Fall 2016

Parameters

Cullen College of Engineering Magazine

UNIVERSITY of HOUSTON | ENGINEERING

STRAIGHT FROM THE MOVIES


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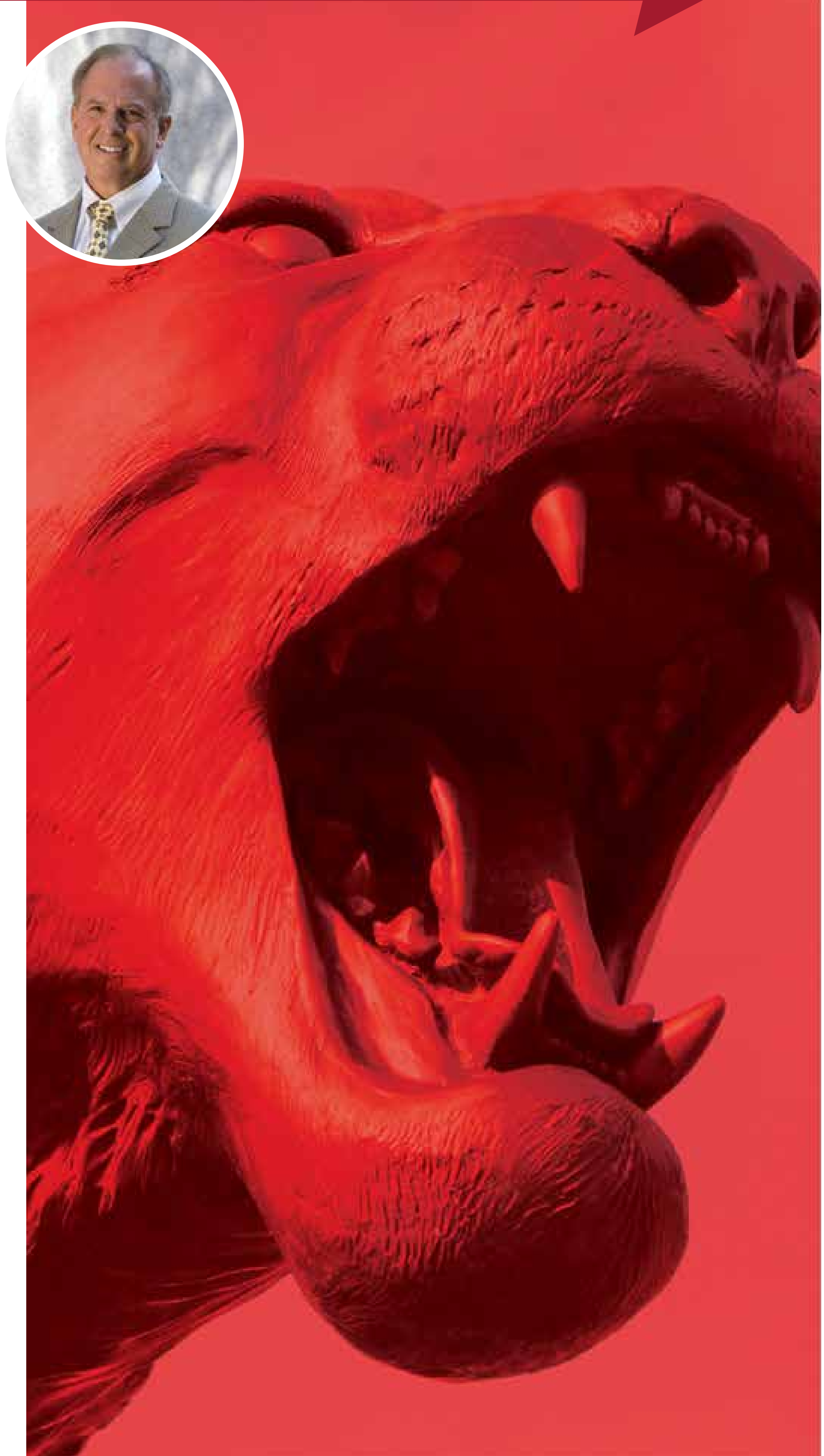
THE RESULTS ARE IN



For many scientists and engineers, science fiction films and television shows such as "Star Wars" and "Star Trek" inspired us early in our lives to question, to explore and to never stop seeking solutions that improve the quality of people's lives. Martin Cooper, director of research and development at Motorola, credited the "Star Trek" communicator for his first mobile phone design in the early 1970s.

The 1966 film "Fantastic Voyage" imagined a future in which humans could shrink to microscopic sizes and travel through the human body to repair brain damage from the inside; today, researchers are studying how to use nano-robots for the same purpose.

Stanley Kubrick's "2001: A Space Odyssey" mesmerized audiences of scientists and non-scientists alike with its uncannily realistic imagining of space and space travel; in fact, the film was so well-imagined that many of the fictional technologies depicted in "2001" are currently in use on NASA spacecraft, including flat-screen computer monitors, in-flight entertainment and even exercise modules. The film resounded so deeply with NASA's astronauts that crew members aboard the International Space Station in 2008 sent a special message to the Academy of Motion Picture Arts and Sciences' Samuel Goldwyn Theater in Beverly Hills, California, where a celebration for the film's 40th anniversary was being held.

I wonder: had these once-unbelievable fantasies not been played out on the big silver screens, sparking the imaginations of millions of people all over the world, would these works of science fiction have ever come to be reality?

Science fiction and fantasy movies provide us with the space to imagine what the future might look like; they allow us to explore the world not as it is, but as we wish it could be. In this issue of *Parameters*, we show our appreciation for the movies that inspired us as scientists and engineers while pitching a few screenplay-worthy ideas of our own.

I invite you to explore how the UH Cullen College of Engineering is creating realities that seem straight from the movies in this issue of *Parameters Magazine*.

