, taking several hours to complete a collection. The leukapheresis process itself damages many of the cells it captures, so the amount of processed blood must be large enough to accommodate the loss.

The leukapheresis machines are expensive to buy and run. They are also bulky and require specially trained technicians to operate. Add up these factors, and it's hard to find one at work outside major medical centers in large cities of well-developed countries.

"If you have a brilliant system that is available to only a few, the impact is small," Shevkoplyas said. "We looked at this and we said: 'There's got to be a better way.'"

## A different idea

The research team envisions replacing the large centrifugation-based machines with a small device, about the size and shape of a small frisbee, engraved with about a hundred tiny channels specially designed to separate T-cells from the rest of the blood cells by size, in a process called 'controlled incremental filtration' (CIF).

The device will be disposable and easy to operate, without a need for any complex equipment. Instead of attaching a patient to a leukapheresis machine and spinning the blood in a centrifuge to separate the T-cells, a technician would simply pass the blood through the device.

"The patient can come to a regional hospital for this procedure without any need to travel to a major hospital," Shevkoplyas said. He also sees the devices being transportable enough to be taken almost anywhere, even to remote areas of the world.

*"We want to democratize this process," Shevkoplyas said.*

In addition to being less expensive to build and operate, Shevkoplyas sees the new device as doing a better job, too. "It would extract the T-cells very efficiently with no damage to the cells."

Because of this, the device will be able to collect sufficient numbers of T-cells from about a cup or two of whole blood obtained via a regular blood-draw, which is more gentle and much faster than leukapheresis, especially important for patients suffering with serious disease.


The team's work is in its beginning stages, but already is showing good results. "I see good progress. We're ahead of the time frame," he said.

The Cancer Prevention & Research Institute of Texas grant covers \$200,000 of research expenses. The project, titled "Novel High-Throughput Microfluidic Device for Isolating T-cells Directly from Whole Blood to Simplify Manufacturing of Cellular Therapies," is expected to continue through August 2021. 🌟

UH Researchers Win Grant to Create

# SUPERIOR CLASS OF MAGNETIC MATERIALS

BY RASHDA KHAN


 STANKO BRANKOVIC AND ROBLES HERNÁNDEZ

The Semiconductor Research Corp. awarded a three-year, \$240,000 grant to University of Houston researchers to design a new electrodeposition process and solution to create a new alloy with superior qualities and broad applications.

**Stanko Brankovic**, a globally-renowned electrodeposition authority at the UH Cullen College of Engineering, is the Principal Investigator on the project. **Robles Hernández**, an associate professor at the UH College of Technology who specializes in materials characterization using transmission electron microscopy, is the co-PI.

“This research will bring new ways of synthesizing magnetic materials using electrochemical process,” said Brankovic, professor of electric and computer engineering as well as chemical and biomolecular engineering.

Electrodeposition – the electrochemical process of synthesizing a thin layer of metal on top of a different substrate, or conducting surface, to modify its external properties – is a cost-effective approach to creating new alloys. It’s already used to fabricate microelectronics and magnetic recording technologies.

“We combine the parameters of the solution – such as pH, composition and temperature – with fundamental processes at the electrochemical interface, such as additive incorporation, metal deposition, thin film growth, stress control and more,” he said. “This should result in a superior design and synthesis of magnetic materials for applications at the field frequencies beyond 1 GHz.”


Growing use of magnetic thin films and inductor chips for analog circuits in everything from mobile phones to defense sector tech-

nologies is increasing the demand for new alloys with low energy losses to serve as the core material during the electromagnetic induction process.

“Our goal is to design magnetic material which will have very good magnetic properties, such as saturation magnetization, magnetic softness (ability to change magnetization direction at very small external fields), and at the same time be able to support magnetization (permeability) and high electrical resistivity,” Brankovic said. “These are all necessary to create new classes of magnetic materials which will have very low energy losses during electromagnetic induction at high-field frequencies.”

*The new alloys and their electrodeposition/synthesis process developed by the researchers could foresee an immediate and direct implementation in future product designs and development and can be easily integrated in an existing manufacturing scheme.*

Brankovic is also director of the Electrochemical Nanofabrication and Nanomaterials Synthesis Group at the Cullen College. His research team focuses on better understanding of the physical and chemical processes that occur at the electrochemical interface and their uses in producing materials and nanostructures with novel functionality and applications.

“This new research is a continuation of the magnetic materials research carried out by my group for the last 15 years,” he said. “It is based on long standing ideas proposed and proved by my previous fundamental work, which has gained support and validation from industrial partners.” 

## Researchers Take a Cue From Nature to CREATE BULLETPROOF COATINGS

BY JEANNIE KEVER

*Shrimp, lobsters and mushrooms may not seem like great tools for the battlefield, but three engineers from the University of Houston are using chitin – a derivative of glucose found in the cellular walls of arthropods and fungi – and 3D printing techniques to produce high-impact multilayered coatings that can protect soldiers against bullets, lasers, toxic gas and other dangers.*

Although corn is better known as a sustainable, bio-based material, chitin offers promise as a commonly available material that could be processed and used in some products that now require petroleum-based plastics, said **Alamgir Karim**, Dow Chair Professor of chemical and biomolecular engineering.

“What if we could process these materials and get them to a certain level of performance, so we could do some really good things in the plastics world?” he asked. “They would be biodegradable by design, so they could decompose and return to Mother Nature.”

Karim, who also serves as director of the International Polymer & Soft Matter Center and of the materials engineering program at UH, is principal investigator on the project, funded by a \$660,000 grant from the U.S.

Department of Defense. **Venkatesh Balan**, assistant professor of engineering technology, and **Megan Robertson**, associate professor of chemical and biomolecular engineering, are co-principal investigators.

They are charged with developing tough, durable and antimicrobial multilayer films capable of resisting an impact from projectiles or lasers while simultaneously absorbing toxic gas. Karim said the work will also have applications beyond the military, potentially expanding its environmental benefits.

Chitin is the primary component of cell walls in fungi and the exoskeletons of arthropods, including crustaceans, insects and mollusks. It’s also found in fish scales. It can be harvested and processed to produce chitosan, or de-acetylated chitin, a fiber that is also produced and sold as a dietary supplement to treat obesity, high cholesterol, high blood pressure and Crohn’s disease. Chitosan is easier to handle than the brittle chitin.

Balan, whose lab produces bio-molecules for medical and industrial use, is using chemical and enzymatic processes to produce the chitosan molecules using crustacean shells. “We are trying to do the same thing with mushrooms,” he said, noting that mushrooms yield a more consistent degree of polymerization sustainably, helping to standardize production of chitin and then process it to become chitosan.


A stable source of chitosan polymers will be just the beginning. Robertson will determine how to alter the atomic composition at the surface of the chitosan in order to improve how it interfaces with the functional layers. Her research includes designing sustainable and biodegradable polymers derived from renewable resources.

*That enhanced compatibility between the chitosan and the polymer will improve the coating’s ability to trap gas or absorb the impact from a projectile, she said.*

That’s where Karim comes in – he is engineering a multilayer system that will be comprised of a hardened impact-resistant layer; an energy-absorbing crush layer reminiscent of the

way modern cars are designed to crumple on impact, safeguarding the passenger capsule; a layer to absorb toxic gas, with charcoal nanoparticles dispersed in the chitosan; and a textile adhesion layer, which will bind the coating to canvas and other textiles.

That will involve 3D printing different chitin nanoparticles and chitosan-fabricated or reinforced crush-zone design structures and testing them to determine their ability to withstand an impact.

“It is a very good, environmentally friendly project,” Karim said, and one that will have applications for the automobile, construction and other industries. 

“

*What if we could process these materials and get them to a certain level of performance, so we could do some really good things in the plastics world?*

”

- ALAMGIR KARIM



## New Material, Modeling Methods PROMISE ADVANCES IN ENERGY STORAGE

BY JEANNIE KEVER

The explosion of mobile electronic devices, electric vehicles, drones and other technologies have driven demand for new lightweight materials that can provide the power to operate them. Researchers from the University of Houston and Texas A&M University have reported a structural supercapacitor electrode made from reduced graphene oxide and aramid nanofiber that is stronger and more versatile than conventional carbon-based electrodes.

The UH research team also demonstrated that modeling based on the material nanoarchitecture can provide a more accurate understanding of ion diffusion and related properties in the composite electrodes than the traditional modeling method, which is known as the porous media model.

“We are proposing that these models based on the nanoarchitecture of the material are more comprehensive, detailed, informative and accurate compared to the porous media model,” said **Haleh Ardebili**, Bill D. Cook Associate Professor of Mechanical Engineering at UH and corresponding author for a paper describing the work, published in ACS Nano.

More accurate modeling methods will help researchers find new and more effective nanoarchitected materials that can provide longer battery life and higher energy at a lighter weight, she said.

The researchers knew the material tested – reduced graphene oxide and aramid nanofiber, or rGO/ANF – was a good candidate because of its strong electrochemical and mechanical properties. Supercapacitor electrodes are usually made of porous carbon-based materials, which provide efficient electrode performance, Ardebili said.

While the reduced graphene oxide is primarily made of carbon, the aramid nanofiber offers a mechanical strength that increases the electrode’s versatility for a variety of applications, including for the military. The work was funded by the U.S.

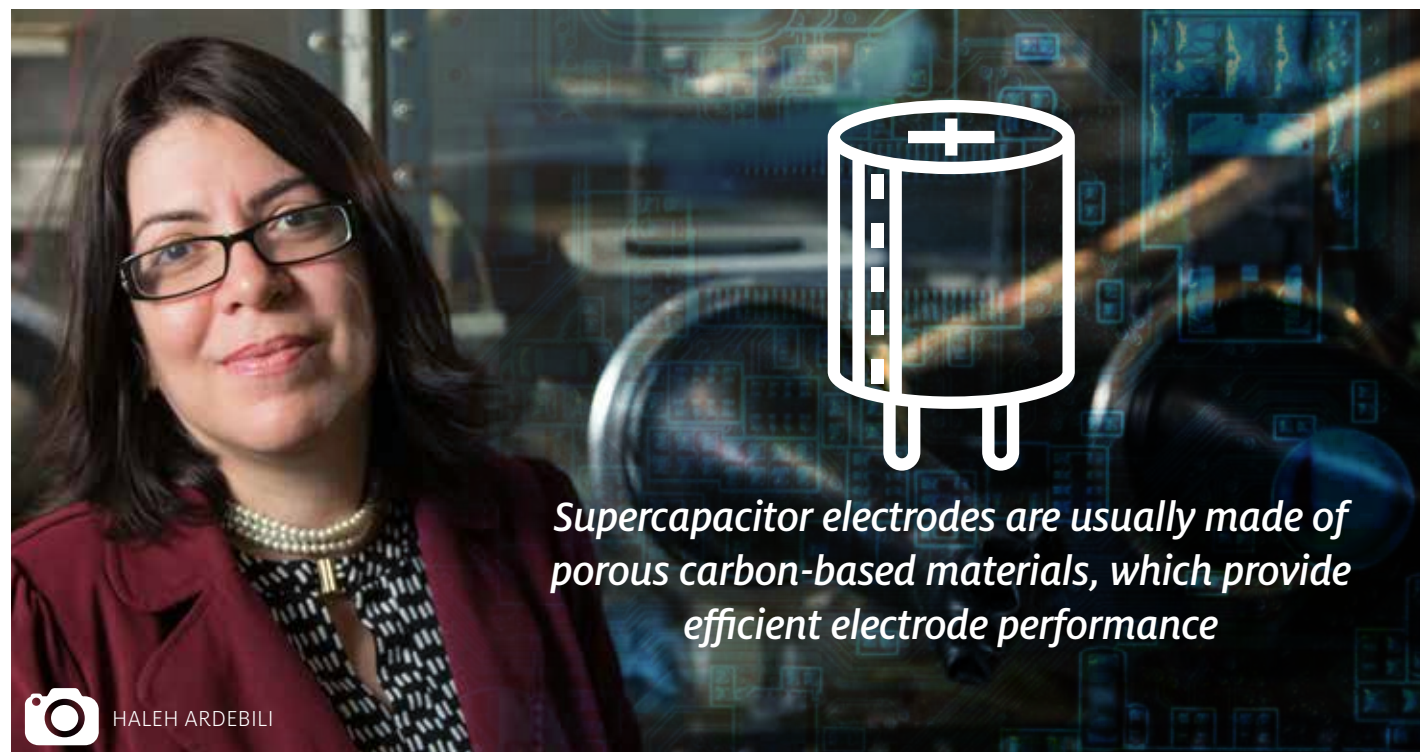
## MATERIALS

Air Force Office of Scientific Research.

In addition to Ardebili, co-authors include first author **Sarah Aderyani** and **Ali Masoudi**, both of UH; and Smit A. Shah, Micah J. Green and Jodie L. Lutkenhaus, all from A&M.

The current paper reflects the researchers’ interest in improving modeling for new energy materials. “We wanted to convey that the conventional models out there, which are porous media-based models, may not be accurate enough for designing these new nanoarchitected materials and investigating these materials for electrodes or other energy storage devices,” Ardebili said. That’s because the porous media model generally assumes uniform pore sizes within the material, rather than measuring the varying dimensions and geometric properties of the material.

“What we propose is that yes, the porous media model may be convenient, but it is not necessarily accurate,” Ardebili said. “For state-of-the-art devices, we need more accurate models to better understand and design new electrode materials.” ⚡



*Supercapacitor electrodes are usually made of porous carbon-based materials, which provide efficient electrode performance*



HALEH ARDEBILI

## TECHNOLOGY

# Harnessing the Power of GALLIUM NITRIDE & MACHINE LEARNING

BY JEANNIE KEVER

Military installations, especially on ships and aircraft, require robust power electronics systems to operate radar and other equipment, but there is limited space onboard. Researchers from the University of Houston will use a \$2.5 million grant from the U.S. Department of Defense to develop compact electronic power systems to address the issue.

**Harish Krishnamoorthy**, assistant professor of electrical and computer engineering and principal investigator for the project, said he will focus on developing power converters using gallium nitride (GaN) devices, capable of quickly storing and discharging energy to operate the radar systems.

He is working with co-PI **Kaushik Rajashekara**, professor of electrical and computer engineering, and Tagore Technology, a semiconductor company based in Arlington Heights, IL. The work has potential commercial applications, in addition to military use, he said.

Currently, radar systems require large capacitors, which store energy and provide bursts of power to operate the systems. The electrolytic capacitors also have relatively short lifespans, Krishnamoorthy said.

GaN technology offers the promise of more efficient and compact power conversion than silicon-based technology. That’s because they are wide bandgap semiconductors. GaN devices can be turned on and off far more quickly – over 10 times as quickly as silicon devices, Krishnamoorthy said. The resulting higher operating frequency allows passive components in the circuit – including capacitors and inductors – to be designed at much smaller dimensions.

But there are still drawbacks to GaN devices. Noise – electromagnetic

interference, or EMI – can affect the precision of radar systems, since the devices work at such high speeds. Part of Krishnamoorthy’s project involves designing a system where converters can contain the noise, allowing the radar system to operate unimpeded.

He also will use machine learning to predict the lifespan of GaN devices, as well as of circuits employing these devices. The use of GaN technology in power applications is relatively new, and assessing how long they will continue to operate in a circuit remains a challenge.

“We don’t know how long these GaN devices will last in practical applications, because they’ve only been used for a few years,” Krishnamoorthy said. “That’s a concern for industry.” 🔴



There are big advantages to 5G networks. In addition to faster speeds, 5G offers greater bandwidth and network capacity, paving the way for a future of driverless cars, connected devices and more high-definition connections for virtual meetings and telemedicine. But the rollout in the United States and elsewhere has been stymied by gaps in available technology that could operate at the high frequencies required by 5G.

An electrical engineer at the University of Houston is creating a roadmap toward that 5G future, using a \$1.7 million grant to design and build a system capable of supporting 5G infrastructure.



**Harish Krishnamoorthy**, assistant professor of electrical and computer engineering, is working on the Department of Defense-funded project with New Edge Signal Solutions, a Massachusetts company which builds high-speed broadband radio frequency systems. Krishnamoorthy, whose lab focuses on power electronics, said successful adoption of 5G networks will require adapting software to support the demands. “But first, we need hardware that is fast enough and capable of supporting 5G.”

That’s where he comes in, charged with developing a higher power 5G envelope tracking power supply that can operate with a bandwidth of 100 megahertz (MHz) or higher; current state-of-the-art envelope bandwidth in commercial applications is about 20 MHz for a peak power of greater than 65 watts, he said. The higher bandwidth allows 5G systems to offer better speed, resolution and clarity.

Envelope tracking is a type of power supply modulation technique that continuously adjusts the converter voltage used by the radio frequency power amplifier in order to keep it running at peak efficiency. Boosting both frequency and power at the same time is technically challenging, in part because of the excess heat produced. The continuous adjustment via envelop tracking can significantly reduce the amount of waste heat produced by the system, despite the higher power output.

4G systems, by comparison, typically operate on established frequencies at lower peak power and at a lower bandwidth. One hundred MHz is just a starting point for 5G, Krishnamoorthy said. “Even getting to that point is hard with current technology. We will need to advance power electronics to support that.” The goal over the five-year life of the project is to exceed 100 MHz at close to 200 watts peak power.

Krishnamoorthy said the work will proceed in steps, “through the use of better device technologies, paralleling power converters and including a smart error correction technique, without which we would be unable to achieve the efficiency as well as linearity targets of the project.”



# UH Researchers Improving Resolution in 3D DATA COLLECTED BY DRONES

BY JEANNIE KEVER



Drones have become a quick and relatively inexpensive way to capture on-the-ground images of geographic areas, offering valuable information to soldiers and others.

But those images have a drawback: they often can’t accurately be compared with images taken previously – images which generally were collected using different standards and formats – in order to determine how the terrain has changed over time.

Researchers with the National Center for Airborne Laser Mapping at the University of Houston are using a \$1.89 million grant from the U.S. Army Corps of Engineers to create a set of algorithms that would allow users to more precisely align datasets collected at different times and reliably estimate changes between images

captured at different times.

**Craig Glennie**, principle investigator with NCALM and associate professor of civil and environmental engineering at UH, said just-in-time data collected by drones can be helpful on the battlefield or in other circumstances. “More and more, people want to take older data and compare it to newer data and see if anything has changed, and there’s not really a mechanism to do that with any confidence.”