Warm regards,

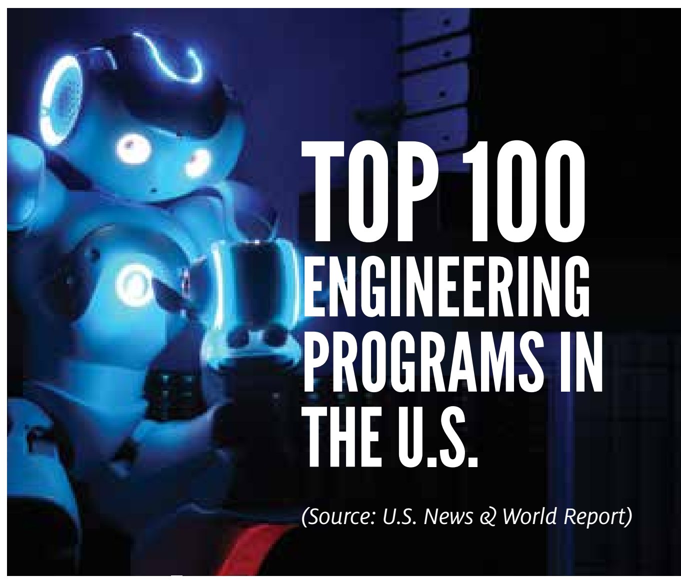
Joseph W. Tedesco

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

BY THE UH ENGINEERING NUMBERS

BEST ENGINEERING SCHOOL OF 2017

(Source: U.S. News & World Report)



TOP 100 ENGINEERING PROGRAMS IN THE U.S.

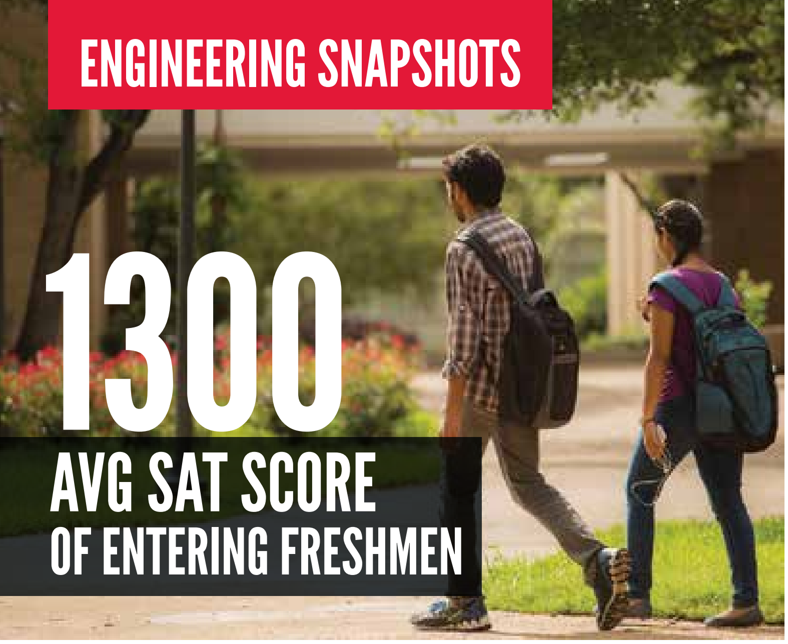
(Source: U.S. News & World Report)

13 NATIONAL ACADEMY OF ENGINEERING FACULTY MEMBERS

5,000+ STUDENTS

$26M+ RESEARCH EXPENDITURES

ENGINEERING SNAPSHOTS

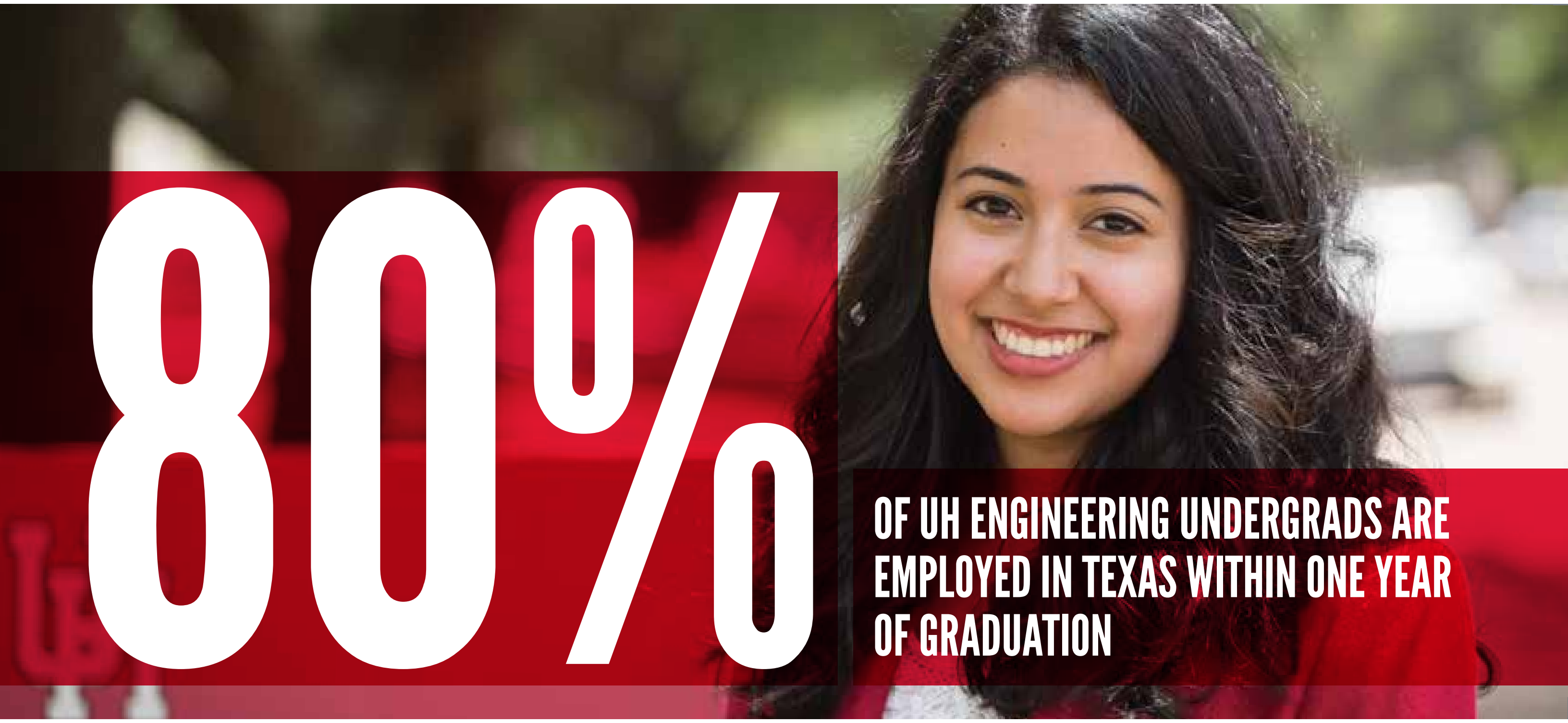


1300

AVG SAT SCORE OF ENTERING FRESHMEN

130

TOTAL FACULTY



80%

OF UH ENGINEERING UNDERGRADS ARE EMPLOYED IN TEXAS WITHIN ONE YEAR OF GRADUATION

$103,390

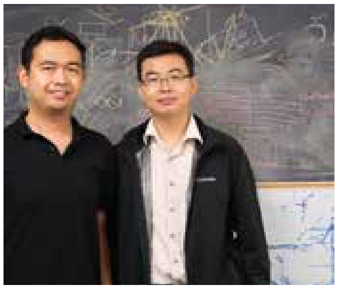
AVERAGE ANNUAL SALARY OF ENGINEERING PROFESSIONALS IN HOUSTON, TEXAS

(Source: U.S. Bureau of Labor Statistics, 2015)

19,000+

TOTAL ALUMNI OF THE CULLEN COLLEGE

YOUR PROSPECTS



UH ENGINEERING BACHELOR'S DEGREES AND 2016 PROJECTED ANNUAL SALARIES

Academic Major	Mean Salary Nationwide	Mean Entry-Level Salary in Houston, TX
Biomedical engineering	$61,108	$81,300*
Chemical engineering	$69,196	$76,000**
Civil engineering	$61,734	$66,242**
Computer engineering	$65,606	$68,240**
Electrical engineering	$66,269	$71,000**
Environmental engineering	$60,375	$62,000**
Industrial/manufacturing engineering	$62,242	$63,321***
Mechanical engineering	$65,593	$72,000**
Petroleum engineering	$89,563	$97,000**

Source: Winter 2016 Salary Survey, National Association of Colleges and Employers
* *Source: U.S. Bureau of Labor Statistics*
** *Source: PayScale.com*
*** *Source: Salary.com*

YOUR BEST BET

UH ENGINEERING MASTER'S DEGREES AND 2016 PROJECTED ANNUAL SALARIES

Academic Major	Mean Salary Nationwide	Mean Entry-Level Salary in Houston, TX
Aerospace/aeronautical engineering	$72,887	$83,850**
Biomedical engineering	$71,140	$85,970*
Chemical engineering	$79,894	$83,002**
Civil engineering	$67,962	$75,000**
Computer engineering	$74,513	$79,000**
Electrical engineering	$74,896	$87,337**
Environmental engineering	$65,857	$93,230*
Industrial/manufacturing engineering	$73,756	$109,970*
Materials engineering/science	$74,721	$104,900*
Mechanical engineering	$75,391	$85,000**
Petroleum engineering	$97,333	$103,337**

Source: Winter 2016 Salary Survey, National Association of Colleges and Employers
* *Source: U.S. Bureau of Labor Statistics*
** *Source: PayScale.com*

WE ARE BRINGING UH ENGINEERING'S BEST TO KATY'S BRIGHTEST

INTRODUCING THE FIRST-EVER UNIVERSITY OF HOUSTON ENGINEERING CLASSES IN KATY

FALL 2016

UNIVERSITY of HOUSTON | ENGINEERING

UNIVERSITY OF HOUSTON OFFERS ENERGY-FOCUSED ENGINEERING COURSES IN KATY

BY AUDREY GRAYSON

This fall, the University of Houston's Cullen College of Engineering began offering two energy-focused engineering courses at the Houston Community College (HCC) Northwest-Katy Campus, about a mile north of Interstate 10 at 1550 Foxlake Drive.

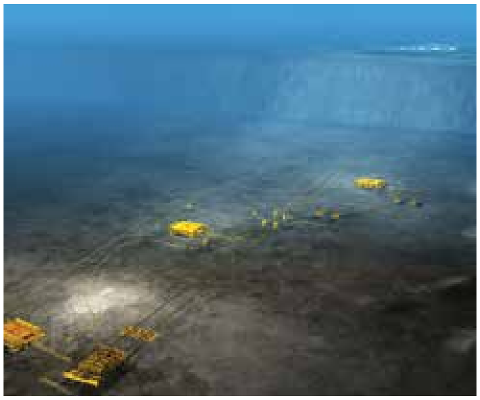
The graduate-level courses in petroleum engineering and subsea engineering – both in high demand along the West Houston Energy Corridor – are the first of many UH engineering courses offered in the Katy area.

A new UH branch campus in Katy will offer degrees most relevant to current industry demands, including engineering, business and education. A grand opening of the UH Katy facilities located near I-10 and the Grand Parkway is tentatively scheduled for 2018.

Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College, said the college's administrators didn't want to wait that long to begin offering engineering courses in Katy.

"Katy is one of the fastest-growing areas in the Houston region, and the demand for energy and engineering talent in Katy has never been greater. We want those who live in the area to have access to a world-class engineering education in their own backyard," Tedesco said.

The courses are taught by world-renowned faculty. **Christine Ehlig-Economides,** a member of the National Academy of Engineering, teaches "PETR 6314: Pressure Transient Testing." The course explores the theory and application of pressure transient testing of oil and gas wells for determination of reservoir properties and near-well damage or stimulation.



Subsea engineering industry leader **Burak Ozturk** teaches "SUBS 6330: Pipeline Design," a comprehensive overview of subsea pipelines, including lessons on pipeline design, flow assurance, material selection, installation and construction, inspection and integrity management. Students who successfully complete the pipeline design course may apply the credits toward a certificate in subsea engineering from UH.