The main investigators on the project are **Preston Hartzell**, an assistant research professor at NCALM who is also involved in a similar project funded by the National Geospatial-Intelligence Agency, and Glennie. The most complete datasets are collected by aircraft flying over an area, which allows researchers to use more powerful mapping equipment and to access GPS satellite data. The combination of more powerful equip-

ment and GPS data makes those datasets more precise, Glennie said.

*Drone-collected data offers a different advantage – drones are small, nimble and less intrusive. But they aren’t able to access GPS data as accurately and, because the equipment they carry is smaller and lighter weight, they can’t collect as much information.*

To allow researchers to reconcile disparate datasets, Hartzell and Glennie will develop new algorithms – Glennie describes them as a new tool set – that can

accurately highlight data signaling changes while ignoring extraneous or inconsequential data.

NCALM is a National Science Foundation-supported research center, based at UH and operated in conjunction with the University of California-Berkeley to provide LiDAR-generated topographical data for researchers around the world. This project is an extension of its ongoing earth science work, including earthquake monitoring projects.

Glennie said the results will be useful in mapping natural disasters, as well as for military applications, including to help Houston and other cities accurately gauge the extent of flood damage following a hurricane or other major storms.

The resulting tools and methodology will be shared with other researchers through the open-source Point Data Abstraction Library.

THE STORY OF UH'S

# FIRST

BLACK WOMAN CHEMICAL ENGINEER

BY STEPHEN GREENWELL



SINCE HER EARLIEST DAYS GROWING UP IN HOUSTON'S THIRD WARD, CYNTHIA OLIVER COLEMAN, P.E., SAID HER PARENTS TOLD HER THE *DREAM* THEY HAD FOR HER, AND THAT SHE NEEDED TO STUDY HARD TO MAKE GOOD GRADES SO SHE COULD GET A SCHOLARSHIP FOR COLLEGE.

"My parents were never able to attend college, and they always had low-paying jobs," she said. "So the *DREAM* was for me to obtain a college degree that would enable me to secure a high-paying job."

In high school, Coleman excelled. She was a member of the National Honor Society, Student Council and the Charmettes Social Club; the first girl in the Junior Engineering Technological Society; the recipient of two science fair trophies; the captain of the Archery Team; and a finalist in the National Achievement Scholarship Program.

**"UPON GRADUATION, I WAS AWARDED THE SCHOOL BOARD PLAQUE FOR OUTSTANDING SENIOR GIRL, RECOGNIZED AS VALEDICTORIAN OF MY CLASS OF 1967, AND I WAS AWARDED TWO SCHOLARSHIPS – THE FOUR YEAR WORTHING SCHOLARSHIP, AND THE FIVE YEAR LADIES AUXILIARY OF TEXAS SOCIETY OF PROFESSIONAL ENGINEERS SCHOLARSHIP," SHE SAID.**

But when she was first considering her post-secondary education options, her choices seemed limited if she wanted to pursue chemical engineering, despite her stellar academic record and extracurriculars. >>>

"As I was growing up, Texas Southern University was the only college I knew I could attend because it was the only Black college in the Third Ward," she said. "In my junior year in high school, I just happened to hear about engineering. When I realized I could not obtain a chemical engineering degree from Texas Southern University, I started looking for another college."

The University of Houston was a private school until 1963, at which point it also started to desegregate. Coleman started at the school in 1967, and later became the first Black woman chemical engineering graduate in 1971. She and another woman were also the first two women to graduate with chemical engineering degrees.

**"I TOOK A HUGE LEAP OF FAITH TO PURSUE CHEMICAL ENGINEERING AT UH BECAUSE IT WAS A WHITE UNIVERSITY THAT HAD RECENTLY INTEGRATED IN 1963," SHE SAID. "I WAS NOT SURE HOW I WOULD BE TREATED WHEN I STARTED AT UH IN 1967, BUT THE ATMOSPHERE WAS OKAY AND BETTER THAN THAT OF SEVERAL OTHER SOUTHERN UNIVERSITIES THAT WERE SHOWN ON TV DURING THIS TIME."**

Coleman added that there was another cultural pressure at the time beyond race.

"When I was at UH, I was a young Black woman pursuing chemical engineering during a time when women were discouraged from pursuing the male-dominated engineering profession, because nobody would hire a woman as an engineer, especially not a Black woman," she said.

Coleman said initially, her engineering classmates were "civil but not welcoming," so she felt isolated at times. However, the ability to go home to her parents helped.

"I was a commuter student with no car, so my parents drove me to UH early in the morning and picked me up in the evening with the one car my family had," she said. "My parents understood how hard I had to work so they made sure that our home was a quiet and loving place for me to study very long hours."

The hard work paid off though, as Coleman racked up a string of accolades, including being on the Dean's List for five consecutive semesters. She was a member of the National Honor Society for Freshman Women students, as well as the National Honor Society for Chemistry Women. Her sophomore year, she received the American Institute of Chemical Engineers Scholarship, and she was awarded the American Institute of Chemical Engineers Award, for being the outstanding sophomore with the highest overall GPA. In her junior year, she received the Atlantic Richfield Scholarship.

Socially and academically, Coleman pointed at two Greek organizations as being key in her development.

"In 1969, I became the second woman to be initiated in UH's chapter of Tau Beta Pi, the prestigious National Honor Society for engineering students," she said. "Later, I became the first woman to hold an office. For many decades, women were not able to join the prestigious Tau Beta Pi, but later its constitution was amended to permit women who >>>



COLEMAN WORKING ON A CHEMICAL ENGINEERING EXPERIMENT. PHOTO ORIGINALLY TAKEN IN 1971. COURTESY OF HOUSTON PUBLIC LIBRARY.





COLEMAN SPEAKING AT THE 2019 ANNUAL 'WOMEN IN RED' NETWORKING EVENT HOSTED THROUGH THE CULLEN COLLEGE OF ENGINEERING.

qualified to join. Later, I was elected Secretary of UH's chapter of American Institute of Chemical Engineers. Some of my fondest memories of being at UH were meeting my future husband and being initiated in Alpha Kappa Alpha Sorority, Inc., which was the first Black sorority on campus."

Coleman said her engineering professors were equally as tough and supportive with her as any other student. Coleman noted that one of the professors later became her advisor, and that he challenged her to excel in her engineering studies.

"He was the best advisor for me," Coleman said. "His name was Dr. Frank Worley, and he was undoubtedly the toughest advisor on campus, but he helped me to overcome my doubts about engineering. He also helped me realize how resilient I was and that I could achieve more than I ever thought possible. I graduated Magna Cum Laude with a B.S. in chemical engineering."

**DESPITE HER ACADEMIC SUCCESS THOUGH, COLEMAN SAID SHE AND HER PARENTS WERE ALWAYS WORRIED ABOUT WHETHER COMPANIES WOULD HIRE A WOMAN ENGINEER. AS A RESULT, SHE WORKED HARD TO SECURE MULTIPLE INTERNSHIPS.**

"Due to the uncertainty about women being able to get a job as an engineer, my parents insisted that I prove to myself that at least one engineering company would hire me," she said. "In addition to studying so hard, I searched for a summer internship by calling almost every engineering company in Houston to secure my first work experience. Brown and Root Construction Company hired me as a process engineer, and everyday my parents would drive me there and pick me up."

The next summer, she completed an internship as a reservoir engineer at the Shell Oil Company. She was still worried about landing a job after college, but she was pleasantly surprised when Exxon – known as Humble Oil at the time – Shell and other companies all extended offers to her.

"Exxon's offer was the overall best, and it also enabled me to work in downtown Houston, not far from the Third Ward where I grew up," she said, adding that it capped off a slew of 'firsts' for her and her family.

"On 1971 graduation day, my parents' **DREAM** for me that later became my **DREAM** for myself was fulfilled better than any of us could have imagined! I had achieved both the college degree and secured a high-paying job! Additionally I became the first Black woman as well as one of the first two women ever to receive a chemical engineering degree from UH. Also, I became first in my family to graduate from college. Then, I bought my first car and started my chemical engineering career at Exxon, where I was surprised to learn that I was Exxon's first and only woman engineer."

Since her graduation, and during and after a 33-year career at Exxon, Coleman has been an important supporter of University of Houston programs. In 2019, she was inducted into the Cullen College of Engineering Bridgebuilder Society. The society recognizes and honors individuals who have made impactful gifts to the college. It is the highest honor the college bestows upon a donor.

Coleman has remained involved with efforts to recruit and to support first-generation college students at the university. She is a frequent contributor to the yearly Women in Engineering celebration, the Women in Red Movement, and an award named in her honor is given to the >>>



COLEMAN RECEIVING HER BRIDGEBUILDER AWARD FROM DEAN TEDESCO



COLEMAN AT THE 2019 WOMEN IN RED EVENT

top graduating female senior student. She said her experience as being the 'first' in many ways – first from her family to graduate college, first Black woman chemical engineering graduate from UH, first woman engineer at Exxon – inspires her to continue giving back.

**“BECAUSE MY DREAM CAME TRUE ON GRADUATION DAY, I IMMEDIATELY STARTED MY LIFELONG MISSION TO HELP OTHER WOMEN AND MINORITIES TO PURSUE ENGINEERING,” SHE SAID. “NOW ALMOST 50 YEARS LATER I AM STILL ON THAT MISSION TODAY.”** ⚙️

## THE CULLEN COLLEGE'S COMMITMENT TO RACIAL EQUALITY

BY STEPHEN GREENWELL

As part of the University of Houston's continued commitment to having a robust and diverse student body, the Cullen College of Engineering has several initiatives and faculty positions related to recruiting, retaining and cultivating minority students.

The most prominent of these efforts is the Program for Mastery in Engineering Studies – PROMES. Pronounced “promise,” the program provides engineering students with recruitment, academic advising, workshops, scholarships and professional and personal development opportunities. As a result, it often supports first-generation college students.

**Jerrod Henderson** is the director of PROMES and an instructional associate professor of chemical and biomolecular engineering. He has been in that role for four years now, and has noted some of the strengths of UH as compared to other institutions.

“I believe that UH is not only a place that has the diversity in numbers, but also, unlike many places, there is an appreciation for diversity and inclusion,” he said. “There are resources to support our diverse student body. For example, there are affinity group support organizations like the Society of Asian Scientist and Engineers, the National Society of Black Engineers, and the Society of Hispanic Professional Engineers and the UH Center for Diversity and Inclusion.”

University-wide, there has been a push to increase the diversity of the faculty. According to July 2020 figures released by UH, minority tenured and tenure-track faculty members increased by 46 percent from 2014 to 2019. A five-point plan was adopted to increase opportunities, which includes an emphasis on using rubrics and behavioral interviewing to mitigate bias, as well as mid-career workshops and more robust health-care and childcare options for employees.

Henderson has also been named as a Cullen College representative who will serve on the university's Race Relations and Social Justice Committee, along with **Dean Joseph Tedesco** and **Deborah Rodrigues**, an asso-

ciate professor of civil and environmental engineering. He was hopeful that this group would be focused on actionable steps, as opposed to just general talk about increasing diversity.

“As a part of the task force, I hope that we move beyond conversations to action,” he said. “I hope that we are able to make recommendations of evidence based approaches to impact Race Relations and Social Justice.”

Henderson added that he already saw some opportunities for the Cullen College to attract and recruit students with an increased presence at events.

“I would like to see more initiatives and action taken to recruit more underrepresented minorities [URM] in STEM,” he said. “For example, I attend conferences like the National Society of Black Engineers Annual Conference, the Black Engineer of the Year Awards and Conference, and the Society of Hispanic Professional Engineers Annual Conference. UH does not have a strong presence at the College or Graduate School Fairs at these conferences. We often have discussions on how to increase the numbers of URM in STEM on campus, I believe one simple step is to attend and have a strong presence at these conferences that URM students attend.”

Doing more outreach at the high school level, and also offering more financial support and help with standardized testing, were other action items Henderson suggested.

“We need more recruitment scholarships for URM students, because we know that the financial burden of college may make it virtually impossible for students to attend,” he said. “This barrier is often exacerbated among first generation and URM students. I've also met URM students who want to attend college, and who might even have good high school grades, but they are not accepted into college or their major because of lack of preparation for standardized tests like the ACT and SAT. Often, exposure to the mechanics of these standardized tests and test prep may help these students perform better.” ⚙️



**EGR COOGS vs. COVID**  
FACING OFF AGAINST A  
GLOBAL PANDEMIC

IN MID-MARCH, AS THE NOVEL CORONAVIRUS BEGAN TO RIP THROUGH HARRIS COUNTY, THE UNIVERSITY OF HOUSTON MADE AN UNPRECEDENTED MOVE TO TRANSITION ALL INSTRUCTION AND SERVICES ONLINE – A DIFFICULT BUT NECESSARY DECISION. DESPITE THE CHALLENGES IN NAVIGATING THIS NEW VIRTUAL WORLD, THE CULLEN COLLEGE IMPROVISED AND FOUND WAYS TO CONNECT AND CELEBRATE THE MILESTONES AND SUCCESSSES OF ITS COMMUNITY. WE WERE FORCED TO CHANGE, AND WITH THAT WE HAVE LEARNED MANY IMPORTANT LESSONS ALONG THE WAY REGARDING OUR CAPACITY FOR RESILIENCE AND STRENGTH.

As the world continues its battle with SARS-CoV-2, much remains unknown about how life will continue to adapt as we learn to live with the virus. And one day, when the novel coronavirus is no longer a threat, all we will have left will be the lessons we learned and the stories we tell. Stories of how our students persevered, how our alumni supported the community, and the breakthroughs our researchers made. These stories of resilience, innovation and hope will tell others of our experiences and will hopefully help pave the way for a better future. >>>

# PUSHING THROUGH THE PANDEMIC: UH STUDENTS THRIVE DESPITE CHALLENGING WORLD CONDITIONS

BY STEPHEN GREENWELL

**FORCED TO ADAPT BECAUSE OF THE WORLDWIDE COVID-19 PANDEMIC, THIS YEAR'S GRADUATES OF THE CULLEN COLLEGE OF ENGINEERING NEVERTHELESS PROVED THEIR RESILIENCY, USING REMOTE LEARNING AND TECHNOLOGY TO NETWORK WITH THEIR CLASSMATES AND PROFESSORS, AND TO EARN THEIR DEGREES.**



FARES ALJAWFI

**Fares Aljawfi** began his educational journey in the United States for the spring semester of 2015 at Houston Community College. However, the transition was immediately difficult for him, and it has continued through the pandemic.

"Two months into my first semester here in the states, a civil war started in Yemen, my home country," he said. "It was very unfortunate and worried me to accept the fact that my family is always under the danger of being attacked by airstrikes. But, my family was always very supportive. With some encouragement from my parents, I decided to continue my journey and never give up on my dream of being an engineer."

Aljawfi graduated from HCC with highest honors in May 2017, at which point he transferred to the University of Houston to pursue a bachelor's degree in mechanical engineering at the Cullen College of Engineering.

"I was granted temporary protect-

ed status in the United States, and I was able to obtain a work authorization card through my new status," he said. "It was challenging to keep up with my four engineering classes and work a full-time job to help and support myself. Day after day, I had to alter my life and work harder to reach my goals. And by the end of my bachelor's degree, the COVID-19 pandemic started."

Unfortunately, Aljawfi felt the effects of this worldwide issue directly. His grandparents passed away shortly before he took his senior year finals, and before his virtual graduation ceremony.

"I lived with my grandparents from the age of two to seven years old. I spent five years at my grandparents' home and I was very close to them," he said. "They were one of the main reasons I had the passion to continue my education at a university in the United States. They have always been encouraging and supportive, and I never imagined that I was never going to see them again when I left my country back in 2015."

While Aljawfi has a lot of experience already with remote learning and staying in touch with his family virtually, it hasn't necessarily been by choice.

"During the five years I've been a student here, I have never traveled back home," he said. "I haven't seen my family in over five years except in video calls. Airports in Yemen have been permanently closed since the beginning of 2015. It is one of the hardest feelings. I left my home country with the hope that I could see my family every summer or at least every other summer."

Aljawfi said he was able to finish his degree because of the strong support system he's built in the United States. He was a member of the University of Houston's Formula Society of Automotive Engineers team, helping to design the suspension system for a competition Formula-styled race car.

As far as the future goes, Aljawfi says he wants to earn his master's in mechanical engineering at



some point, but he's also open to opportunities in industry. He's also preparing to take the Fundamentals of Engineering Examination, which is one of the steps to become professionally licensed.

When it comes to the past and his work to complete his degree, though, he thinks of his grandparents.

"I had to stay here in Houston to continue my last semester and finalize my senior design project," he said. "I am dedicating my bachelor's degree to my grandparents. I wish they had the chance to live and see me graduate, because I was sure that they were going to be so proud of my accomplishments as their oldest grandson."

**ONLINE ALLOWS FOR INCREASED COMMUNICATION, VIRTUAL GRADUATION SPEAKERS**

**Christian Bernard Alarcon** completed his B.S. in biomedical engineering this spring, thanks in part to the support from his friends.

"My groupmates and I, for the engineering senior design projects, we had to switch to using Google Calendar and regular reminders through texts in order to discuss meetings and remind ourselves when Zoom calls would occur," he said. "Despite not being able to physically work on our projects, we came up with a thorough review of the literature that supports our project."

Although Alarcon was able to complete his degree, he did have to adjust his research plans with the "Brain on Art Initiative", which is led by **Dr. Jose Luis Contreras-Vidal** in electrical and computer engineering.

"We halted plans to run a spotlight exhibition with the Blaffer Museum due to the campus closures," he said, adding that he was hopeful that something could be done in the future, since he is staying in the Houston area. "We've adjusted our focus from data collection to data analysis and machine learning from years of pre-collected data from other projects."

Part of the sprint down the final stretch for his degree included regular Zoom calls with his friends, Alarcon said, as web streams replaced face-to-face contact. With everyone forced inside, it even increased communication at times.

"It's strange to say, but we saw each other more often through these online calls," he said.

The effort to stay in touch culminated with their own graduation ceremony, featuring about a dozen friends. Alarcon said they even had two alumni speakers for the event – **Keana Madrinan** (UH '18, B.S. in Kinesiology: Exercise Science) and **Cameroon Gomez** (UH '19, B.S. in Kinesiology: Fitness and Sports).

"It was a fun time," he said, laughing. With his bachelor's degree in hand, Alarcon said he will be continuing at the University of Houston this fall, albeit in a different department.