The Texas Workforce Commission estimates that petroleum engineering will be among the fastest-growing occupations in the state of Texas through 2022, with demand for petroleum engineers increasing by 49 percent. Roughly 875 new petroleum engineering positions will be added across the state each year, according to TWC estimates.

The nation's first subsea engineering graduate program was launched at UH in 2012 in direct response to industry workforce demands. Offshore oil and gas reserves account for an increasing share of global energy production, but the supply of engineers skilled in the design and maintenance of subsea systems for energy production continues to lag behind.

> "WE WANT THOSE WHO LIVE IN THE [KATY] AREA TO HAVE ACCESS TO A WORLD-CLASS ENGINEERING EDUCATION IN THEIR OWN BACKYARD." - DEAN JOSEPH W. TEDESCO

Both courses are open to degree-seeking students and, with the consent of the respective programs, non-degree-seeking students. Both courses may be applied toward a master's degree in petroleum or subsea engineering based on successful admission into the respective graduate programs.

Tom Holley, former interim chair of the UH department of petroleum engineering, said the petroleum engineering course offerings in Katy are geared toward working engineers who are looking to set themselves apart in the workforce.

"We want to provide access to education in the Katy area that will help to fill in the gaps we anticipate in the energy workforce," Holley said.

"It's our responsibility to make it as easy as possible for people to get a top-notch subsea engineering education where they work and live," said **Matthew Franchek,** director of the subsea engineering program at UH.

FOR MORE INFORMATION
on the UH Engineering courses in Katy, visit www.egr.uh.edu/engineering-katy.

UH MOVES UP IN GLOBAL RANKINGS FOR ISSUED PATENTS

BY JEANNIE KEAVER

The University of Houston is among the top 100 university systems in the world for granted U.S. utility patents in 2015.

The rankings, released last July by the National Academy of Inventors and Intellectual Property Owners Association, show the UH System ranks second among Texas systems, behind only the University of Texas. The University of California System is ranked No. 1, as it has since the rankings began in 2013.

This is the first year UH cracked the top 100, tied for No. 80 with 29 utility patents issued in 2015. UT was issued 191 and ranked fourth; other Texas schools on the list included the Texas A&M University system and Rice University, tied at No. 96 with 25 patents each.

UH has put increasing emphasis on translating academic research into useable technologies over the past few years. Royalty income at the flagship campus – which is money generated by patents issued for technologies or products developed at UH that is split between the inventor, the college in which the inventor works and the University – was $22 million in 2015, the most generated by any U.S. public university without a medical school. That is up from $1.1 million in 2008.

The rankings cover utility patents, which are "issued for the invention of a new and useful process, machine, manufacture, or composition of matter, or a new and useful improvement thereof," according to the U.S. Patent and Trademark Office, and account for about 90 percent of all patents issued.

Ramanan Krishnamoorti, interim UHS vice chancellor and UH vice president for research and technology transfer, said the rankings are a sign of the faculty's creativity and drive, along with an institutional focus on supporting research to solve society's problems.

"Whether it's a new drug or a smarter way to produce oil, academic researchers are driven not only by the search for basic knowledge, but by a desire to solve problems," Krishnamoorti said. "The University has put an increased focus on helping researchers move their work from the lab bench to commercialization while also advancing basic science and engineering, and it is paying off."

UH CRACKS TOP 100

UNIVERSITY SYSTEMS IN THE WORLD FOR GRANTED U.S. UTILITY PATENTS IN 2015

THE FULL REPORT
of the Top 100 Worldwide Universities Granted Patents in 2015 can be found at www.academyofinventors.com/pdf/top-100-universities-2015.pdf

CHEVRON INSPIRES GIRLS TO ENGINEER THE FUTURE AT THE UNIVERSITY OF HOUSTON

BY NATALIE THAYER

On Saturday, April 2, the hallways and classrooms in the UH Cullen College of Engineering bustled with activity as nearly 300 girls tackled tough engineering concepts through fun, hands-on activities at the first annual "Girls Engineering the Future!" event.

The event, which is sponsored by Chevron and hosted by the Cullen College, introduces Houston-area 4th-8th grade girls to the wide world of engineering through activities and workshops led by Cullen College professors and student organizations. Chevron volunteers also helped at various activity stations throughout the day.

Girls had the chance to play with pink "magic goop" at a station hosted by UH American Society of Mechanical Engineers (ASME) students, make bread "fossils" with students from the UH Society of Petroleum Engineers (SPE) and build an electrical circuit with students from the UH Institute of Electrical and Electronics Engineers (IEEE). Other activities and workshops included an egg drop station and a jewelry-making robot station, among many more.

TO LEARN MORE
about the event, please visit www.egr.uh.edu/girls-engineering-the-future.

UH PROFESSOR MEETS WITH CONGRESS ABOUT NATIONAL ROBOTICS INITIATIVE

BY JEANNIE KEAVER

A robotics expert with the University of Houston Cullen College of Engineering met with members of Congress and other scientists last June to discuss the National Science Foundation's (NSF) National Robotics Initiative.

Aaron Becker, assistant professor of electrical and computer engineering, is funded under the initiative for his work in swarm robotics, or controlling the movement and behavior of large numbers of robots. He was invited by the NSF to participate in the Congressional Robotics Caucus on June 9.

Much of Becker's work involves millirobots – millimeter-sized robots – which have medical applications, from delivering targeted drug therapy to performing minimally invasive surgery.

Becker said the event was an extension of outreach efforts he and his lab routinely do at schools, scout meetings and community events. "Robotics is a special way to introduce STEM subjects," he said.

While he and his students taught girls to make UH earrings during a "Girls Engineering the Future!" event in April, the goal was a bit more serious in Washington, D.C., as the NSF sought to help members of Congress and their staffs better understand the role that robotic technologies will play in healthcare, manufacturing, transportation and other sectors.

"It's showing some of the visual aspects of what we do," Becker said. "My goal was to share some of the great things we're doing, how the University of Houston is a hotbed of innovation."

A paper Becker and two collaborators from Harvard Medical School presented at last year's IEEE International Conference on Robotics and Automation described how medical millirobots, powered by the magnetic field in an MRI machine, could offer targeted drug delivery or surgical intervention.

MRI – or Magnetic Resonance Imaging – scanners exert a magnetic field, which Becker has demonstrated can be harnessed and used to move tiny metal-filled robots through the body's blood vessels. Additional algorithms can be used to steer them to a specific target and even to instruct them to assemble a type of "Gauss gun" inside the body, which can provide the power to pierce tissue for drug delivery or microsurgery.

"THE UNIVERSITY OF HOUSTON IS A HOTBED OF INNOVATION."

- AARON BECKER

Becker's lab also is working on several projects outside medicine, including one which would use robotics to kill mosquitos. Despite claims about mosquito-repelling plants, bug-zappers and the like, he said the only effective solution is pesticides, but as mosquitos become resistant to the chemical makeup, new pesticides are continually needed. The project is undergoing testing.

A second project, done in collaboration with UH geoscientists, uses drones and small robots to monitor and assess areas for potential oil and gas development. Many regions targeted by energy companies for potential development lack roads and other infrastructure, Becker said, making robotics an efficient way to set sensors and perform other tasks.

"It's a new way to explore," Becker said. "It's expensive to drill an oil well. You want to be sure you're in the right place."

UH PETROLEUM ENGINEER APPLIES OIL RECOVERY TECHNOLOGY TO CLEAN UP LEAKED JET FUEL SITE IN DENMARK

BY AUDREY GRAYSON

With help from a UH petroleum engineering professor, a technology originally developed by the oil and gas industry to extract residual oil from reservoirs is now being applied to clean up the site of an underground fuel leak in Denmark.

The novel application of the oil recovery technology was designed by **Konstantinos Kostarelos,** associate professor of petroleum engineering at the UH Cullen College, along with his graduate students and a cadre of talented collaborators from all over the world.

In 2013, the Danish Ministry of Defense asked Kostarelos, who was serving as a faculty member at the University of Cyprus at the time, to work on this project after identifying an underground pipeline at a fuel storage facility that leaked massive amounts of jet fuel into the ground. Over time, the leak spread to a groundwater aquifer, creating environmental concerns for nearby residents.

> "REAL WORLD APPLICATION IS WHAT I ALWAYS STRIVE FOR IN MY PROJECTS. IT GIVES STUDENTS THE MOTIVATION TO SEE SOMETHING THROUGH TO THE END."
>
> - KONSTANTINOS KOSTARELOS

The Danish Ministry of Defense hired a private environmental consulting firm, NIRAS A/S, to carry out the implementation of the technology at the site of the fuel leak. NIRAS A/S then provided funding to Kostarelos and his students at the University of Cyprus to conduct preliminary laboratory research to support these efforts.

A NEW TRICK FOR AN OLD OIL RECOVERY METHOD

Crude oil development relies on both primary and enhanced recovery methods to ex-

ENERGY


From left: Travis Comer, Jay Ho Lee, Konstantinos Kostarelos, Sujeewa Palayangoda, Alex Lee

tract all of the available oil from a reservoir. Primary methods, such as using pumps and the natural pressure inside of the reservoir to drive the oil to the surface, only recover about half of the total oil inside of a reservoir. Enhanced Oil Recovery (EOR) methods must be employed to recover the remaining oil, which is usually trapped inside of tightly packed sand or the microscopic cracks and pores in rocks.

One safe and efficient method of recovering residual oil involves injecting environmentally-friendly and biodegradable chemical formulations – usually made up of polymers and detergent-like surfactants – to allow the oil to flow more easily through the porous rocks. High-pressure brine is then injected into the reservoir, allowing the oil to flow downstream where it is collected at another well.

"As far as I know, we are the only group in the world applying this enhanced oil recovery method to clean up the site of an underground fuel leak," Kostarelos said.

After Kostarelos' team identified the best formulations, the data collected from these tests was delivered to their collaborator Phillip de Blanc, an adjunct professor at Rice University and environmental engineer with the consulting firm GSI Environmental. De Blanc then ran numerical simulations on the data to predict how the surfactant formulation would perform on a much larger scale at the site of the fuel leak.

Since arriving at the University of Houston in 2014, Kostarelos and his graduate students have been conducting small-scale tests on rock core samples by replicating in-situ conditions and studying the effects that different surfactant formulations have on extracting the residual oil from the rocks' pores.

Now that Kostarelos' team has successfully designed this EOR method for an entirely new application, clean-up efforts at the site of the fuel leak are fully underway. NIRAS A/S divided the site into six stages, with two stages already completed. After completing each stage, or row, of the cleanup effort, NIRAS A/S reports the results to Kostarelos and his team, who then compare the data with the computer simulations and make adjustments to the formulations as needed.

So far, the success of the EOR technology at removing the residual fuel at the site of the leak has surprised even Kostarelos.

"We recovered more fuel than anticipated, and the water that came up was more fuel-laden than any of us were expecting," he said.

In total, 320 gallons of jet fuel were recovered from the first two rows of the site – so much more fuel than anticipated that the firm had to order storage tanks to temporarily hold the fuel-laden water until it could be treated.

Equally impressive as the technology's efficiency at cleaning up the fuel, Kostarelos said, was the speed at which it worked: the residual oil from each row was removed within one week.

Environmental consultants estimate that between 6,500 and 10,500 gallons of jet fuel remain in the contaminated aquifer. After the clean-up efforts come to an end, Kostarelos and his team plan to publish an article on the lessons learned from the project. So far, his group has presented their research at two conferences and will soon publish a paper in the journal *Science of the Total Environment*.

In addition to the speed and efficiency of this approach to cleaning up oil leaks or spills, Kostarelos said the use of surfactants allows for fine-tuning of the chemical formulations used in the cleanup efforts. A one-size-fits-all approach to cleaning up leaks and spills isn't feasible because of the unique conditions of each site – that is, the temperatures, pressures and other factors that can impact the success of oil recovery methods.

"This technology can be applied with tailoring to other sites throughout the world and yield as good of results as we're seeing here, at other sites," Kostarelos said.