"I'm currently shifting the skills I've learned in biomedical engineering to focus more on clinical biology," he said. "I'll be staying in Hou-

ston to join the College of Natural Sciences and Mathematics masters in biology program.

**THE TRANSITION HAS ACTUALLY NOT BEEN DIFFICULT SO FAR. I'VE BEEN PRETTY ACTIVE WORKING FOR DR. CONTRERAS-VIDAL'S ECE LAB, SO I STILL GET TO LEARN TRANSLATIONAL ENGINEERING AND MEDICAL RESEARCH."** ⚙️

JOINING THE FIGHT:

## UH ENGINEERING PROFESSORS TURN THEIR FOCUS TO COVID-19 RESEARCH IDENTIFYING VULNERABLE POPULATIONS

BY STEPHEN GREENWELL

A trio of researchers connected to the University of Houston has developed a planning tool to identify vulnerable portions of the population most in need of testing and support, with those along industrial areas and well-traveled waterways at the most risk.

**Dr. Hanadi Rifai**, a professor of civil and environmental engineering at the University of Houston, is the corresponding author for a new paper, "Assessing COVID-19 Risk, Vulnerability and Infection Prevalence in Communities." The co-authors are **Dr. Winston Liaw**, a professor of health systems and population health sciences at the College of Medicine; and **Dr. Amin Kiaghadi**, a joint affiliated postdoctoral fellow working with Rifai and Dr. Clint Dawson at the University of Texas' Oden Institute for Computational Engineering & Sciences.

Liaw said, "Using this tool, policymakers can identify neighborhoods with a higher potential for becoming the next hot spots, efficiently match community resources with community needs, and

ensure that equipment, personnel, medications, and support are available to everyone, particularly the most vulnerable and those in greatest need. This strategy is essential to address historical trends that have preferentially delivered resources to those with means resulting in gaps in quality."

"The work we did is important, but more than that, it is needed by many decision-makers," Kiaghadi said. "I am not sure there is any study like this one that could provide a holistic perspective on vulnerability by looking at various aspects of it."

Rifai said that based on preliminary analyses, there are some population groups – such as older people, those with preexisting health conditions or people with respiratory illnesses – that are more at-risk for transmission of and death from the coronavirus. By using census data, Rifai said their goal was to identify these populations ahead of time to proactively guide public resources.

"We're not saying this is the final

answer, we're saying that the framework is an advisable one for our communities going forward," Rifai said. "If you're in a higher vulnerability category, then you can make an informed decision to work remotely and prevent exposure."

For their work, the researchers identified five categories of at-risk populations:

1. People with limited access to hospitals and medical care.
2. People with underlying medical conditions, like respiratory illnesses and hypertension.
3. People with higher environmental exposures like air pollution and water contamination.
4. People in areas vulnerable to natural disasters and flooding.
5. People with specific lifestyle factors, like obesity, drinking and smoking.

According to the paper, the highest-overall risk areas based on all five categories are in economically disadvantaged communities along with those located near the Houston Ship Channel (HSC) and the

east and northeast parts of the county, while the populations with the least combined risk factors were in the western fringes of Harris County.

Kiaghadi said, "The fact that if you live in a specific part of the county, that makes you more vulnerable to the disease because you have been exposed to chemicals, or in an area prone to flooding, and have less access to medical care, is something I wanted to highlight by doing this research."

According to figures from the paper based on 2018 census tract data, there are 722,357 residents of Harris County – about 17 percent of the population – in at least one risk category. Of this group, 171,403 are between 45 and 65 years old, and 76,719 are 65 years old or greater – both of which have been identified as being higher at-risk groups for death from COVID-19.

Rifai said that that in some ways, the current COVID-19 pandemic had similarities with the research



her group has done previously on natural disaster response.

"In my group, we have been engaged with national disaster research for more than 15 years now, since Hurricane Katrina, and this is really a natural disaster caused by a biological agent," she said. "It has a significant effect on everyday life, like natural disasters do, it has just carried on for longer."

Similar to a natural disaster, dealing with the pandemic puts stress on the social safety net, and factors like the proximity to a hospital can effect outcomes. Rifai stressed that their research is meant as a tool to provide rough guidance as to where resources will need to be allocated.

"If you're going to turn business back on, you want to know where to test and protect first," she said. "It's a planning tool that holistically looks at the population in Harris County, with the data available. If you expect people to get sick in parts of the city and you don't have hospitals that can handle it, you need to account for that."

Rifai also noted that as more data became available, they would be able to fine tune the model.

"Our testing rate is among the lowest in the United States, and it would be really nice to test more in those areas," she said. While there is still much work to be done, the framework may be able to help move efforts in the right direction. Rifai said they hoped to be able to expand beyond Harris County with more data.

**"LOOKING INTO THE FUTURE, WE'D LIKE TO EXPAND ON THE MODEL AND INTO OTHER GEOGRAPHICAL AREAS OF TEXAS," SHE SAID. "IF WE GAIN ACCESS TO THE INFORMATION, WE CAN HELP WITH SUPPORTING DECISION-MAKING." 🛠️**



DR. HANADI RIFAI

## SEARCHING FOR A CURE:

# ONE UH PROFESSOR IS TESTING INHALATION VACCINES FOR COVID-19

BY LAURIE FICKMAN



**Navin Varadarajan**, M.D. Anderson Associate Professor of Chemical and Biomolecular Engineering is testing inhalation vaccines. Think FluMist for COVID-19.

“For airborne pathogens, the nasal mucosa is the first point of defense that needs to be breached,” said Varadarajan. “Mucosal immunity and vaccines are fundamentally important for a wide range of pathogens including influenza, severe acute respiratory syndrome coronavirus (SARS-CoV) and the current SARS-CoV-2.” Still, he said, nasopharyngeal immunity is understudied.

Varadarajan is using the spike protein, which helps the virus enter the target cell and is the major target for neutralizing antibodies as it binds to the cellular receptor called angiotensin converting enzyme-2 (ACE2) for virus entry. He prefers using proteins because of their ability to induce strong immune responses, flexibility and scalability, and absence of infectious particles.

Varadarajan notes several considerations of pivotal importance in designing an efficient, but safe mucosal vaccine.

“As with any vaccine, a variety of factors determine their efficacy including the antigen used for eliciting a response, the adjuvants and immunomodulators, the efficient delivery of the antigen to appropriate target cells, and the route of vaccination,” he said.

Varadarajan is collaborating with Xinli Liu, associate professor of pharmaceuticals, who is synthesizing a new liposomal adjuvant. ⚙️



## MIXING IT UP:

# UH ENGINEERING ALUMNUS TRANSITIONS HOUSTON DISTILLERY OPERATION TO PRODUCE HAND SANITIZER FOR COVID-19 PANDEMIC

BY CHRIS STIPES



Weeks before the novel coronavirus reached the United States, **Carlos De Aldecoa (BSIE '97)** got a frightening taste of its wrath – his aunt in Madrid, Spain was hospitalized with COVID-19. After several weeks in the intensive care unit, she managed to recover. But De Aldecoa knew it was only a matter of time before the invisible enemy would reach the U.S. and wreak havoc at home. Now was the time to prepare, he thought.

“There was a lot of talk about how cleanliness and sanitizing was critical to stopping the spread of the virus,” said De Aldecoa.

It wasn't long before stores across the country were sold out of alcohol-based hand sanitizer (and toilet paper, but that's a different story altogether). Alcohol-based? It was a light bulb moment for De Aldecoa, who manufactures liquors and spirits for a living. As president and CEO of Texas' largest distillery, Gulf Coast Distillers on Houston's East End, the University of Houston alumnus recognized a unique op-

portunity to shift operations from producing distilled spirits – vodka, bourbon, whiskey and gin – to making hand sanitizer.

“We already have bottling operations and sourcing of ethanol. We have the team, facilities and equipment, so let's quickly retool and do our part to help the community stay protected,” De Aldecoa recalled of his idea to shift production efforts. He then applied for an additional industrial permit for alcohol manufacturing from the federal government to begin production.

### SPIRITS TO SANITIZER

In just a matter of weeks, C4U hand sanitizer was created, named after Carlos's 5-year-old son, Carlos IV. Since mid-March, bottling operations have been running around the clock, six days a week. By the middle of May, the distillery had produced an astounding 500,000 gallons of sanitizer, or as much as 15,000 gallons per day. ▶▶▶



## GIVING BACK: PETROLEUM ENGINEERING ALUMNUS DONATES MASKS TO UH

C4U is being sold in retail locations across the country, but the company has also donated more than \$325,000 of product to first responders, hospitals and non-profits. And while many industries have been forced to lay off or furlough employees due to COVID-19, De Aldecoa added about 35 employees to his family-run operation, including many out-of-work restaurant and hospitality workers.

That's not to say there haven't been challenges. After conducting extensive research on federal and state regulations for the manufacturing of sanitizer, the company faced "significant issues" sourcing materials, including bottles, caps and ingredients for the sanitizer itself. But solving problems is what De Aldecoa does best, even dating back to his time at UH's Cullen College of Engineering where he earned a bachelor's degree in industrial engineering in 1997.

A year after graduation, he founded Cadeco Industries with his father, growing the family coffee business started by his grandfa-

ther in the 1920's in Spain. Family always comes first for the De Aldecoa's. Carlos's four sisters, two of whom are also UH graduates, have pivotal roles within the family's group of companies. **María Patricia Echeverry**, the company's vice president of operations, also has an M.S. in industrial engineering from the University of Houston.

### DISTILLING KNOWLEDGE

**Juan Carlos Martínez De Aldecoa**, Carlos' nephew, represents the fourth generation of the business. The 20-year-old works as brand director for the distillery while also juggling classes as a full-time UH student.

"To be able to work alongside my uncle and grandfather and the rest of my family during this unprecedented time is something I'm really grateful for. I'm like a sponge, and I love to learn," said Juan Carlos, a sophomore interested in studying entrepreneurship, business and economics.

Juan Carlos started working at the

family company at 14, filling bags of coffee by hand and sweeping floors, but listened closely to how his relatives conducted business, always taking notes and staying laser-focused on his goals.

"My goal is to be an innovator and risk taker and come up with creative ideas to grow businesses," he said. "But even more important I want to leave a footprint in this world ... not just come, make money and leave. I want to make a difference."

The pandemic has proven to be a real-life lesson in business for Juan Carlos—he's seen his family's company navigate supply chain disruptions and regulatory issues. He's bore witness to innovation, as operations pivoted, becoming more relevant while also filling a desperate need during a crisis.

"We switched our focus to sanitizer because we knew we had the potential to help out," Juan Carlos said. "We didn't want to furlough employees like many people were doing. We wanted to be creative,

and with [Carlos] being an engineer from U of H, his degree really helped him out here. He got creative and decided it was time to think outside of the box, and not do what everyone else was doing, so he turned distilling alcohol into making hand sanitizer. We are the largest distillery in Texas, and as such, we set a very large precedent for all the other distilleries in the country."

"Surround yourself with positive people. Have a winning team with a winning attitude and put your heart into it," said De Aldecoa. "Whatever you do in life, just be passionate about it and know it's going take a significant amount of work."

As for the work making the much-needed sanitizer? De Aldecoa said it will continue as long as the market demands it.

"The more we can pump this stuff out, the more we can control the spread of the virus and that's really what we're trying to achieve." 🚀

BY STEPHEN GREENWELL



As the coronavirus spread throughout the United States, one Cullen College of Engineering alum felt compelled to act and to support the university that helped him.

**GQ Guo** graduated from the college with a master's in petroleum engineering in 2017, but continued to monitor the pandemic in Houston following his graduation. When one of his friends in

China opened a mask factory, Guo arranged to send 800 masks to the university.

"Thanks to him, I managed to obtain the masks and shipped them to UH immediately," Guo said. "It is hard to say what motivated me exactly. I was just feeling that I needed to do it. I needed to take that responsibility."

The masks were received by **Dr. Mohamed Soliman**, the petroleum engineering department chairman and the William C. Miller endowed chair professor. Soliman said he remembered Guo well, from when he was a student at the college

"This guy was so active, I was extremely impressed," Soliman said. "He brought people from industry to talks, facilitated donations and was really doing a first-class job ... After he got a job here in the states, I wasn't surprised at all, because he's a very energetic guy. Only a year or so later, he decided to quit and form his own company."

Soliman noted that this was not

the first time that Guo had donated to the department and the Cullen College of Engineering.

"He came to my office for a graduation party, and he told me he wanted to donate something to the party," Soliman said. The donation meant a lot to Soliman, noting the position most graduates are in.


Guo said the supportive environment of the college always encouraged him to give back. He started GQ (Good Quality) Petro LLC. in July 2017, shortly after his graduation. It provides consulting services, technical training and market research to bridge North American and Asian energy markets. When Guo's company made its first profit in April 2018, he donated to the university again.

"If you are in a place where everyone is passionate, energetic and optimistic, you will be one of them," he said. "Another reason is belief. I believe in UH, and I trust my professors and my friends over there. I feel proud of it. No matter what happened, I knew UH friends and faculty were backing me up." 🚀

# FACULTY EXCELLENCE

## AT THE CULLEN COLLEGE



 PRADEEP SHARMA:  
GUGGENHEIM  
FELLOWSHIP WINNER

DESPITE THE CHALLENGES BROUGHT ON BY THE NOVEL CORONAVIRUS, THE FACULTY AT THE CULLEN COLLEGE HAVE BEEN HARD AT WORK STRIVING FOR EXCELLENCE IN RESEARCH AND ACADEMIA. THREE MEMBERS OF THE FACULTY WON PRESTIGIOUS AWARDS IN RECENT MONTHS, AND THE COLLEGE IS DELIGHTED TO HIGHLIGHT THEIR ACHIEVEMENTS. READ ON TO LEARN MORE ABOUT HOW OUR FACULTY ARE ENGINEERING EXCELLENCE IN HOUSTON AND BEYOND. >>>





**PRADEEP SHARMA: GUGGENHEIM FELLOWSHIP WINNER**  
**BY JEANNIE KEVER**

Pradeep Sharma, a mechanical engineer at the University of Houston, was selected for a Guggenheim Fellowship, this year's only recipient in the engineering category.

Sharma, M.D. Anderson Chair Professor of mechanical engineering and chairman of the department, uses mathematical and computational approaches to understand physical phenomena across a number of disciplines, from materials science to biology. In announcing the new fellows, the John Simon Guggenheim Memorial Foundation cited his work in explaining why some people are able to instantly reproduce a piece of music they just heard, while others – even those who are serious about music – cannot.

The fellowship honors artists, writers, scholars and scientific researchers, who are chosen based on their previous accomplishments and what foundation officials describe as their “exceptional promise.”

Sharma's work has long been nationally recognized; he received the 2019 James R. Rice Medal from the Society of Engineering Science for “creative contributions to understanding the science underpinning flexoelectricity and its applications to engineered and biological systems.” He previously has been recognized with a Fulbright fellowship and the American Society of Mechanical Engineers Melville medal, among other honors.

The Guggenheim Fellowship, however, came as a surprise. “They are so competitive, I really didn't expect it,” Sharma said.

The Guggenheim Foundation has granted more than \$375 million in fellowships to over 18,000 individuals since they began in 1925. Recipients include Nobel laureates, Fields Medalists, poets laureate, members of the national academies and winners of the Pulitzer Prize, Bancroft Prize, Turing Award and National Book Awards, among other honors

This year's fellowships recognize 173 people, selected from an initial field of 3,000, with Sharma the only engineer to chosen.

The foundation purposely seeks out artists, scientists and others whose work encompasses the full spectrum of society. Foundation president Edward Hirsch said that is perhaps even more important this year.

“It's exceptionally encouraging to be able to share such positive news at this terribly challenging time,” he said. “The artists, writers, scholars

and scientific researchers supported by the fellowship will help us understand and learn from what we are enduring individually and collectively.”

Sharma said he will use the award to further his work on a question that has puzzled him for years: Why are some people, even those not trained as musicians, able to hear a piece of music and immediately reproduce the melody on a piano or other instrument, while others cannot. His wife, it turns out, is one of those who can. Sharma, despite being “very passionate about music,” could not. He devoted himself to the study of music for almost a decade, training himself to translate what he heard into notes he could play.

“Part of it is the brain, but the question I want to ask is, is there something structurally different in her ears that she can hear music better? I am looking for a physics explanation for her ability.”

Scientists have a good understanding of how the hearing mechanism works as sound waves enter the ear and move against the tiny hair cells inside. Those hair cells change the vibrations generated by the sound waves into electrical signals that are sent to the brain for decoding.

Sharma said he will investigate to see if certain physical characteristics of those hair cells – geometry, physical properties and even electrical activity around the cells – play a role in how people understand and interpret music.

Paula Myrick Short, UH senior vice president for academic affairs and provost, said she was pleased to see Sharma's groundbreaking work recognized by the Guggenheim Foundation.

“Dr. Sharma's body of work crosses disciplines to tell us more about the world in which we live,” Short said. “He has impressive accomplishments in fields ranging from material science to biophysics, and this award will allow him to push into additional frontiers.”

**DAVID MAYERICH: NSF CAREER AWARD WINNER**  
**BY LAURIE FICKMAN**

Researchers at the University of Houston last year reported a new imaging method capable of producing fast and inexpensive three-dimensional images, offering the potential to more easily track the progress of conditions such as Alzheimer's disease and cancer at the cellular level.

David Mayerich, an assistant professor of electrical and computer engineering at UH and corresponding author for a paper describing this work in *Scientific Reports*, is now at work on Part 2: a software platform to produce searchable digital atlases of whole organs at the cellular level.

He has received a \$500,000, five-year CAREER award from the National Science Foundation to pursue the project. The original imaging method grew out of his work with the BRAIN Center, an NSF-supported collaboration between UH and Arizona State University to design, develop and test novel neurotechnologies.

Mayerich describes the project as a Google Maps-style platform, offering both searchability and context for high-resolution 3-D images of whole organs. This platform would allow researchers – and ultimately, clinicians, students and others – to easily search normal and diseased organs to track change over time in animal models and determine how widespread a disease might be at the subcellular level.

“We had a lot of preliminary data from our work at the BRAIN Center, but there wasn't any software for working with these very large datasets,” >>>

“We've developed this ability to collect massive amounts of data. Now we have to provide the software to make it accessible.”