SEEING IT THROUGH TO THE END

Kostarelos said his team is also focused on improving the economy-of-scale for their surfactant formulations so that less of the formula is needed to get the same, or better, results.

To conduct this work, Kostarelos and his students are creating synthetic rock core samples to study the flow behavior of oil and their surfactant formulations. Typically, researchers looking to study the flow of oil through rock cores must order rock samples from the sites they wish to study, which can cost millions of dollars and take months or even years to receive a two-inch specimen.

Kostarelos' team, which includes three graduate students and research scientist Sujeewa Palayangoda, is currently perfecting a technique for synthesizing 12-inch-long homogeneous rock core specimens each week, allowing his group to conduct repeated tests without the exorbitant cost and time associated with getting rock core samples from the field.

All of this work, Kostarelos said, is extremely important for his graduate students – Travis Comer, Jay Ho Lee, Alex Lee – as they embark on their careers in petroleum engineering.

"Real world application is what I always strive for in my projects," Kostarelos said. "It gives students the motivation to see something through to the end, because the research is tied to a real-world problem that needs to be solved."

UH ENGINEER IMPROVES COMPUTER MODEL TO FIND BETTER OIL SPILL REMEDIATION STRATEGIES

BY AUDREY GRAYSON

After a major oil spill, government agencies and energy companies have limited time to make decisions on how to remediate the disaster and clean up the spilled oil. Officials currently rely on computational models that predict the behavior of an oil plume in order to determine the best strategies for containment and clean-up.

While these models provide insights on the spill that are crucial for rapid response clean-up efforts, existing simulations don't account for some processes that play important roles in determining the direction, shape and overall size of an oil plume.

A professor at the UH Cullen College of Engineering is improving the computational model used to predict the behavior of oil plumes in deepwater blowouts, such as the BP Deepwater Horizon disaster in 2010. Once deployed, the improved models will provide insights to more effectively remediate these kinds of oil spill disasters.

Di Yang, assistant professor of mechanical engineering at the Cullen College, and his collaborators at Johns Hopkins University and the University of California, Los Angeles, received $877,162 from the Gulf of Mexico Research Initiative (GoMRI) in support of this research. A total of $247,490 will support Yang's portion of the research at UH.

In order to glean as much useful information as possible about an oil spill within an hour or less, officials rely on rapid response models, or integral plume models, that simulate only the average behaviors of an oil plume in the near-field of a leaking oil well. These models provide general information on the amount of oil spilled, how long it will take for the oil to reach the ocean's surface and in what direction the oil plume will likely travel.

But there are many small-scale interactions and processes that can have a profound impact on the overall behavior of an oil plume. For instance, the sizes of the oil droplets and gas bubbles released from the site of an underwater blowout have an impact on the shape of the near-field plume and its interactions with the ambient seawater. Small-scale turbulence at the edge of the oil or gas plume also plays a vital role in the mass and momentum exchange between the plume and the ambient sea.

Due to time and computational power constraints, this information is either averaged together or filtered out of simulations in integral plume models.

"The rapid response model has critical value for quickly determining how to respond to an oil spill, but the accuracy of this prediction heavily relies on the incorporation of other physical models to supplement the rapid response model. This accounts for the effects of some critical physical processes that are filtered out due to averaging," Yang said.

Yang and his colleagues are using Large Eddy Simulation (LES), a high-fidelity computational simulation technique for modeling turbulence in fluid dynamics, to fill in the gaps of the current integral plume models. The physical models developed by Yang's team can be seamlessly integrated into existing integral plume models without requiring additional computational power or time to receive the results.

"Using the computer power and resources currently available, we will directly resolve as much information as possible that the current integral models can't resolve," Yang said.

Yang began this research as a postdoctoral researcher at Johns Hopkins University in 2013. With funding from GoMRI, Yang's team studied the complex physical systems at play when spilled oil travels across the surface of the ocean.

Results of the research showed that not only large-scale systems – such as climate and ocean flow – play important roles in the dispersion of oil, but also small-scale interactions between oil droplets and upper-ocean turbulence. His team also found that the use of dispersants – chemicals used to break oil into smaller droplets so that it biodegrades more readily in the ocean – can profoundly impact how and where an oil plume travels across the ocean's surface.

> "WE WANT TO PROVIDE INSIGHTS TO FIND BETTER REMEDIATION STRATEGIES FOR RESPONDING TO THESE KINDS OF OIL SPILLS IN THE FUTURE."
>
> - DI YANG

Once the underlying physics of these interactions were quantified, Yang's team used their findings to supplement the large-scale ocean circulation models used for predicting regional dispersion of an oil spill in the Gulf of Mexico.

"There's a big gap between the smallest scale resolved by ocean circulation models and the scales at which the oil plume and ocean turbulence interact, so that's what we're filling in," he said.

Next, Yang and his colleagues focused on modeling the behavior of an oil plume at the site of a deepwater blowout. In a study published in the *Journal of Fluid Mechanics* last May, Yang's team simulated a lab-scale multiphase plume that mimicked the dynamics of the Deepwater Horizon plume as it burst vertically from the well at the ocean floor. The team then used a numerical model they developed to understand the underlying physics of the oil plume's behavior.

In the case of the BP Deepwater Horizon Blowout in 2010, government officials approved the company to apply dispersant directly at the site of the burst well, nearly 1,500 meters below the surface of the ocean.

"It reduced the damage a lot, but it's been questioned how efficiently that strategy actually worked," Yang said. "We want to provide insights to find better remediation strategies for responding to these kinds of oil spills in the future."

Using LES, Yang's team advanced the understanding of the fundamental physics and physical processes that contribute to the behavior of the oil as it shoots upward from the well at the ocean floor.

"The more we understand the fundamental physics, the more accurate our integral models will be. Now, when the rapid response model spits out averages, there will be fundamental physics underlying its results," said Yang.

With the current funding from GoMRI, Yang's group will take their research a step further by integrating both the vertical and horizontal model of oil dispersion into a complete framework.

"Right now, if a company or the government wants to look for a model that can capture all of the essential flow physics to provide a precise prediction of how an oil plume will behave during its entire fate – from the bottom of the ocean to the surface – we don't have that kind of model," Yang said. "After we understand the true physics and integrate these models together, we will be able to predict with greater accuracy how an oil plume will behave, and that will lead to better remediation strategies for future oil spills."

MICHIGAN WATER CRISIS INSPIRES UH RESEARCH ON LEAD IN WATER LINES

BY NATALIE THAYER

The National Science Foundation (NSF) awarded **Yandi Hu**, assistant professor of civil and environmental engineering at the UH Cullen College, a three-year, $188,531 grant to explore lead phosphate formations in water distribution lines.

The recent water crisis in Flint, Michigan, caused by lead release in water distribution lines, is an example of the value of such research and an inspiration for Hu's work.

"This is a wonderful project because of its direct link with real-world application," she said.

After the city of Flint's water supply was switched from Lake Huron to the Flint River in 2014, a host of problems flooded into area residents' homes. Many residents reported foul-smelling, brown-colored water coming from their faucets and some reported experiencing health problems. In late 2015, it was determined that these issues were related to a high lead concentration in the water caused by corroded lead water lines.

Typically, phosphate is added to water sources as a corrosion inhibitor to prevent the lead in distribution pipes from dissolving into the water. Phosphate catches lead iron as it releases from the pipes and deposits it back onto the pipes' surfaces as a solid mineral scale. Mineral scales, which build up over time, serve to immobilize the lead and reduce the lead concentration in the water.

When the city of Flint changed water sources, a corrosion inhibitor was not added to the highly corrosive waters of the Flint River. Subsequently, the untreated water dissolved the pre-existing lead phosphate mineral scales inside the pipes, exposing the lead pipes directly to the corrosive water. As lead leached into the water, it oxidized the disinfectant chloride, which is added to water sources to kill disease-causing pathogens, rendering it ineffective and increasing the health hazards present in the water.

Lead phosphate particles can either be deposited into the water as homogeneous precipitates or onto the pipes as heterogeneous precipitates.

"The homogeneous precipitates have the chance to be carried along the distribution line, resulting in elevated particulate lead concentrates in the tap water," Hu said. "But heterogeneous precipitates that form on pipes will be immobilized in the distribution lines."

Hu and her colleagues from Washington University, Daniel Giammar and Jill Pasteris, are investigating both homogeneous and heterogeneous lead phosphate precipitation in lead distribution pipes. Lead phosphate precipitation is affected by pre-existing mineral or organic coatings on the pipes and the various elements of the aqueous chemistry, such as alkalinity and organic matter in the water source.

In her lab at the Cullen College, Hu's research focuses on investigating the nanoscale interactions that occur along distribution pipe surfaces, mineral scales and aqueous components of water sources in transportation lines to understand the fundamental mechanisms that control heterogeneous lead phosphate mineral scale formation. Her colleagues at Washington University, funded by the NSF and Water Research Foundation, are investigating the homogeneous lead phosphate formation and conducting tests on actual pipes collected from several cities in the United States.

"THIS IS A WONDERFUL PROJECT BECAUSE OF ITS DIRECT LINK WITH REAL WORLD APPLICATION."

- YANDI HU

ENVIRONMENT

UH ENGINEER INVESTIGATES GEOLOGIC CARBON SEQUESTRATION TO COMBAT CLIMATE CHANGE

BY NATALIE THAYER

Yandi Hu, assistant professor of civil and environmental engineering at the Cullen College, is collaborating with researchers from the Lawrence Berkeley National Laboratory (LBNL) to combat global climate change by exploring the use of geologic carbon sequestration to reduce atmospheric carbon dioxide (CO_2) emissions.

The research project, funded by a four-year Department of Energy (DOE) grant, is led by Donald DePaolo, director of the Center for Nanoscale Controls on Geologic CO_2 at LBNL. Hu's other collaborators include Carl Steefel of LBNL, Andrew Stack of the Oak Ridge National Laboratory and Bo Cao, her doctoral student at the Cullen College.

CO_2 is released into the atmosphere by various natural processes, such as biological decay and decomposition, and human activities including deforestation and the burning of oil, natural gas and other fossil fuels. As evidenced by global climate talks and the recent Paris climate agreement, scientists and researchers from around the world are seeking methods to reduce atmospheric CO_2 emissions. Hu and her colleagues are investigating how geologic carbon sequestration can be used to reduce the concentration of carbon dioxide in the atmosphere caused by human activities.

Geologic carbon sequestration involves capturing CO_2 from coal power plants and injecting it into the earth's subsurface. Before CO_2 can be transported to injection sites it must be converted into a liquid state, which is achieved by applying high levels of pressure to the gas. Once injected underground, the CO_2 can be trapped in the subsurface through structural, capillary, solubility and mineral trapping. Hu is researching mineral trapping, which involves the conversion of CO_2 into carbonate minerals to permanently store it in the subsurface.

"In the subsurface brine, there are [minerals] such as calcium, magnesium and iron that can react with the dissolved CO_2 to form carbonate minerals like calcite," she said.

Hu and Cao are using a novel technique, quartz crystal microbalance with dissipation (QCM-D), to quantify the calcite growth rate. The data collected will be used in future large-scale simulations by Steefel and Stack to help predict the time it will take for CO_2 to be permanently stored in the subsurface reservoir.

"The Lawrence Berkeley National Lab is a distinguished and high quality research lab, so they have a lot of choices when selecting collaborators," said Hu. "I think [my collaborators] chose to partner with our college on this project because we offer such unique expertise and capabilities."

The Center for Nanoscale Controls on Geologic CO_2 is one of 32 nationwide Energy Frontier Research Centers (EFRC) implemented by the DOE's Office of Science to encourage partnerships among universities, national labs, nonprofit organizations and for-profit firms. EFRCs provide a platform to accelerate research needed to meet critical energy challenges, according to the Office of Science.

UH RESEARCHER PURSUES NEW APPLICATIONS FOR "HOT" ELECTRONS

BY JEANNIE KEAVER

Three years after his discovery of porous gold nanoparticles – which offer a larger surface area because of their porous nature – a UH Cullen College of Engineering researcher is continuing to explore the science and potential applications.