- DAVID MAYERICH



*For her proposal to create algorithms that deliver information about brain states, Faghih earned one of the most prestigious awards given by the National Science Foundation, the Faculty Early Career Development (CAREER) Award.*



he said. "We wanted a platform for doing just that: analyzing massive tissue datasets and making them browsable."

"We've developed this ability to collect massive amounts of data. Now we have to provide the software to make it accessible."

He said the potential for publicly available whole-organ atlases to affect biomedical research and education is terrific, and routine generation of tissue maps will allow researchers to build detailed models of complex diseases, opening the door to new precision treatments and scalable drug discovery.

Ultimately it could be of use to clinicians and diagnosticians, allowing complete visualization of tissue biopsies instead of more traditional two-dimensional histological slices.

CAREER awards also support educational components, and Mayerich said that in addition to proving useful in educating the next generation of biomedical professionals, he will be working with St. Mary's, a nearby pre-kindergarten through sixth grade school, to design and test a browsable atlas that can be used for K-12 programs by integrating a virtual reality platform for visualization.

**ROSE FAGHIH: NSF CAREER AWARD WINNER**  
**BY LAURIE FICKMAN**

As schools and universities around the globe pivot to online teaching, and millions of students stare at screens during their school day, it is hard to imagine a personalized learning experience. But UH assistant professor of electrical and computer engineering, Rose Faghih, sees it differently, and it all starts with students wearing smartwatches that deliver information about their emotional and cognitive states.

"Say a student has been watching an online video for eight minutes and has become disengaged; if we can track that, we could automatically pause the video for that student and give them a short quiz to make sure they're keeping engaged," said Faghih. The ability to react individually to a student in that manner will be made possible through closed loop brain-aware wearable architecture, currently lacking in common smartwatches.

For her proposal to create algorithms that deliver that kind of information about brain states, Faghih earned one of the most prestigious awards given by the National Science Foundation, the Faculty Early Career Development (CAREER) Award. It supports faculty early in their career who the NSF believes will eventually serve as academic role models in research and education, and lead advances in their fields. The five-year award, worth \$525,000, was given to Faghih for her project called MIND-WATCH, an acronym for Multimodal Intelligent Noninvasive brain state Decoder for Wearable Adaptive Closed-loop architectures.

Faghih's signal processing and control algorithms, or infrastructure, for a wearable device delivers information on three types of brain states – stress, cognitive engagement (or boredom) and cognitive learning, based on multiple signals from the wearer including sweat response, respiration, cardiac function and temperature.

Faghih calls it a navigation system for the brain. "It overcomes the barriers to achieving brain-aware wearables by pioneering a transformative system-theoretic computational toolset for noninvasive closed-loop wearable architectures that monitor and modulate brain function without needing neural recordings," said Faghih. In other words, judging



brain states has never been so easy; not needed is electroencephalogram (EEG) testing and monitoring, in which electrodes are attached to the scalp or a cap to measure brain activity.

The potential applications for the closed loop technology are endless.

"Another application can be for the elderly. If they are home alone, and they are not engaged, or they are depressed, the algorithm can detect it in a smart home setting and then change the frequency or color of light in their home, or start playing music in the background so they become engaged again," said Faghih, who will be testing the smart light and music system in her lab.

Success for Faghih seems to have no end in sight, as she has continued to pull in accolades since her CAREER award was granted. Faghih was recognized by the Institute of Electrical and Electronics Engineers' Women in Engineering Magazine, with a feature in its June issue. The article, "Women to Watch – The New Face of Engineering: Faghih Is Applying Her Research to Make an Impact on People's Lives," is available on the IEEE Xplore website.

Most recently, Faghih was named to MIT Technology Review's prestigious annual list of Innovators Under 35, in the category of visionary. 🚀

# SICSA's Bannova Earns ASCE OUTSTANDING TECHNICAL CONTRIBUTION AWARD

BY STEPHEN GREENWELL



 OLGA BANNOVA SPEAKS TO A GROUP OF UNIVERSITY STEM STUDENTS FROM JAPAN AT SICSA DURING A TRIP TO HOUSTON ASSOCIATED WITH NASA'S GLOBAL EDUCATION PROGRAM.

For a prestigious career featuring more than two decades of research, and 60 papers and presentations, University of Houston professor **Dr. Olga Bannova** was named the winner of the 2019 Outstanding Technical Contribution Award from the American Society of Civil Engineers Aerospace Division Executive Committee.

Bannova also serves as the director of the Sasakawa International Center for Space Architecture at the University of Houston, which provides the world's only Master of Science for space architecture. Bannova was nomi-

inated for the award by Dr. Ramesh Babu Malla, a professor at the University of Connecticut's Institute of Materials Science and a chairman of the ASCE Space Engineering & Construction Committee.

*"I'm very thankful for Dr. Malla nominating me, which came as a big surprise to me," Bannova said.*

"Although we haven't collaborated on projects yet, I've been actively

working with him to advance ASCE's Aerospace Division Technical Committee on Space Engineering and Construction, and organizing, chairing and presenting design and research for human spaceflight technical papers at Earth and Space conferences."

Because of the COVID-19 pandemic, the 2020 ASCE conference and the awards presentation has been postponed to a future date. While Bannova said she was honored to be named the award recipient, she thought it would be more important for her work and the university's research going forward.

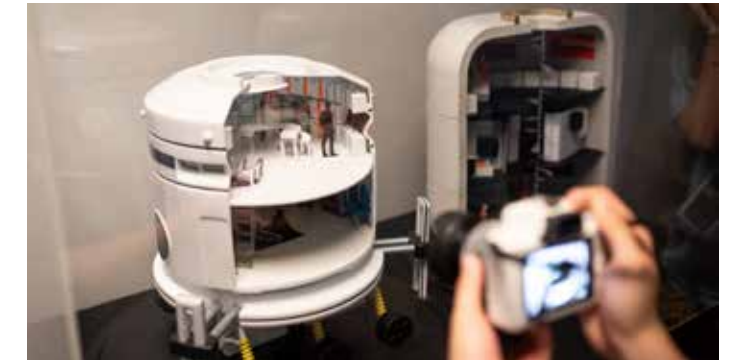
*"It is important not just for me, but for the field of space architecture," she said. "[It] indicates that our discipline is receiving recognition from the space industry, which will help our students and graduates in their professional life."*

In his nominating letter, Malla wrote, "Dr. Bannova has made significant and seminal contributions and is a leader in the field of space architecture and in planning and designing of facilities for extreme environments on Earth. She has contributed significantly in the research and design studies of orbital and surface habitats and settlements, including inflatable structures, special design influences and requirements for different gravity conditions in space, and habitat concepts for extreme environments on Earth for over two decades."


When asked about some of the projects that stuck in her memory, Bannova identified one that took place on the top of Greenlandic glacier, where human factors demand design responses somewhat similar to ones in space conditions.

"One of the earlier projects that I initiated and led was designing a new science facility for the NSF's Summit station in Greenland," she said. "Not only because it was a challenging project and we worked closely with scientists and a logistics company that supports NSF activities in the Arctic, but because we were invited to travel there, test our mock-up that we built close to the Summit camp, and talk with people who dedicate their life to working in the polar extreme environment, which has many similarities with living and working in space."


She added, "Of course, there are space projects that were very exciting and equally demanding, such as the Minimal Functionality Habitable Element NASA study, where we collaborated with Boeing and ILC Dover on two separate teams."



*Going forward, Bannova said she was focused on continuing her work on space exploration.*

 OLGA BANNOVA LISTENS TO A PANEL DISCUSSION FEATURING INTERNATIONAL ASTRONAUTS DURING THE ASSOCIATION OF SPACE EXPLORERS (ASE) SYMPOSIUM COMMUNITY DAY ON 10-16-19.

Going forward, Bannova said she was focused on continuing her work on space exploration.

"There are several research areas that will be critical for expanding human space exploration beyond Low Earth Orbit," she said. "Designing next generation space habitats requires integration with AI, utilization of smart materials and new approaches for radiation protection. Right now, I'm working with my colleagues from Purdue, Vienna Technical University and few other institutions on integrating mixed reality technologies in space habitats." 

# CCE ADDS 3 NEW ASSISTANT PROFESSORS

for Fall 2020 semester

BY STEPHEN GREENWELL

Three new assistant professors recently joined the civil and environmental engineering department at the Cullen College of Engineering – **Dr. Vedhus Hoskere**, **Dr. Xie Hu** and **Dr. Dimitrios Kalliontzis**.



Hoskere will start the Structures and Artificial Intelligence Lab (SAIL) at the college.

“The research will span the broad area of artificial intelligence applications in structural engineering,” he said. “My doctoral work at the University of Illinois with Billie F. Spencer Jr. focused on developing artificial intelligence, machine learning and computer vision solutions for rapid and automated civil infrastructure condition assessment.”

He completed his doctorate in civil and environmental engineering this summer, along with a M.S. in computer science at the University of Illinois at Urbana-Champaign earlier this year in May. He earned a M.S. in civil and environmental engineering from there in May 2016, and his B.S. in civil engineering was completed at the B. M. S. College of Engineering in Bengaluru, India back in May 2014.

In the aftermath of natural disasters like earthquakes, fast and reliable assessment of structures is crucial to allow people to resume occupation of their homes and offices with delays severely exacerbating economic and societal disruption. To mitigate these problems, Hoskere’s research investigates development of an automated inspection framework for buildings and viaducts using drones and deep learning methods. He has also worked closely with the U.S. Army Corps of Engineers to develop solutions for automated inspections and monitoring of navigational locks and dams that form a crucial part of the inland navigation system. In

his free time, he enjoys singing Indian classical music, swing dancing, flying drones, and going on runs and hikes.

Hu will be working at the National Center for



Airborne Laser Mapping, which she described as a well-known geosensing institution and a draw when applying for a position.

“The strength of LiDAR and multiple remote sensing techniques, as well as engineering and environmental expertise, help establish an ideal platform for interdisciplinary studies,” she said. “The CEE department and the university are extremely supportive. The mutual respect and appreciation within an institute are necessary for good science and research, and also for my career development. That’s what brought me here.”

Hu uses radar imagery, taken from satellites or aircrafts, to measure the ground motion within millimeter accuracy.

“This approach can be used to monitor various kinds of geohazards, and the Earth’s shallow and deep processes associated with natural or anthropogenic triggers, such as landslides, earthquakes, aquifer systems, mining, oil and gas production and groundwater pumping,” she said.

Hu earned her Ph.D. in geophysics from Southern Methodist University in 2018. She received a master’s in remote sensing from Wuhan University in 2014, and her B.E. in GIS from the China University of Geosciences (Wuhan) in 2011. Prior to being hired by UH, Hu worked as a postdoctoral researcher at the University of California, Berkeley. In her free time, Hu enjoys spending time with her family and friends, as well as traveling.



Kalliontzis said the University of Houston’s continued improvement was a reason it appealed to him.

“Year by year, the Cullen College of Engineering rises in the *US News & World Report* rankings, which shows momentum when it comes to advancing its position in the map of research and teaching innovations,” he said. “This is a great environment for a young faculty to be in, in order to seek academic growth and contribute to the college’s endeavor for excellence.”

He added, “The Department of Civil and Environmental Engineering offers a great teaching and research environment with unique experimental facilities for structural testing. The department has a long history of experimental and computational research in the area of concrete structures, offering great collaborative opportunities for a young faculty member whose research vision is along the same lines.”

Kalliontzis said his research combines computational modeling techniques with laboratory testing to better understand how critical structures behave under extreme loading conditions.

“What would be the consequences of an earthquake, tsunami or hurricane hitting our homes, hospitals or other critical structures, especially amid a pandemic? Can we design these structures to resist natural hazards without experiencing any damage?” he said. “Using the generated knowledge, my research develops new concepts for designing new structures and for retrofitting existing ones.”

Kalliontzis received his doctorate in structural engineering from the University of Minnesota, Twin Cities, in August 2018. He earned a master’s in structural engineering from Iowa State University in August 2014, and received his diploma in civil engineering from the Aristotle University of Thessaloniki in Greece.

Since earning his doctorate, Kalliontzis has been a postdoctoral researcher at the University of California, San Diego. In his free time, he enjoys traveling, running, spending time with his family, and reading books about history, cosmology and religion. 🌀

# WILLSON EARNS ESTHER FARFEL AWARD; FOUR OTHERS TABBED FOR FACULTY, STAFF HONORS

BY STEPHEN GREENWELL



Several members of the Cullen College of Engineering were recognized earlier this year by the Office of the Provost’s 2020 Faculty and Staff Awards, headlined by **Dr. Richard Willson** of biochemical and biophysical sciences earning the Esther Farfel Award, the highest honor given yearly.

The award, a symbol of overall career excellence, carries a cash prize of \$10,000. Nominees must be tenured faculty members who have held a full-time, continuous faculty appointment for at least five academic years prior, and demonstrate excellence in all areas of faculty responsibility. The selection committee considers 1) the significance and national/international impact of the candidate’s research or creative activity; 2) evidence of outstanding teaching ability; and 3) distinctive and exemplary service to the university, the profession and the community.

Willson is the Huffington-Woestemeyer Professor of Chemical and Biomolecular Engi-

neering at the university. His research focuses on biomolecular recognition and its applications in separations and molecular diagnostics. He has more than 50 academic publications to his credit.



The Moores Professorship – which lasts for five-years and is renewable – was awarded to four professors at the university. Included among

them was **Dr. Stuart Long**, a professor in the Electrical and Computer Engineering Department. His research interests include applied electromagnetics, an array of antenna-related pursuits, and engineering education, outreach, retention and recruiting.



The Career Award, given to faculty who have demonstrated excellence in teaching over the course of their career at the University of Houston, was bestowed upon **Dr. Karolos Grigoriadis** of mechanical engineering. He is also the director of the aerospace engineering program, and his research interests include dynamic systems and controls – feedback control systems analysis and design, linear and nonlinear systems theory, robust and fault-tolerant control, model reduction, filtering and system optimization.



**Dr. David Shattuck**, of electrical and computer engineering, received an award for Distinguished Leadership in Teaching Excellence. The award is given in recognition of faculty who have made sustained and significant contributions to education within the context of their responsibilities as a full-time faculty member.

Shattuck has worked on the development of computer-based tools, programs and textbooks for effective instruction in circuit analysis and electronics. He has also contributed to the fourth edition of the textbook *Electric Circuits* by James Nilsson. He has also served as a reviewer for several journals and textbook publishers. >>>



**Dr. Lars Grabow**, of chemical and biomolecular engineering, was one of three winners of the Undergraduate Research Mentoring Award. The award recognizes the mentorship efforts of faculty at all stages of their careers and acknowledges faculty who have made a significant impact in their field by supporting and mentoring undergraduate students in research and scholarship endeavors for at least five years.

Grabow's group uses computational methods to understand and predict chemical processes that occur on solid-gas and solid-liquid interfaces. In particular, the group's work focuses on heterogeneously catalyzed reactions relevant for energy production, energy storage,

photocatalysis, pollution mitigation and the production of useful chemicals.

### Rodrigues, Palmer Honored with UH Awards for Excellence

Two faculty members at the Cullen College of Engineering were recognized as recipients of the University of Houston's Awards for Excellence in Research, Scholarship and Creative Activity for the 2019-20 academic year.

The award recipients were evaluated by the Excellence in Research, Scholarship and Creativity subcommittee, and honored by the office of Amr Elnashai, Vice President for Research and Technology Transfer. The awards recognize faculty at the levels of Assistant Professor, Associate Professor and Professor.

**Dr. Debora F. Rodrigues**, of civil and environmental engineering, was recognized in the Associate Professor category. The award recognizes faculty who have established a growing record of outstanding research, scholarship

and creative contributions, and who are emerging leaders in their field.

Rodrigues joined the department in 2010. The central topic of her research is water quality and sustainability, which focuses on a better understanding of the aquatic system and its microbial ecology, investigation of the effects of nanomaterials on the environment through application of molecular biology and nanotoxicological tools, and development of new nanotechnologies and biotechnologies to keep the aquatic system safe and remove unwanted contaminants.

**Dr. Jeremy Palmer**, of Chemical & Biomolecular Engineering, was recognized in the Assistant Professor category. The award recognizes faculty who have demonstrated great potential in research, scholarship and creative endeavors by virtue of the exceptional quality of their early contributions.

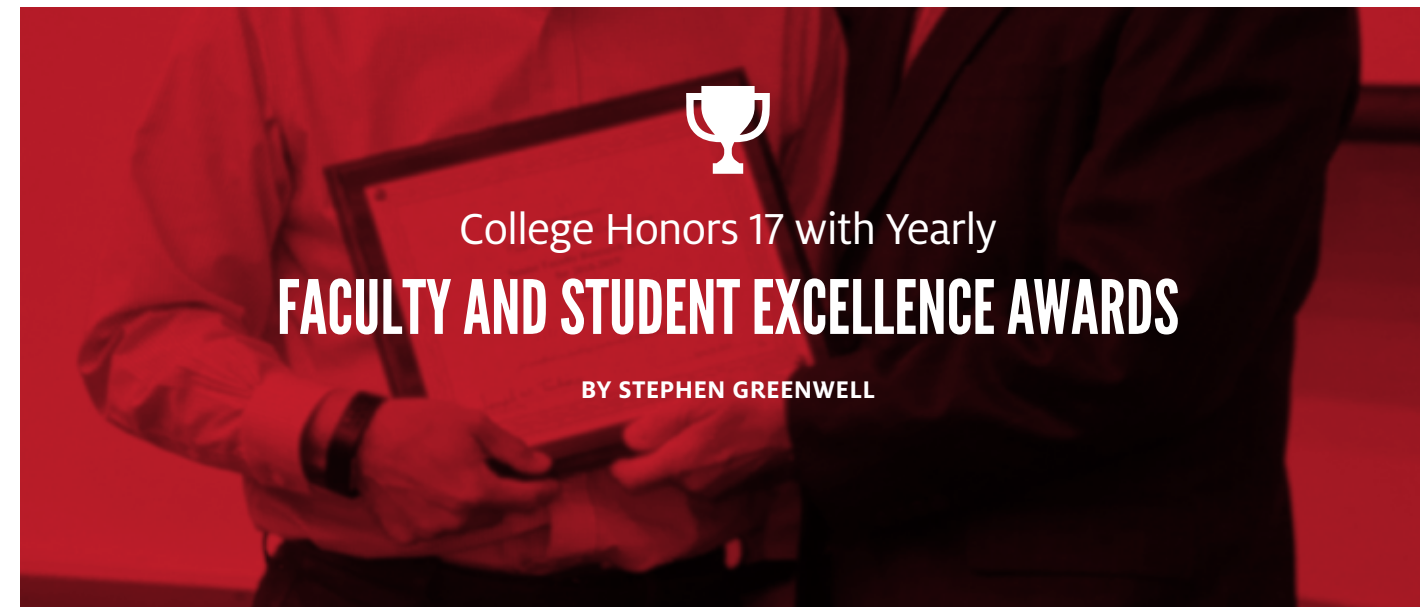
Palmer is the Ernest J. and Barbara M. Henley Assistant Professor of chemical and biomolecular engineering. Some of his research areas include materials by design, soft and complex media, and glasses and metastable liquids. ⚙️



DEBORA F. RODRIGUES



JEREMY PALMER



## College Honors 17 with Yearly FACULTY AND STUDENT EXCELLENCE AWARDS

BY STEPHEN GREENWELL

**Joseph W. Tedesco**, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering, announced that 17 students and faculty members had been selected as recipients in the 2019-2020 Faculty and Student Excellence Awards, which recognize teaching and research achievements.

*"Each year, the Cullen College recognizes the exemplary contributions and achievements of its faculty and students," he said. "These contributions come in many forms, from conducting groundbreaking research to mentoring and advising students, all of which have helped bring the University of Houston to top-tier status."*

The William A. Brookshire Teaching Excellence Award recognizes faculty who demonstrate an unwavering commitment to exemplifying the highest levels of teaching excellence inside the classroom. **David Shattuck** of electrical and computer engineering was bestowed the honor this year.

The W.T. Kittinger Teaching Excellence Award was given to **Matthew Franchek** of mechanical engineering. The award is traditionally one of the highest teaching honors given at the Cullen College. This award recognizes outstanding teaching and service to students.

**Karolos Grigoriadis** of mechanical engineering received the Career Teaching Award. The honor is given intermittently, and reserved for faculty who have shown a lifetime commitment to students.

The Cullen College of Engineering Faculty Excellence Award (formerly funded by Fluor Corporation) is the highest honor afforded to a faculty member for research. This year's recipient was **Kirill Larin** of biomedical engineering. This award recognizes career excellence in research, teaching and service.

The 2019-2020 Teaching Excellence Award recognizes outstanding teaching and service to students. This year's faculty awardees were:

- **Sheereen Majd** of biomedical engineering
- **Stacey Louie** of civil and environmental engineering
- **Rose Faghieh** of electrical and computer engineering
- **Shailendra Joshi** of mechanical engineering

This year, the following teaching assistants were awarded:

- **Tina Kazemi** of biomedical engineering
- **Amir Rahmati** of mechanical engineering
- **Vishal Talari** of mechanical engineering

The Research Excellence Award recognizes faculty for their outstanding research contributions. This year's senior-level faculty awardees were:

- **Muna Naash** of biomedical engineering
- **Jacinta Conrad** of chemical and biomolecular engineering

Junior-level faculty who received awards this year were:

- **Stacey Louie** of civil and environmental engineering
- **Rose Faghieh** of electrical and computer engineering

The Andrea Prosperetti Research Computing Faculty Award recognizes faculty within the college who have demonstrated a singular achievement in the broadly defined topics of scientific computing and data science. This year's awardee was **Di Yang** of mechanical engineering.

**Dajla Neffati** of mechanical engineering received the Andrea Prosperetti Research Computing Faculty Award. The honor recognizes graduate students and postdoctoral researchers who have made outstanding contributions to research in data science and high-performance computing as well as their applications.

The Career Innovator award recognizes a track record of successful efforts by faculty in innovation and entrepreneurship during their career at UH. Qualifications include dedication to technology transfer, commercialization and startups. This year's awardee was **Sergey Shevkoplyas** of biomedical engineering.

**Jae-Hyun Ryou** of mechanical engineering was honored with the Rising Innovator Award. It recognizes efforts by tenured associate faculty in innovation and entrepreneurship at UH who have demonstrated a track record of mentorship, in addition to clear efforts in transferring technology to practice. ⚙️



UH Petroleum Engineering Student

# SELECTED TO ATTEND IPTC 2020

BY RASHDA KHAN



NHUNG NGUYEN

**Nhung Nguyen**, a junior majoring in petroleum engineering at the UH Cullen College of Engineering, was one of 100 students chosen from around the world to attend the Education Week program of the 2020 International Petroleum Technology Conference (IPTC) which was held January 11-15, 2020, in Saudi Arabia.

*Education Week is designed to provide college juniors and seniors insight into the petroleum industry, as well as the opportunity to work together on a joint assignment, go on field trips and network with major industry employers. IPTC covers travel and accommodation expenses for the selected students.*

Originally from Vietnam, Nguyen said she was looking forward to traveling to a new country and learning about the culture, history and oil industry. "I am excited to work on a team with students from around the world. It will be an awesome chance to apply what I learned at school and develop my skills," she said. "This is a great opportunity for me to grow myself and represent UH."

Nguyen plans to pursue a master's degree in either data science or reservoir engineering. She currently works as a research assistant at the Cullen College and serves in leadership roles with the UH chapter of the Society of Petroleum Engineers (SPE).

She has also volunteered with the Chevron Girls Engineering the Future Day, an annual Cullen College event designed to introduce Houston-area girls, from grades 4-8, to science, technology, engineering and mathematics concepts through fun, hands-on activities. Nguyen has also volunteered with the Houston Food Bank and the National Society of Leadership and Success.

*IPTC, one of the world's foremost oil and gas events, is a multi-disciplinary technical event committed to the dissemination and sharing of emerging technologies, best practices and knowledge. It is sponsored by the American Association of Petroleum Geologists (AAPG); the European Association of Geoscientists and Engineers (EAGE); the Society of Exploration Geophysicists (SEG); and the SPE. ⚙️*



# UH ENGINEERING STATE-SPACE ESTIMATION COURSE PROJECTS

Presented At Two IEEE Conferences

BY RASHDA KHAN

**Dilranjan Wickramasuriya** and **Hamid Fekri Azgomi**, doctoral students of **Rose Faghieh**, assistant professor of electrical engineering at the UH Cullen College of Engineering, made several presentations at two different IEEE (Institute of Electrical and Electronics Engineers) conferences last November.

Three of these presentations were projects from the "State-Space Estimation with Physiological Applications" course designed and taught by Faghieh where the two Ph.D. students served as teaching assistants. The class allows students to work on a real-world biomedical engineering problem where they apply the tools learned in class. The problem is broken down into smaller parts and several milestones are set for the students during the semester.

Azgomi used the Cullen Travel Fellowship Grant he won to travel to California and present the papers at the 53rd IEEE Asilomar Conference on Signals, Systems and Computers. Faghieh also organized an invited session on "Signal Processing

Advances in Neural Modeling" at the conference. Wickramasuriya presented work at the IEEE-EMB Special Topics Conference on Healthcare Innovations and Point-of-Care Technologies (HI-POCT) held this year at the National Institutes of Health (NIH) in Bethesda.

Attending both conferences provided valuable experiences for both students, said Faghieh. "They were able to network with other researchers in the same field, get a flavor for some of the hot-topics in different areas and share experiences with other faculty and students alike," she said. "The HI-POCT conference in particular was an opportunity to see first-hand the perspectives of the clinical community on different research topics, which are quite different to the way engineers see things."

Likewise, the Asilomar conference afforded the opportunity to gain insights into advanced signal processing research perspectives, Faghieh added. >>>

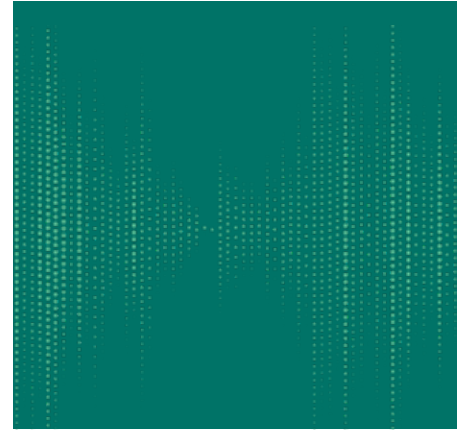


### REAL-TIME SEIZURE STATE TRACKING USING TWO CHANNELS: A MIXED-FILTER APPROACH

(M. B. Ahmadi, A. Craik, H. F. Azgomi, J. T. Francis, Jose L. Contreras-Vidal and R. T. Faghih) - 53rd IEEE Asilomar Conference on Signals, Systems, and Computers.

Epilepsy affects several million people worldwide. Unfortunately, the condition is resistant to medication for quite a number of epilepsy patients. As a result, a lot of research has focused on the automated detection of epileptic seizures from electroencephalography (EEG) signals. EEG measures the electrical activity from networks of neurons firing within the brain. When an epileptic seizure occurs, the neurons fire abnormally. The occurrence of a seizure can be preceded by a pre-seizure phase and followed by a post-seizure phase.

In this research, the authors modeled a seizure state variable as being related to both a binary and continuous-valued EEG feature. The two features were chosen to maximize the chance of detecting seizures for each patient. By using a control-theoretic formulation and appropriate statistical tools, the seizure state was tracked using just these two features. The data was separated into different segments for training, validation and testing. Since the method estimates the occurrence of a seizure using a continuous-valued state variable, the intensity of the seizure could also be determined. The method could eventually be used to anticipate the occurrence of an epileptic seizure and apply corrective control before it happens.



### EMOTIONAL VALENCE TRACKING AND CLASSIFICATION VIA STATE-SPACE ANALYSIS OF FACIAL ELECTROMYOGRAPHY

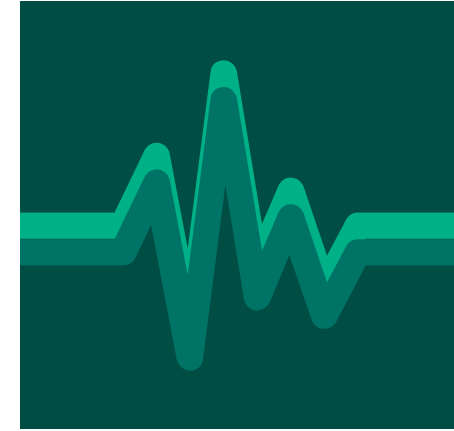
(T. Yadav, M. M. U. Atique, H. F. Azgomi, J. T. Francis and R. T. Faghih) - 53rd IEEE Asilomar Conference on Signals, Systems, and Computers.

Human emotion can be categorized along two different axes named valence and arousal. Valence denotes the pleasure-displeasure axis of emotion while arousal captures the accompanying activation or excitement.

Changes in physiological signals accompany different emotions. For instance, subtle variations can occur in heart rate, breathing and facial muscles with emotion. In this research, the authors developed a model that related an internal unobserved emotional valence state to a binary and continuous-valued feature extracted from a facial electromyography (EMG) signal. An EMG signal captures the electrical activity associated with a particular muscle.

The method was tested out on a dataset where subjects were shown music videos to elicit different emotions. The music videos were chosen from a variety of genres for this purpose. The formulated model was able to accurately predict emotional valence across a number of trials. The method could eventually be used in a smart living space where different types of music are automatically played to a person depending on his/her emotions and mood.

Automated emotion recognition could also help develop the next generation of living spaces and learning environments that are sensitive to emotion and mood.



### EMOTION RECOGNITION BY POINT PROCESS CHARACTERIZATION OF HEARTBEAT DYNAMICS

(A. S. Ravindran, S. Nakagome, D. S. Wickramasuriya, J. L. Contreras-Vidal and R. T. Faghih) - IEEE-EMB Special Topics Conference on Healthcare Innovations and Point-of-Care Technologies (HI-POCT).

As noted above, the valence and arousal axes can be used to account for variations in human emotion. A third axis, known as dominance, relates to the degree of control that is felt.

In this work, the authors developed a method to classify high and low levels of valence, arousal and dominance based on heart rate variations alone. A person's heart beats at a rate of about 72 beats a minute. This can be measured using electrocardiography (EKG) or by measuring someone's pulse. The heartbeats can be modeled as a stream of binary events where a '1' occurs where there is a heartbeat and a '0' occurs elsewhere.

By modeling the inter-arrival times between the '1's (i.e., the timings between heartbeats) as a binary point process, different features of heart rate were extracted, such as different heart rate statistics as well as how fast beat-to-beat changes were occurring (i.e., frequency-domain features).

The researchers classified these heart rate features into the different categories of emotion using state-of-the-art deep learning methodologies in a group of subjects who viewed a series of music videos meant to elicit different emotions. In addition to these, the following papers were also accepted to and presented at the same conferences. Again, Faghih served as the senior author.



### WEARABLE BRAIN MACHINE INTERFACE ARCHITECTURE FOR REGULATION OF ENERGY IN HYPERCORTISOLISM

(H. F. Azgomi and R. T. Faghih) - 53rd IEEE Asilomar Conference on Signals, Systems, and Computers

Cortisol is the body's main stress hormone. Its primary purpose is to raise blood glucose levels in response to external stressors. It is categorized among the class of hormones known as glucocorticoids. Disorders of cortisol typically involve the secretion of too much cortisol (hypercortisolism) or too little cortisol (hypocortisolism). Cushing's disease is a type of hypercortisolism.

In this research, the authors used a control-theoretic model relating an unobserved energy state in the body to different binary and continuous-valued blood cortisol measurements. Cortisol secretion also follows a 24-hour rhythm (known as a circadian rhythm).

The researchers designed the control necessary to reinstate circadian rhythmicity in simulated blood cortisol measurements from patients with Cushing's disease. The control design also took into consideration drug dynamics that are commonly used for treatment. Based on the control signal, a drug dose for infusing cortisol in the morning and a similar dose for clearing cortisol at night were recommended. These suggested doses would then be able to help resolve daytime energy drops and nighttime sleeping difficulties in Cushing's patients.



### FACIAL EXPRESSION-BASED EMOTION CLASSIFICATION USING ELECTROCARDIOGRAM AND RESPIRATION SIGNALS

(D. S. Wickramasuriya, M. K. Tessmer and R. T. Faghih) - IEEE-EMB Special Topics Conference on Healthcare Innovations and Point-of-Care Technologies (HI-POCT).

Many methods have been developed to automatically recognize emotion from different physiological signals. A number of these methods rely on neural signal recordings that are relatively inconvenient to monitor in the long-term. Moreover, in a number of studies, the subjects self-report their emotions on different scales. Unfortunately, due to inter-subject variability, not all the subjects use the same scale in a consistent manner.

Facial expressions provide a more reliable means of extracting the emotional truth of a subject. In this work, the authors attempted to see whether the extremes of emotional valence (as labeled using facial expressions) could be captured using simple heart rate and breathing measurements. Based on features extracted from heart rate and breathing at locations where subjects laughed or visibly displayed aversive reactions to movie clips that were shown to them, an accurate classification of high and low valence was shown to be possible.

This last work began as a National Science Foundation REU (Research Experience for Undergraduates) project during the summer of 2018 and expanded into a conference paper.

All these publications are based on research funded in part by the NSF. 🌟

## HERE ARE BRIEF DESCRIPTIONS OF THEIR RESEARCH PUBLICATIONS:

## UH BIOMEDICAL ENGINEERING STUDENT WINS NSF GRANT

to Present Research at AfroBiotech Conference

BY RASHDA KHAN

**Daniel Ajuzie**, a biomedical engineering doctoral student at the UH Cullen College of Engineering, presented a poster at the American Institute of Chemical Engineers' inaugural AfroBiotech Conference 2019 held last October in Atlanta, Georgia. He won a National Science Foundation award to cover the conference registration.

*Ajuzie's poster was titled "Quantifying the Effects of Hydrogen Peroxide-induced Oxidative Stress and Iron Stress on Escherichia coli Growth and Persistence."*

His advisor is **Elebeoba E. May**, associate professor of biomedical engineering, director of the BME Research Program and director of the May-MIDAS (Multi-scale Immunobiology Designs Algorithms and Simulations) laboratory.

### The Research

Persistence is one of the reasons why bacterial infections responsible for cystic fibrosis lung infections, tuberculosis and urinary tract infections are difficult to treat. Ajuzie and the rest of the May-MIDAS researchers are exploring the role of various stressors, such as iron, on bacterial persistence.

Iron is an important element in biological processes and has been found to affect the growth of micro-organisms. It is also involved in a phenomenon known as Fenton reaction, which is a catalytic process that produces molecules called reactive oxygen species and causes cell death.

Ajuzie said that he and the other researchers in the May-MIDAS lab employ integrated mathematical modeling and experimentation approaches in investigating questions like—How does bacteria control iron levels flowing into the cell? How does bacteria respond and cope with host mechanisms of iron stress and hydrogen peroxide induced stress? How damaging are those stresses anyway? Can researchers identify therapeutic strategies that ally with the body's natural response to mount a more targeted response to disease causing bacteria?

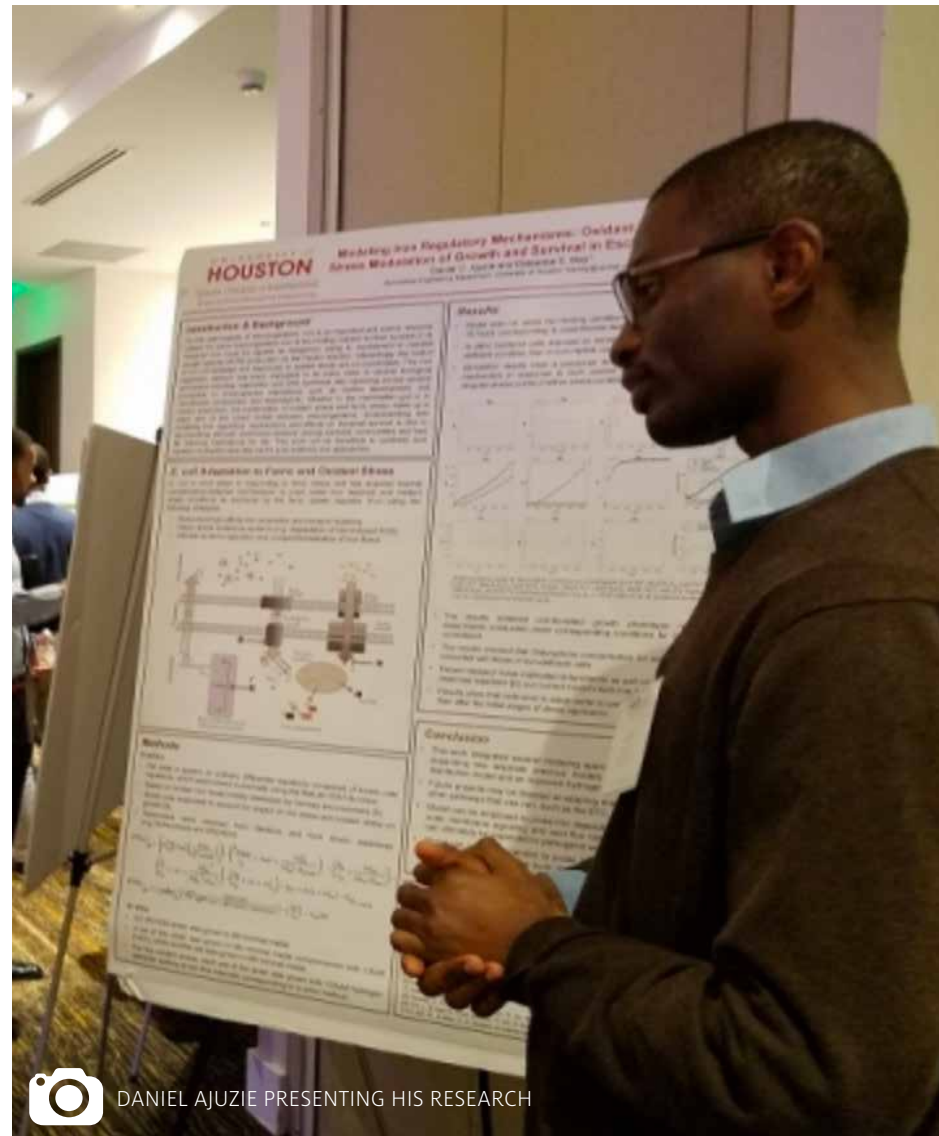
"We want to find the best ways to inform drug design strategies directed at bacterial clearance," Ajuzie said. "This is important even more so now, as we draw closer to the post-antibiotic era, where a more mechanistic and quantitative understanding of bacterial stress coping mechanisms will constitute the bare minimal requirement in tackling infections."

Ajuzie said he learned a lot, met several dis-

tinguished researchers, shared his research and enjoyed several great discussions on leading concerns and new research breakthroughs at the conference. "I'm thankful to Dr. May, the NSF and the Department of Biomedical Engineering for their support," he added.

May shared that Ajuzie is an excellent student and has a promising career ahead of him. "His strong engineering background and natural scientific curiosity is just the right mix for the challenging interdisciplinary questions my lab investigates," she said. "This conference allowed Daniel to showcase his work, but I think even more important he had a chance to interact with internationally recognized scientists and engineers and see there are no limits to where his scholarship can take him."

Hosted by the AIChE's Society for Biological Engineering, the conference aimed to highlight the achievements of African Americans in the field of biotechnology. 🌱



DANIEL AJUZIE PRESENTING HIS RESEARCH

## RUBBERY CIRCUITS LEAD TO FIRST PLACE

For Biomed's Ershad

BY STEPHEN GREENWELL

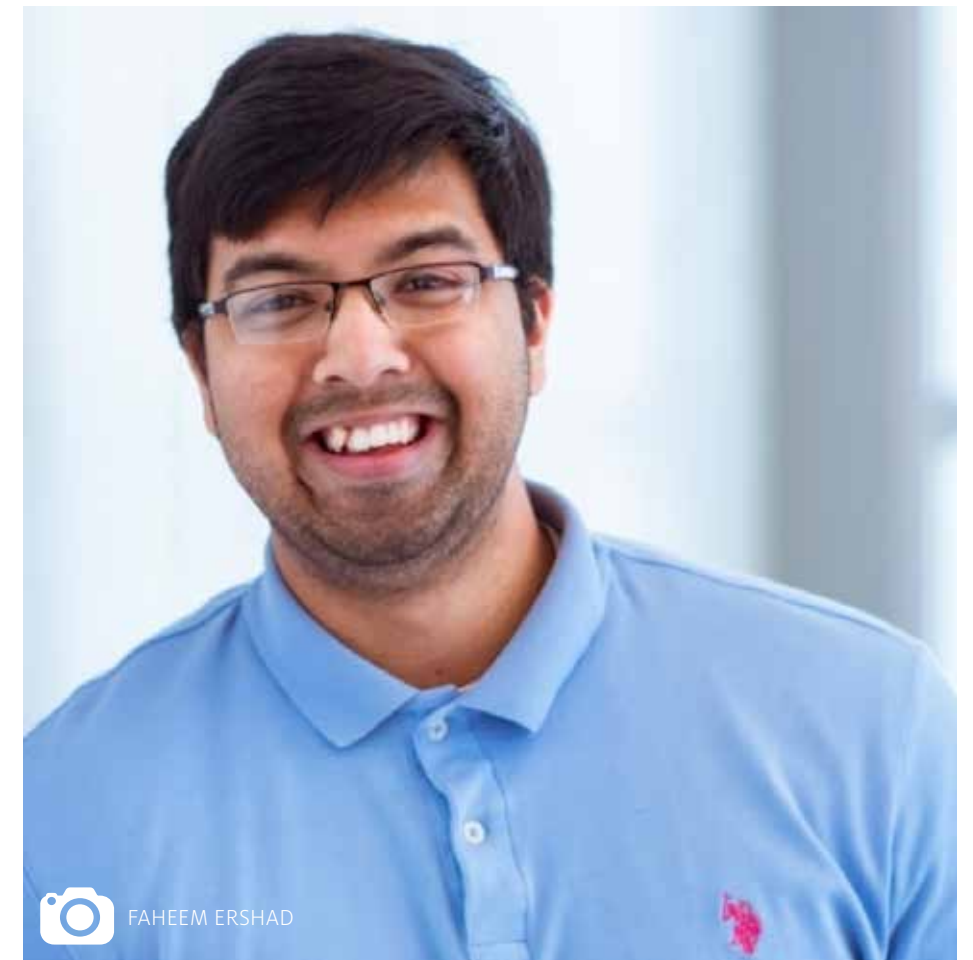
When **Faheem Ershad** first came to the University of Houston as a biomedical engineering undergraduate student in 2014, he had some interest in teaching in the future, but that interest has only increased as he has served as a teaching assistant and pursued a doctorate in the field.

That passion for education and teaching has also come across in his research and professional presentations, as Ershad earned a first-place finish in the graduate student poster competition at the NASA 2020 Human Research Program Investigators' Workshop in January 2020.

Ershad's poster, "Fully Rubbery Circuits, Sensors, and Smart Skins," describes potential applications for rubber-like "stretchable" materials and their electronics. The ability to use these electronics as robotic sensing "skins," wearable or implantable sensors for the human body, or in other applications where conventional electronics are not suitable, would provide obvious benefits.

"A lot of the technologies that you might find in a clinic or wearables used for sensing heart rate, pulse, and other vitals of that nature usually have rigid form factors," he said. "When patients wear them, they feel uncomfortable because there's a huge mechanical mismatch between those devices and the human body."

*Ershad said that by detecting the strain from rubbery strain sensors placed on the joints of a robotic hand, they've been able to translate the gestures of the robotic hand into sign language and demonstrate how these soft sensors could be useful for possible human-machine communication.*



FAHEEM ERSHAD

In addition, these rubbery electronics can be made into multiplexed tactile skins, enabling the robots to "feel" touch on different areas of the sensing "skin." There are also implications for health and heart-related research.

Ershad said this was the second time he had presented in this particular poster competition. The technology and methods used have attracted attention from NASA, as well as private industry.

However, Ershad said that for now, he hopes to pursue a faculty position after completing his doctorate and post-doctorate careers. A graduate of Cinco Ranch High School in Katy, he first got interested in teaching his senior year, when a friend got him a job at Mathnasium.

"You get a wide range of students there," he said. "You'd get to work with kindergartners in some instances, and in others, you'd work with college students studying university physics."

Throughout his undergrad, Ershad was also active in the classroom as a teaching assistant and as a workshop facilitator with the Scholar Enrichment Program. He said he was particularly challenged – in a good way – by a non-traditional student who also happened to be a veteran.

"I felt that through that experience, I really grew as both a student and an aspiring teacher," he said. "I was able to interact with someone that was so much more experienced in life, and they had ways of asking questions that I hadn't thought of, and that made me a much better individual."

*Ershad, currently a second year PhD student, anticipates finishing his doctorate degree in 2023. In April 2019, he was one of three Cullen College students to receive National Science Foundation (NSF) graduate research fellowships.*

"I have the next few years funded through the NSF, and I aim to finish my graduate career with that funding," he said. "I hope to continue disseminating my research and actively engaging in teaching and mentoring opportunities to open as many doors as possible for my future career." 🌱





## UH IE GRAD STUDENTS HONORED FOR OPERATION ROOM EFFICIENCY

BY STEPHEN GREENWELL

A pair of University of Houston graduate students earned a third-place finish for their model to handle operation room cases at the annual Healthcare Systems Process Improvement Conference, presented by the Society of Health Systems in Savannah, Georgia, in February 2020.

**Moaz Ahmed** and **Muhammad Zia-ul-Haq Hussain** took the honors home for the university. The process started with the distribution of a case study and spreadsheet in September 2019. Ahmed said that after discussing the problem with Hussain, they took guidance from **Dr. Jiming Peng**, an associate professor of industrial engineering at UH.

"Instead of the conventional approach which most teams used, we treated this situation as a linear optimization scheduling problem and took guidance from Professor Jiming Peng," Ahmed said. "He advised me clearly and I still remember that, 'For this problem linear optimization is the primary tool then comes in simulation.'"

According to Ahmed, in simple terms a conventional approach is to run multiple scenarios in a dynamic simulation, then use the data to

achieve the best result. However, this can be time consuming and not necessarily optimal.

When linear optimization is used with well-defined constraints – as he and Hussain did for the case study – an optimal result is produced. Then, a dynamic simulation can be used to assess and make necessary improvements.

*"I am glad that I took his word and successfully created a linear optimization model that incorporated all constraints regarding patient arrival time, operating hours, patient type and case type," Ahmed said.*

Their results qualified them from more than 30 teams competing worldwide to present at the conference. They received a sponsored trip and registration for the conference, and finished third,

behind two teams made up of doctoral students.

"Our work was greatly admired by everyone and we were youngest team competing," Ahmed said. "We were able to secure third place, \$1,000 prize money and gained lots of experience." Ahmed said he's always been interested in improving efficiency, and after spending two years in industry with Toyota, he decided to pursue a master's degree. He wants to help avoid past cycles of hiring runs followed by layoffs with better efficiency.

"Instead of eliminating unnecessary expenditure and effective utilization of capacity, many companies often end up hiring more people to increase capacity. Later, under recession, they end up firing people," he said. "I intend to help industries in implementing these improvements, but first I need to master them.

The master's program offered at U of H is a complete program covering all these elements. This program is very well structured with major focus on operations and statistics. Moreover, the variety of international students creates a very stimulating learning environment." 🌟

Students Prove Mettle

## VIA CHALLENGING CAPSTONE CLASS

BY SARA STRONG

*It happens in the spring  
of every academic year.*

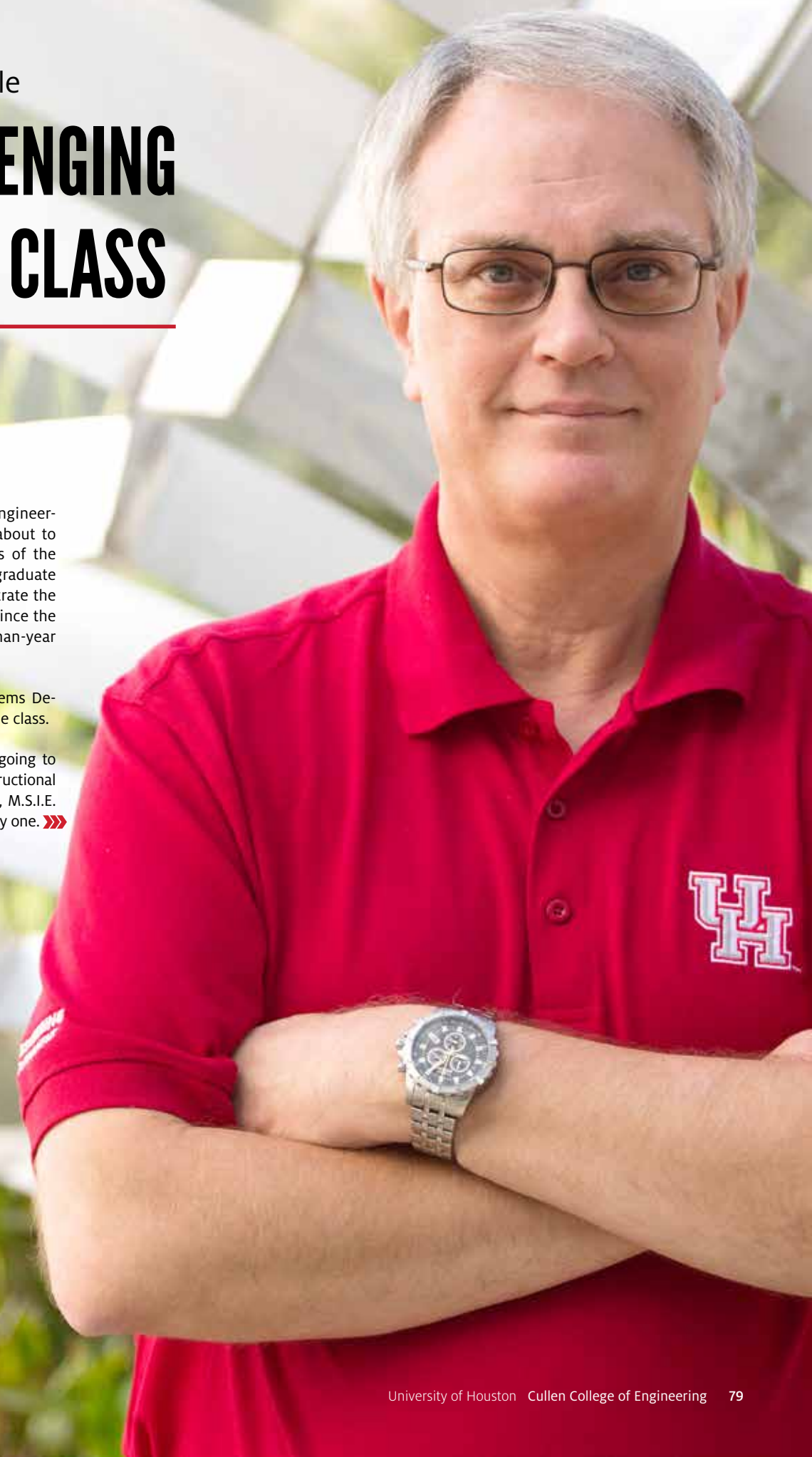
Teams of Cullen College industrial engineering students, most of them seniors about to graduate, work to polish final details of the biggest assignment of their undergraduate years. This is their chance to demonstrate the theory and skills they have acquired since the day they walked into their first freshman-year engineering class.

It is the well-known Engineering Systems Design course, also known as the capstone class.

"This is the hardest class you're ever going to take." It is with those words that Instructional Associate Professor **Randal Sitton** ('85, M.S.I.E. '88, Ph.D. '92) welcomes students on day one. >>>



RANDAL SITTON



Every student is assigned a team, and the team is paired with a strategic partner that has a problem. Each of those partners – some of Houston’s leading corporations, hospitals, city departments and other players in the local economy – has identified a complex issue that keeps their systems from running at peak efficiency.

With the teams assigned and challenges identified, Sitton steps out of his role as a professor. From that point forward, he may oversee and occasionally advise but will never direct.

Each student team examines every aspect of the challenge, using the same inquiry process a team of experienced engineers would use. By the end of the semester, their task is to propose a remedy that is feasible and affordable, and – most importantly – effectively addresses the problem.

For the student teams, the goal is to emerge as star problem solvers ready to launch professional engineering careers. After a few class meetings to define expectations, this course has no further classroom time, no lectures and no other non-project assignments. In the end, it is the students’ performance that counts.

### *“The project is the class,” is how Sitton describes it.*

Sitton has led the class for the past five years. He is an industrial engineer who built successful careers with USPS and Houston METRO, before returning to his alma mater to teach. While an undergraduate at Cullen College of Engineering, he completed two capstone projects, one for each of his double majors. (He still calls it his “year of hell.”)

For industrial engineering, he and his team compared costs and practicality of various material choices for a packed column, which is an apparatus used in chemical plants to separate substances. His chemical engineering team set out to design and budget construction of an ammonia-producing plant, only to conclude that new ammonia plants, even meticulously designed ones, were not financially practical at that time.

Why allow students to trudge through the frustration? Because professional engineers have to work through what they don’t know, just as the students did, and many of their promising concepts turn out the same way. The early, real-world lesson inspires Sitton today in his approach with his Engineering Design Systems classes.

## High expectations

He teaches his students to “hit the ground running,” he said, as they take on the roles of professional engineers. “I expect them to function at that level.”

If the road got bumpy for 2016 graduate **Rosie Ortiz**, the tough memories have faded. Ortiz and her fellow team members successfully streamlined an internal data entry system for METRO, which operates Houston’s vast bus and light rail system. Her team’s work decreased by two-thirds the time needed to process data for transportation software and contractor data reports.

“For this course, we applied all the fundamentals we learned in previous classes,” Ortiz said. “We weren’t ever shown what to do. We had to work that out for ourselves.” She now enjoys a busy career as a warehouse supervisor for Cameron, a Schlumberger company that provides equipment and services for oil and gas



drilling operations around the world.

As one of about 200 students who have proven themselves in Sitton’s capstone classes, Ortiz now reverses the roles by welcoming her former professor’s current students. She lets them learn the ropes under her watch at Cameron’s facility in Katy, to the west of Houston. This semester she has a team of five Engineering Systems Design students from UH.

“It is a great feeling to be able to help out other Cougars, and I am very proud of seeing them interact with my (Cameron) team, learning and applying their skills like the engineers they all are,” Ortiz said.

As they grapple with solving real-life problems in the warehouse, the students apply Lean Six Sigma manufacturing management principles, collect data, generate AutoCAD drawings and study cost-data analyses.

“They ask questions when they need a bit of guidance, but I am allowing them to let their ideas and imagination roam, allowing them to interact with the shipping and receiving warehouse staff and do hands-on tasks,” Ortiz said.

Sitton calls the strategic partnerships a “win-win situation” for both sides. The experience provides the students with learning experience and recommendations for internships, graduate schools and post-graduation jobs. Clients, too, have much to gain from the collaboration, including a new point of view.

“By looking with a fresh set of eyes, the students are more likely to ask why something is the way it is, while the existing staff too often accepts the current situation as just the way the job gets done,” Sitton said.

The collaboration also introduces corporate clients to the university’s state-of-the-art resources, such as visual simulation, 3-D modeling and fly-through simulations, which may not be available at their own work site.

“So far, we have had very, very good feedback,” Sitton said.

For work with Siemens, one of the program’s frequent strategic partners, the UH capstone collaboration earned recognition as one of two finalists for the Siemens Matters category of the company’s US Excellence Award.

## Getting started

Long before the journey begins, Sitton recruits



the strategic partners and identifies potential projects. With the help of the client, he draws up a one-page project overview statement that defines the problem and its background.

“Next comes what I call the P.O.M.P., for Project Overview and Management Plan,” Sitton said. “It’s the road map from the students. The who, what, when, where, why and how of getting the project done.”

From there, the students dive into the thorough process of the actual engineering. Throughout the problem-solving process, the team brainstorms potential solutions and sets accurate budgets to fund the changes they decide to propose. Weekly meetings with clients and their professor keep all parties informed.

“In late April, the students make a final report and presentation,” Sitton said. A final written report, an oral report and a project poster complete class requirements. Because the process can be intense, some students decrease the rest of their course load.

“We had to manage our own time,” Ortiz said, remembering her Systems Design team’s project in 2016, which required working through spring break. “We found the time for the team

to meet, including on weekends and holidays.”

## Large class

This spring, 45 students were divided into nine teams. “This was one of the biggest classes we’ve had,” Sitton said.

Two of the teams were hosted by Hewlett Packard Enterprises. Each of the other seven strategic partners – Cameron, Cintas, HCA Healthcare, H-E-B, M.D. Anderson Cancer Center, Siemens and TechnipFMC – hosted one team.

“I see my 2016 self,” Ortiz says about the students she mentored. “Remembering when I was in their shoes, excited in learning and being at an actual facility, wearing a hardhat and steel toes, feeling like a real engineer.”

Sitton is proud of his Engineering Systems Design students. Many keep in touch about their new careers or return to visit on career days.

“This class will help them succeed in their career,” he said. “Some of the things that I had to learn in my career by trial of fire, I can teach them, so they won’t have to learn the hard way.” ⚙️

# Seven BME Students SURGE INTO SURF PROGRAM

BY STEPHEN GREENWELL

For the summer of 2020, the Cullen College of Engineering had seven Biomedical Engineering students selected for the Summer Undergraduate Research Fellowship program.

*The SURF program is open to sophomores, juniors and seniors that will be not be graduating in the year of the fellowship. A 3.0 GPA is required for full-time students, and only University of Houston main campus students are eligible.*

As part of the program, students attended a virtual lecture series. Some students presented at an Undergraduate Research Day virtual event on September 29, others will present at a future event planned for April 1, 2021. Students can do research outside of their department for the program. >>>

## IN THEIR OWN WORDS, HERE ARE WHAT OUR STUDENTS WORKED ON THIS SUMMER:



**Katherine Pham**  
(Dr. Jinsook Roh,  
Biomedical Engineering)

I worked on the pediatric exoskeleton project in Dr. Contreras-Vidal's Noninvasive Brain-Machine Interface Systems Laboratory. The goal of this project was to develop a process of creating customizable pediatric exoskeletons that are quick, accurate, and cost-efficient. Finding the best way to create customized braces for these exoskeletons in the SolidWorks application from a 3D scan of an individual's lower limbs, made with the iSense scanner, was the topic of my research.



**Dhriti Patel**  
(Dr. Sheereen Majd,  
Biomedical Engineering)

My summer research project aimed to develop a method for fabrication of alginate hydrogel encapsulating nanoliposomes.

Following the formation of the alginate encapsulated nanoliposomes, I investigated the mechanical elasticity, size distribution, zeta potential and overall stability using the various testing methods provided in the lab.



**Krishna Sarvani Desabhotla**  
(Dr. Jose Contreras-Vidal,  
Electrical & Computer Engineering)

Throughout the 10-week program, I explored the characteristics of intermuscular coordination in healthy controls, versus stroke survivors, when performing isometric and dynamic reaching tasks utilizing electromyographic data.

Through this work, I hope to employ the knowledge about bioelectrical signaling, human physiology and MatLab coding that I learned in class to investigate the muscle activation patterns related to motor impairments caused by stroke.



**Nathan Cao**  
(Dr. Oomman Varghese,  
Physics)

Semiconductor metal oxide sensors have picked up traction in the science community because of their ability to detect extremely low concentrations of volatile organic compounds (VOC) in air. Application of these sensors as a diagnostic tool for cancer are of interest because of their potential for early detection.

However, since many VOCs are common to several diseases, sensors should distinguish the biomarker VOCs well for accurate diagnosis. I researched how to apply pattern recognition techniques such as machine learning to a sensor array to characterize a mixture of VOCs representing different health/disease states.



**Citlali Bataz**  
(Dr. Muayyad Al-Ubaidi,  
Biomedical Engineering)

The project was a literature review on the use of telomerase in clinical research and macular degeneration gene therapies. Telomerase is a protein that extended the ends of the chromosomes. Dr. Al-Ubaidi's lab has a line of transgenic mice, Tert Rosa 26, that will express telomerase when given a drug called tamoxifen.

I looked into the possibility of using a mutation in the telomerase gene to extend the life of healthy photoreceptor cells in the retina. I would like to continue my research in the fall to test the time for telomerase expression in mice and study the retina's response to an increase in telomerase.



**Mariana Lopez Martinolich**  
(Dr. Yingchun Zhang,  
Biomedical Engineering)

During my 10-week internship in the Zhang Lab, the primary focus of my research was on the application of concurrent electroencephalography (EEG) and functional near infrared spectroscopy (fNIRS) in the assessment of the cortical reorganization that occurs during stroke rehabilitation. The Zhang lab is focused on the development and evaluation of portable, low-cost and noninvasive multimodal neuroimaging systems that could expand our understanding of the underlying mechanism for post-stroke functional recovery. This type of clinic-friendly neuroimaging systems will help identify valuable biomarkers for assessing motor function, monitoring motor function recovery, and predicting intervention outcomes for post-stroke patients, thereby maximizing the therapeutic effects of post-stroke rehabilitation protocols.



**Abigail Janvier**  
(Dr. Sheereen Majd,  
Biomedical Engineering)

The Blood-brain-barrier (BBB) is a layer of microvascular endothelial cells within brain capillaries that regulates the transport of molecules in and out of the brain. Unfortunately, this barrier poses an obstacle for therapeutic molecules to reach the brain, thus creating a need for realistic models of BBB in vitro that can represent the BBB in vivo.

To target this necessity, the use of microfluidic devices in combination with brain capillary endothelial cells has proven to be a promising approach to mimic the key features of natural BBB. The focus of my summer research was on the design and seamless incorporation of electrodes within the above-mentioned microdevice in Dr. Majd's lab, which will be critical for TEER measurements. 🌱

## UH, NACME CELEBRATE 2019-20 CLASS

BY STEPHEN GREENWELL

A dozen students from the Cullen College of Engineering's chapter of the National Action Council for Minorities in Engineering (NACME) were celebrated for graduating in the 2019-20 academic year, along with others across the country, during a national Zoom ceremony on June 11.

The ceremony was hosted by NACME Board Chairman Frederiek Toney, Vice President, Global Ford Customer Service Division. The keynote address, "Change: How to Cope, Adapt and Remain Resilient" was delivered by Brian Tippens, a vice president and deputy general counsel at Hewlett Packard Enterprise.

**Dr. Jerrod A. Henderson**, an Instructional Associate Professor in the Chemical Engineering Department at the Cullen College of Engineering, noted that the organization had to adapt in light of the COVID-19 pandemic, like many others.

"This recognition was a great way to celebrate NACME Scholars from across the country, who are going out and diversifying the engineering workforce," he said.

The 12 students graduating in the 2019-20 academic year are:

- Samuel Akinwande
- Marc Alozie
- Miguel Arias
- Daniel Bosquez
- Carolina Delgado
- Joseph Emesih
- Michael Jackson
- Danielle London
- Javier Montejano
- Brandon Santos
- Gideon Tegene
- Carlos Zaleta

Henderson said this year's class of 12 NACME Scholars was representative of the high-quality students the college was graduating now.

"NACME Scholars are among our best, brightest, top-tier academic performers, as well as leaders at the University of Houston," he said. "NACME has been an important resource that



BRANDON SANTOS



JOSEPH EMESIH



SAMUEL AKINWANDE

helps connect our scholars to a small, cohort style community of other high achieving students. In this NACME community of scholars, students challenge each other to grow, and as we like to say in PROMES, 'achieve, connect and trailblaze.' NACME funding also allows these high performing students to concentrate on their studies rather than have to work jobs to pay for their education."

According to the organization, NACME's scholarship program for under-represented

minorities serves as a catalyst to increase the proportion of Black/African American, Native/American Indian, and Latinx/Hispanic American young women and men in STEM careers. The organization inspires and encourages excellence in engineering education and career development, toward achieving a diverse and dynamic American workforce. From 1974 through 2014, NACME provided scholarship support to more than 23,000 minority engineering students across the nation. 🌟



## Odo Earns First Place with 'RARE EVENT' PAPER

BY STEPHEN GREENWELL



CHIWETALU PETER ODO

**Chiwetalu Peter Odo**, a senior Industrial Engineering undergraduate student, was the first-place winner in the IISE South Central Undergraduate Student Technical Paper Competition at Wichita State University in early March.

*Odo's paper, "Rare Event Classification in Multivariate Time Series," is about "rare events" in industry – trying to predict the events before they happen and accentuating preventive actions that could be taken during early stages.*

"I've just always been interested in patterns as far back as I can remember," he said. "I've also been fascinated by pattern recognition."

Rare events are classified as events that occur less than five percent of the time, according to Odo. As part of a presentation he gave on his paper, Odo used the example of a pulp-and-paper industry. A rare event could be a machine overheating, or paper being misaligned, resulting in an inferior product.

"The rare event problem globally, is a billion-dollar problem," he said. "That doesn't even count the amount of times in which assets are abated when they didn't have to be abated. Any unplanned downtime results in significant loss in money, so if you can predict rare events before they happen, that can reduce the commensurate loss."

While his paper is on analyzing rare events, Odo wants to be a data scientist studying a variety of machine learning applications. For example, his senior thesis is on a healthcare application that attempts to prevent cardiovascular disease by providing personalized lifestyle recommendations.

"I have a set of skills, machine learning and analy-

sis skills, that can be applied to anything," he said.

*A native of Nigeria, Odo said he was attracted to the University of Houston because he had family in the metro area, and because it was one of the most diverse campuses in the United States.*

"It's been a big deal for me, not necessarily to blend in, but to not stand out," he said.

Odo started at the college in 2013. After completing his degree, he wants to pursue a doctorate and become a professor. His work is being overseen by **Dr. Ying Lin**, an assistant professor in the Department of Industrial Engineering. 🌟

Petroleum Engineering Alum

# NAMED AS ONE OF TWA'S ENERGY INFLUENCERS

BY STEPHEN GREENWELL

**Dr. Pushpesh Sharma**, a May 2019 graduate from the University of Houston's chemical engineering and petroleum engineering programs, has earned distinction for his work as a doctoral student and with the start-up Inve-

niam Asset Management by being named one of The Way Ahead's 2020 Energy Influencers.

Dating back to 2005, TWA is a publication of the Society of Petroleum Engineers, with content generated and sourced by TWA volunteers, SPE staff and guest authors. According to its website, the publication is written by and for young professionals in the upstream oil and gas industry.

Sharma said he was nominated by Vikrant Lakhnupal, a fellow UH Petroleum Engineering student that he took classes with in 2016. He was notified that he was chosen in April.

"The nominations were coming from all over the world, so I wasn't expecting to be nominated and I was very surprised," Sharma said. "I'm really glad and I'm humbled. I wasn't really expecting it. It's an impressive collection of people working in industry, at big companies, and

I kind of felt like I wasn't suited to be in that group of people. It's very humbling."

According to TWA's write-up for why Sharma was chosen, the publication noted that he was the first graduate student to join the subsurface research laboratory under **Dr. Konstantinos Kostarelos** at the UH Technology Bridge and helped develop the laboratory facilities. His dissertation work on a novel non-thermal heavy oil recovery process provided a green and sustainable alternative to thermal processes and is now a part of a patent application.

Sharma said that Kostarelos was an important mentor during his time as a student, and even after graduation, they've remained in touch.

"He helped me a lot along the way," Sharma said of Kostarelos. "He was and still is very supportive of my work and gave me freedom to research without micromanaging. I want to thank

him for his constant help and motivation."

*Sharma pointed to his work on the Downstream Resilience Innovation Challenge 2018 as something he was proud of during his time at UH. His group won the first prize for their proposal and business plan.*

"The project was how to come up with methods to make downstream energy more resilient," he said. "Our group was in the middle of that project. It was an interdisciplinary project with the Law Center, chemical, mechanical, subsea and industrial engineering departments. It was interesting to work on that, especially with the Law School's involvement. We learned a lot."

Sharma currently works at Inveniam Asset Management, in data analytics. He noted that it was another start-up, similar to how he joined UH's program when it was in the build-up phase.

*"What we're trying to do right now is see how you evaluate energy companies," he said.*

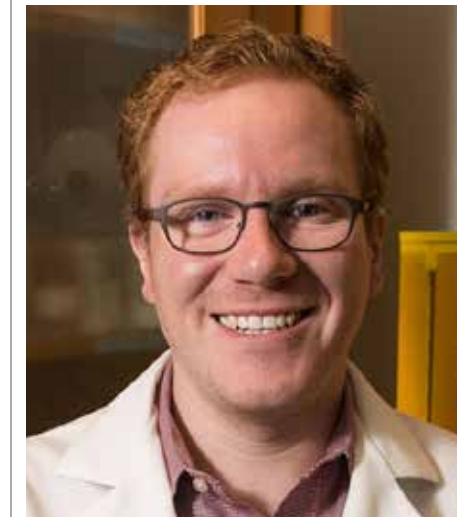
*"Currently, a lot of people look at their financial statements and what the company is doing there, and not what's happening in the field. We collect data about what's actually happening."*

Sharma said he got the opportunity by working with people while at UH, which was his goal when he enrolled.

"Houston is the energy capital of the world, so I was always interested," he said. "Before here, I was working downstream in the oil industry in India ... Joining UH and the Houston area, it provided me with so many connections. I was connected to people in chemical engineering and petroleum engineering." ⚙️

## Alum Poling-Skutvik Tapped FOR TENURE-TRACK POSITION AT URI

BY STEPHEN GREENWELL



When **Ryan Poling-Skutvik** enrolled at the University of Houston in 2013 to pursue a doctorate in Chemical Engineering, he did so because of the school's proximity to industry, not realizing that the experience would open him up to another interest – research.

"I started grad school thinking I would go into industry, which was a lot of why I was attracted to the University of Houston," he said. "Once I joined, I began doing research with **Jacinta C. Conrad** and **Ramanan Krishnamoorti**, and I fell in love with it. I'm kind of the opposite of a lot of students.

After two years as a post-doctoral researcher at the University of Pennsylvania's Department of Chemical and Biomolecular Engineering with Dr. Chinedum Osuji, Poling-Skutvik was offered a tenure track position at the University of Rhode Island. The position will give him an opportunity to continue his research and to teach.

"The reason I really liked Rhode Island is that it balanced teaching and research really nicely," he said. "I enjoy both areas. I enjoy research as a focus, but I do really like teaching. The reason I like academia a lot is the ability to create and transfer knowledge. Both research and teaching serve as different paths to accomplish that goal."

Poling-Skutvik has four core research focuses – complex fluids, nanocomposites, polymer physics and transport processes. He pointed to items like hair gel, plastics and toothpaste as the sort of everyday "squishy" things that he studies.

"My research is broadly defined as soft matter," he said. "It's the study of how squishy things move. There's a lot of different components to that. A lot of what I study is the dynamics of materials from the nano-scale to the micro-scale."

Poling-Skutvik noted that if you can understand these items at a nano-scale, you can control their properties for different applications.

"We want to understand how you can design those materials on a nano-scale, to give us what we need," he said. "A lot of what I study is the physics to how these materials work on a nano-scale, and you can apply that to a lot of fields."

*His interest in research burgeoned at the University of Houston, Poling-Skutvik said, partially because of the school and the city's connection to the industries in the immediate area.*

"I think Houston as a city gives you a lot of understanding why engineering, and specifically chemical engineering, is important for modern life," he said. "At U of H, we do very high-quality research and we are held to high standards, and we can punch above our weight as a department. That was aspirational."

Throughout his years at U of H, Poling-Skutvik said he was pushed to excel by Dr. Conrad, Dr. Krishnamoorti and others. He added that **Dr. Jeremy Palmer**, the Ernest J. and Barbara M. Henley Assistant Professor of Chemical and Biomolecular Engineering, was also vital for his work with simulations.

"One thing that really shaped me coming through U of H was the ability to collaborate and interface with different professors," he said. "I was exposed to a wide variety of different projects and different professors. That's something that doesn't exist in a lot of departments. Both of my advisers were incredibly supportive and helped frame my view of research." ⚙️



PUSHPEESH SHARMA



# WONG ENDOWED PROFESSORSHIP TO SUPPORT VIPULANANDAN

BY STEPHEN GREENWELL

Dr. Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering, announced on May 29 that Dr. **Cumaraswamy Vipulanandan** was selected as the recipient of the newly-established **Honorable Daniel Wong** Endowed Professorship.

*Wong is a distinguished graduate of the University of Houston, earning his Bachelor of Science in Civil Engineering in 1983. This was followed by a Master of Science in Civil Engineering in 1985. He finished his Doctor of Philosophy degree in 1988, which had an emphasis on geotechnical engineering.*

He was recognized as the Distinguished Engineering Alumnus by the Cullen College of Engineering in 2009 and inducted into the Academy of Distinguished Civil & Environmental Engineering Department in 2010. Wong still serves as a senior lecturer for the department and hopes his gift will spur further giving. >>>

THE HONORABLE  
DANIEL WONG



“My goal of this gift is to serve as encouragement for other UH alumni to join in giving to the Civil and Environmental Engineering Department in the form of an endowment,” he said.

Dr. **Roberto Ballarini**, the Thomas and Laura Hsu Professor and Department Chair of UH Civil and Environmental Engineering, noted that Wong has been a strong ally for the department.

*“Dr. Wong has always demonstrated unflinching support of the Civil and Environmental Engineering Department and unbridled enthusiasm for the achievements of its students and faculty,” Ballarini said.*

In 1993, Wong co-founded Tolunay-Wong Engineers, Inc., and he currently serves as the company’s president and CEO. The firm now employs more than 370 engineers, scientists and other professionals, and consults on a variety of projects in the Gulf Coast region. The company’s corporate headquarters is located in Houston and has 11 offices throughout Texas and Louisiana.

In addition to his professional success, Wong has also been a committed public servant. He served as an elected, At-Large City Councilman for the City of Sugar Land from 2002 through 2008. He was also a former Board member of the Houston-Galveston Area Council; and the Texas Board of Professional Engineers from 2006 through 2012, serving six years as its chairman.

His civic involvement consists of former board membership of the Fort Bend YMCA, the American Heart Association and the Literary Council. He is currently a trustee of the Fort Bend Economic Development Council.

The endowed professorship will support the research work of Vipulanandan, which focuses on geotechnical, materials and geoenvironmental engineering. He has been Principal Investigator or Co-Principal Investigator for more than 56 funded projects since 1984, amounting to more than \$5.8 million. Previous projects he has worked on include a \$300,000 study on the maintenance of transportation and storm sewer facilities for the Texas Department of Transportation and a \$150,000 study of the long-term performance of water pipelines for the City of Houston.

Vipulanandan joined the University of Houston as an assistant professor in 1984. He was elevated to an associate professor in 1990 and a full professor in 1995, and he served as the department’s chairman from 2001 through 2009. Since 1994, he has served as the director of the Center for Innovative Grouting Materials and Technology (CIGMAT) at the Cullen College of Engineering. Vipulanandan earned his B.Sc. in Civil Engineering at the University of Moratuwa in Sri Lanka in 1980, followed by a master’s and doctorate at Northwestern in 1981 and 1984, respectively.

In 2005, Vipulanandan received the Fluor Daniel Faculty Excellence Award, the highest award given by the Cullen College of Engineering. Previously, he earned the Senior Faculty Research Excellence Award in 2002, as well as a research award from the Texas Department of Transportation in 2000 for his project on auger cast-in-place. He has also been a member or on a committee for 18 professional organizations, including the American Society of Civil Engineering, Sigma Xi and Chi Epsilon – the National Civil Engineering Honor Society.

Wong said he is friends with Dr. Vipulanandan, commonly known as “Dr. Vipu,” and considered it a great usage of his gift.

“I was in the graduate program at UH when the department hired Vipu as the assistant professor in the Geotechnical program,” he said. “My adviser, Dr. [Michael] O’Neill, hired him at that time and moved me to be Dr. Vipu’s first Ph.D. student, and later on his first Ph.D. graduate. After graduation, I have been involved in supporting Dr. Vipu’s CIGMAT and



DR. CUMARASWAMY VIPULANANDAN



Hurricane Center since their inception. I graduated from UH in the Geotechnical Engineering program and currently Dr. Vipu is the only faculty in the Geotechnical program. It is an honor for me to have Dr. Vipu be the first holder of the Honorable Daniel Wong Endowed Professorship.”

Tedesco thanked Wong for his continued support to the college.

“I would again like to thank Dr. Wong for his generous gift to the university, one that will strengthen our pursuit of knowledge and provide even more stability to the Cullen College of Engineering,” he said. “I look forward to Dr. Vipulanandan’s contributions and future successes in elevating our College’s research goals.” 🌟



# ENDOWMENT ESTABLISHED IN MEMORY OF DR. KAMEL SALAMA

BY STEPHEN GREENWELL

Gwen Salama, the wife of the late **Dr. Kamel Salama** – a professor at the University of Houston's Cullen College of Engineering and the director of the materials engineering program – said his charm and social nature were evident from their very first meeting, which was when she was having problems with her beat-up Volkswagen in November 1970.

“It was one of those strange cold fronts we had, and it was below freezing,” she said. “He was a Good Samaritan. He came up behind me and said, ‘Good morning,’ and I turned around and said, ‘What’s good about it?’ God bless him, he helped me push this car up and down this parking lot.”

Gwen said a few days later, he took her out to dinner. It was the start of a 49-year relationship that produced two children, Joseph Salama and Emilie Hudson.

“He was smart, witty and a good conversationalist,” she said. “He was just an impressive guy, and willing to do the work and be helpful. He had a generosity of spirit that just permeated every aspect of his life.”

Gwen, Joseph and Emilie all said that Kamel’s devotion to the university and especially to his graduate students drove the family’s decision to establish the Dr. Kamel Salama Endowed College Professorship, after he passed in July 2019.

“For my entire life, U of H was so important to my dad, beyond being the place that he really established himself professionally,” Joseph said. “He was sustained by the relationships he developed there over time with his colleagues and his students. When we were thinking of the best way to honor my dad’s memory, the endowment seemed natural and kind of a no-brainer.”

Emilie said, “I don’t think there was ever a question about giving back to the university, it was just a matter of how to facilitate this vision he had ... When we thought about who he was, he was a husband, he was a father, he was a scientist, he was a friend. The thing that made the most sense in

terms of memorializing him was to help facilitate that vision and potential in others.”

Kamel first joined the University of Houston as a visiting professor for a year in 1973, and served as an associate professor until 1978. At that point, he was promoted to a full professor and the director of the materials engineering program. He taught and led a research group at UH for more than 35 years.

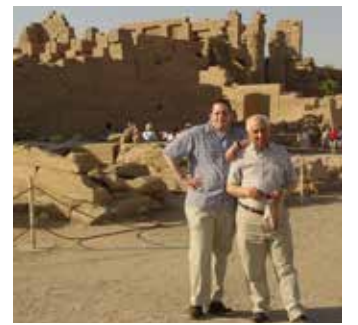
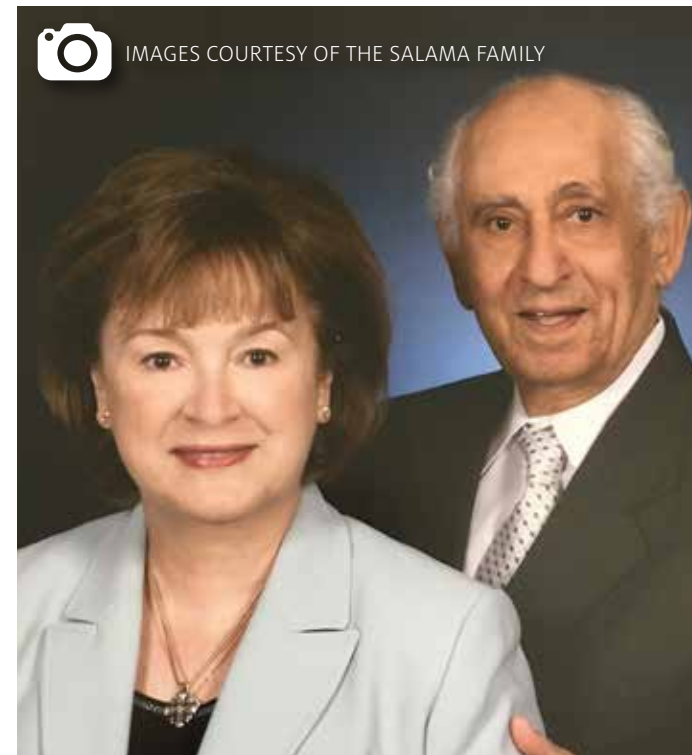
Gwen said that when he joined the UH faculty, he was already an accomplished professional, but the university gave him a chance to lead his own research projects and to pursue his interests.

*“The University of Houston enabled him to blossom as a researcher,” Gwen said. “If he worked hard, he would get the grants, and the university supported him in all of his efforts ... The university was a place where he could flourish. He had supportive deans and chairpersons, and colleagues and students.”*

Each family member noted that Kamel loved to spend time in the lab, and tried to encourage this in his graduate students as well.

“We would bring a Thanksgiving dinner to the lab for his students. Please note that it was in the lab because he wanted them to be in the lab,” Gwen said, laughing.

Joseph and Emilie noted that their father brought them to the university and to his lab often, and also hosted students and professors at their home



for dinner. As a result, it often felt like they had a large, extended family of big brothers and sisters.

“When I was young and my mom was studying for her master’s degree, my dad would take my sister and I to work,” Joseph said. “He’d take us to the lab, and we’d play with the punch card computers, and I can’t imagine how many programs we messed up by sorting them the wrong way. He really wanted us to be around the academic environment there, and to understand the kind of research and how important it was to him. Because of those experiences growing up, that’s why I’m in academics myself.”

**Dr. Venkat Selvamanickam** is now the M.D. Anderson Chairman Professor of Mechanical Engineering at the University of Houston, but he started as one of Kamel’s graduate students. He echoed the remarks from the Salama family with his own, noting that Kamel was tireless when it came to supporting his students.

“To me and all other students in the group, Kamel was really a great father figure,” he said. “Our group was almost all international students, all of us far away from home, probably out of our home country for the very first time. It was very helpful to have our Ph.D. advisor really treating us like family.”

Part of this was helping them acclimate to the United States, such as with everyday tasks like driving.

“When Kamel learned that I was looking to buy a car, he gave me his for just a dollar,” Selvamanickam said. “And when I got into my first accident and was bothered by insurance issues, he comforted me. ‘Don’t worry Selva. All of us get into accidents once a year and have to deal with these problems.’ Obviously, I did not know that was far from the truth, but at that time, that was exactly what was comforting to hear.”

**Dr. John Lienhard**, now the M.D. Anderson Professor of Technology and Culture, Emeritus, was another one of Kamel’s colleagues that stressed his

giving nature. He and his wife Carol vacationed with Kamel and Gwen, and he said Kamel was an important part of welcoming him to the University of Houston.

“He was a good friend to Carol and me from our arrival at UH,” Lienhard said. “He and Gwen put us up in their house while we awaited our moving van. Their many acts of kindness continued for 40 years.”

When it came to his research and his work, Lienhard said his accomplishments were almost too numerous to list.

“He served as a sounding board when I had technical problems that overlapped his knowledge, and he had a talent for damping out friction,” Lienhard said. “I just want to emphasize the essential goodness that marked all his dealings. His great love for Gwen, Joseph, and Emilie, his relations with his colleagues, his care for his students... We all miss Kamel Salama.”

Emilie stressed that her father was always generous, social and intellectually curious.

“He was a very social animal,” she said. “We always had people at the house. If it wasn’t graduate students, it was colleagues. If it wasn’t colleagues, it was friends. It wasn’t altogether uncommon for my dad to call my mom at work and say, ‘We’ll be ten for dinner.’ Whatever the conversation that was going on at the office with colleagues or visiting friends, the conversation couldn’t end where it was, it had to continue.”

Emilie said that she often carpooled with her father when she moved back to Houston – even though she had finished graduate school by that point. It was when she had her children, and her brother’s family started as well, that Kamel finally spent less time around the office.

“He made it a point to be a part of their lives, and I think that speaks to how important family was to him,” she said. “My two girls and my brother’s boys, they have really distinct memories of their grandfather.”

# LIENHARD'S LENS



BY JOHN LIENHARD



## Buildings with wings

The first time I saw a winged building, it caught me with my guard down. It was the Burke Brise Soleil, mounted on the Quadracci Pavilion of the Milwaukee Art Museum. The whole structure rises in the summer morning sun, looking out over Lake Michigan. The wings unfold at 10:00 AM to admit natural light as visitors arrive. The wings fold in over the noon hour – then reopen. They close again for the night at 5:00 PM.

The term *brise soleil* refers to any structure meant to break up direct sunlight. But this one goes far, far beyond mere function. It marks the city of Milwaukee as surely as the Eiffel Tower identifies Paris. The wings are immense – two meters wider than a Boeing 747's wingspan. Opening or closing, they stop us in our tracks. That terribly slow, majestic, inexorable motion leaves us all transfixed.

This was the creation of Spanish architect Santiago Calatrava. He is famous for similar architectural bravura all over Europe and the Americas.

He seldom repeats himself; yet he did create a second set of such wings in New York City.

His New York structure sits at the base of the new World Trade Center. It covers a subway hub beneath the street. When I saw it, still being built, it was a lesson in structural engineering. The wings are terribly complex. Engineers had to levitate a vast lattice of huge moving weights into the sky. The wings on Milwaukee's Museum weigh 90 tons. It took serious foundation work to support them in the sandy soil below.

We engineers instinctively ask if all this is folly or function. Well, it is functional. These lifelike buildings remind us that we are here to serve our world by enriching it with beauty – just as surely as we are here to serve a vast range of far more elemental needs.

 [View more photos online at: enginespics.smugmug.com](http://enginespics.smugmug.com)





# THE ONGOING CORONAVIRUS PANDEMIC

HAS CAUSED THE CULLEN COLLEGE OF ENGINEERING TO CANCEL OR POSTPONE MANY OF ITS ANNUAL EVENTS. WHILE WE MISS THESE EVENTS, THE SAFETY OF OUR COMMUNITY REMAINS OUR TOP PRIORITY.

WE HOPE YOU ENJOY THESE PRE-PANDEMIC PHOTOS, ALL OF WHICH OCCURRED PRIOR TO THE UNIVERSITY OF HOUSTON'S INITIAL CAMPUS CLOSURE IN MID-MARCH.

Please continue to stay safe, and we look forward to gathering together again soon!  
#ForeverCoog



## ENGINEERING THE FUTURE OF MEDICINE

Two professors at the UH Cullen College of Engineering recently received prestigious CAREER Awards from the National Science Foundation to further their game-changing technological research in health and medicine.



**Rose Faghih's** award will support her MINDWATCH proposal, which centers on algorithm-based wearable technology capable of tracking the user's emotional and cognitive state.



**David Mayerich** will use his award funds to develop a software platform to produce searchable digital atlases of whole organs at the cellular level.

Over the last 10 years, the Cullen College of Engineering has received **19 CAREER Awards**. Come see why we have been engineering excellence since 1941.

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## CAREER FAIR SPRING 2020

More than 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 February 2020. More than 1,800 UH engineering students attended the fair, many of whom conducted or scheduled interviews with company recruiters.



## IEEE CHILI COOKOFF

Last March, Cullen College students, alumni and corporate sponsors showed off their culinary prowess at the IEEE Chili Cook Off. In addition to a fun evening of eating, drinking, music and games, the Chili Cook Off is a great networking opportunity for students to meet corporate representatives.





### 2020 ENGINEERS WEEK RECEPTION

For one week in February, engineers around the country are celebrated as part of National Engineers Week, a time to raise awareness of the critical contributions made by engineers and engineering. During the 2020 eWeek, the UH Cullen College of Engineering honored its outstanding students at the annual program and reception hosted by the Engineering Alumni Association.



### UH-FLUOR INDUSTRIAL CONFERENCE

Students and faculty from the UH Cullen College of Engineering attended the UH-Fluor Industrial Conference at the Student Center South Ballroom in November 2019. The conference featured a construction-driven execution design challenge called "Pump it up!"



## 2020 COHORT UH/HCC ENGINEERING ACADEMY INFORMATION SESSION

More than 100 individuals joined representatives from the University of Houston Cullen College of Engineering and Houston Community College in February 2020, for the first official UH/HCC Engineering Academy Information Session. The event was held at the new UH at Katy facility, which officially opened in August 2019.



# ENGINES OF OUR INGENUITY EPISODE NO. 1139: THE WOUNDED STORYTELLER



BY JOHN LIENHARD

Today, we tell the story of an illness.

Two recent books signal a shifting view of medicine. In 1993, Anne Hawkins wrote *Reconstructing Illness*. She invents the word pathography -- the patient's story of his illness. In 1995, Arthur Frank wrote *The Wounded Storyteller*. Frank talks about the narrative power that the wound gives the storyteller. Both stress how important it is for the wounded person to tell about the wound.

"Stories," says Frank, "repair the damage that illness has done to the ill person's sense of where she is in life and where she is going." He tells of a woman, long since declared medically recovered from a cerebral aneurysm. Her body still suffered muscular asymmetries. She was still afflicted with occasional double vision. The word "cured" meant medicine had done all it knew how to do.

The woman referred to her stroke as her ethnicity -- an outwardly minor, but inwardly essential, part of her being. Only in telling the story of her illness, could she finally take her recovery beyond the point at which medicine declared its job done.

We all undergo recoveries. In the process, we're repeatedly called on to tell the story of our illness. We usually answer in the technical language of medicine, distancing ourselves from our own bodies. We also recognize an unspoken obligation to be on the road to wellness.

"The jaw was broken and four teeth knocked out. It took years of reconstructive surgery," says an accident victim. Not, "My jaw!" and

never mind that her face will never be the same. Our ethnicity does change after illness. Our road in life really is redirected.

It takes another language, a subjective tongue, to reveal the wound in terms medicine cannot address. If the storyteller chooses, or dares, to engage that voice, then the illness emerges as the transforming experience it really is.

The doctor's "case report and [the patient's] pathography," Hawkins tells us, "are mirrors set at an oblique angle to experience: each distorts, each tells the truth."

That idea first hit me when I read the diary of 18th-century author Fanny Burney. In 1811 she suffered one of the first mastectomies, long before the use of anesthetics. A year later she finally gave voice to her soul-searing story -- but then only in her diary and only once. The entry is followed by the surgeon's much briefer account. Taken together they give us a chapter in the history of fighting cancer that we'd otherwise never have.

If I were a doctor, I'm sure I too would need distance. I too would try to separate the illness from the patient. I too would limit my arena of combat with illness. But these new books remind us that mind and body are one. Both the recovery from illness, and any full understanding of illness, have a huge dimension which modern medicine is still struggling to see clearly.

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

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

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*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](http://www.uh.edu/engines).*

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