Wei-Chuan Shih, associate professor of electrical and computer engineering, will use funding from the National Science Foundation to study electron oscillation in the nanoparticles and develop ideas for harnessing it.

"We can generate hot electrons by shining light on these nanoparticles, so we are trying to take advantage of that, trying to find a way to make them work," Shih said.

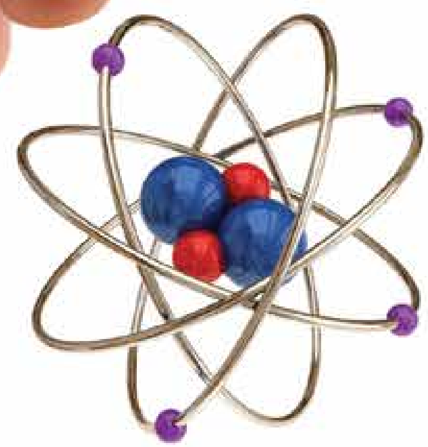
His lab, the NanoBioPhotonics Group at UH, has explored how porous gold nanoparticles react to light for several years; last spring he reported that the light-converted heat can be used to kill bacteria. And last June he described in *Nano Letters* the first time surface plasmon-enhanced near-infrared absorption had been demonstrated for chemical detection and identification.

Light at specific wavelengths "excites" the electrons, or spurs them into movement, he said. Taking advantage of the energy generated by the moving electrons involves measuring what occurs over tiny fractions of time: Once the nanoparticle is struck by light, the electrons are set in motion within a few femtoseconds, or one quadrillionth of a second. The electron oscillation begins to convert to heat after a few picoseconds, or one trillionth of a second.

"It is the hot electrons within the first few femtoseconds that we would like to harvest," Shih said.

Under the NSF grant, Shih said researchers in his lab will study whether the hot electrons can be used to enhance a catalyst that drives chemical reactions and boosts signaling. He will work to enhance that signaling and determine ways to use it.

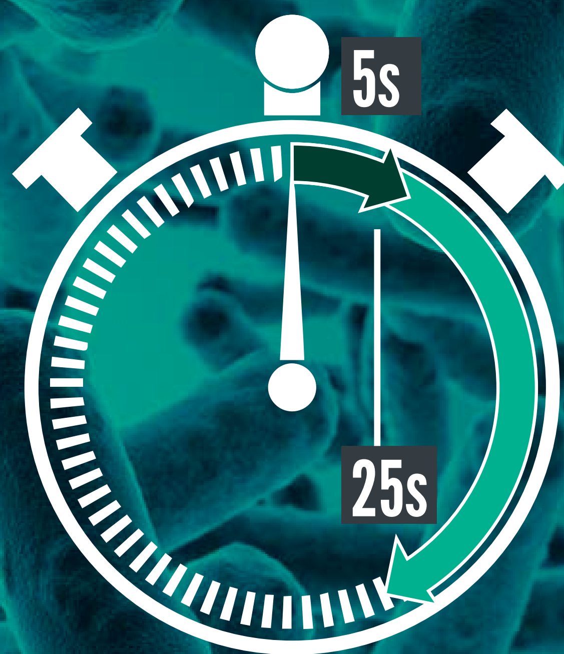
"There is some evidence to suggest plasmonic resonance can promote catalytic reactions," he said of the interaction of light and the nanoparticles. "The light excites these electrons to oscillate within the nanoparticle." Plasmonic resonance describes the way electrons in a piece of metallic nanomaterial react to light, and Shih said it happens only at certain wavelengths.



Research to speed chemical reactions can have huge payoffs in the oil and petrochemical industries, as small improvements can yield large impacts. But Shih is focused on biosensing, using the chemical reactions to produce a stronger signal from tiny targets, more quickly.

"We are interested in ultrasensitive detection of disease, including cancer biomarkers such as nucleic acids and proteins," he said.

Learning to better amplify the signal could have a number of applications. Shih noted that enzyme-linked immunosorbent assay, or ELISA – an analysis commonly used to measure proteins in research labs – depends on a catalysis reaction to boost the signal. Discovering a way to improve the efficiency of the method would have broad consequences, just one example of how the work could be useful, he said.



UH RESEARCH COULD REVOLUTIONIZE TREATMENT OF INFECTION

BY ASHLEY SCHWARTZ

Researchers at the Cullen College of Engineering have discovered an innovative method for destroying bacteria in a matter of seconds by using light to heat highly porous gold nanodisks. A research paper describing the method was featured on the cover of the April issue of *Optical Materials Express*.

The paper, titled “Photothermal inactivation of heat-resistant bacteria on nanoporous gold disk arrays,” was authored by Cullen College professors **Debora Rodrigues** and **Wei-Chuan Shih,** post-doctoral fellows Greggy Santos and Felipe Ibañez de Santi Ferrara, and doctoral student Fusheng Zhao.

In 2013, Shih, an associate professor of electrical and computer engineering, laid the foundation for this research with his discovery that porous gold nanoparticles can reach high temperatures through light absorption. The porosity of the disk-like nanoparticles he studied increased heating efficiency while maintaining stability.

Shih said that once he recognized the novelty of this discovery, he started designing additional experiments to research potential applications for the efficient heating process.

“It was important that [my colleagues and I] developed a method of heating that was fast and didn’t require a large amount of power in order for it to be effective in real world applications,” Shih said.

To explore the potential application for sterilization, Shih enlisted the help of Rodrigues, an assistant professor of civil and environmental engineering. Rodrigues provided bacterial samples of E. coli and performed cell viability tests. Working in Shih’s lab, Santos and Ibañez de Santi Ferrara exposed nanodisks covered with E. coli bacteria to infrared light to study the effect of rapid temperature elevation on the bacteria. When the infrared light raised the surface temperature of the nanodisks to 390 degrees Fahrenheit, all of the E. coli cells were destroyed within seconds.

“Current methods of sterilization involve boiling water or using hot steam, which can take several minutes to hours,” Shih said. “What we show with this research is that in just five to 25 seconds, the bacteria is dead and the disinfection is complete.”

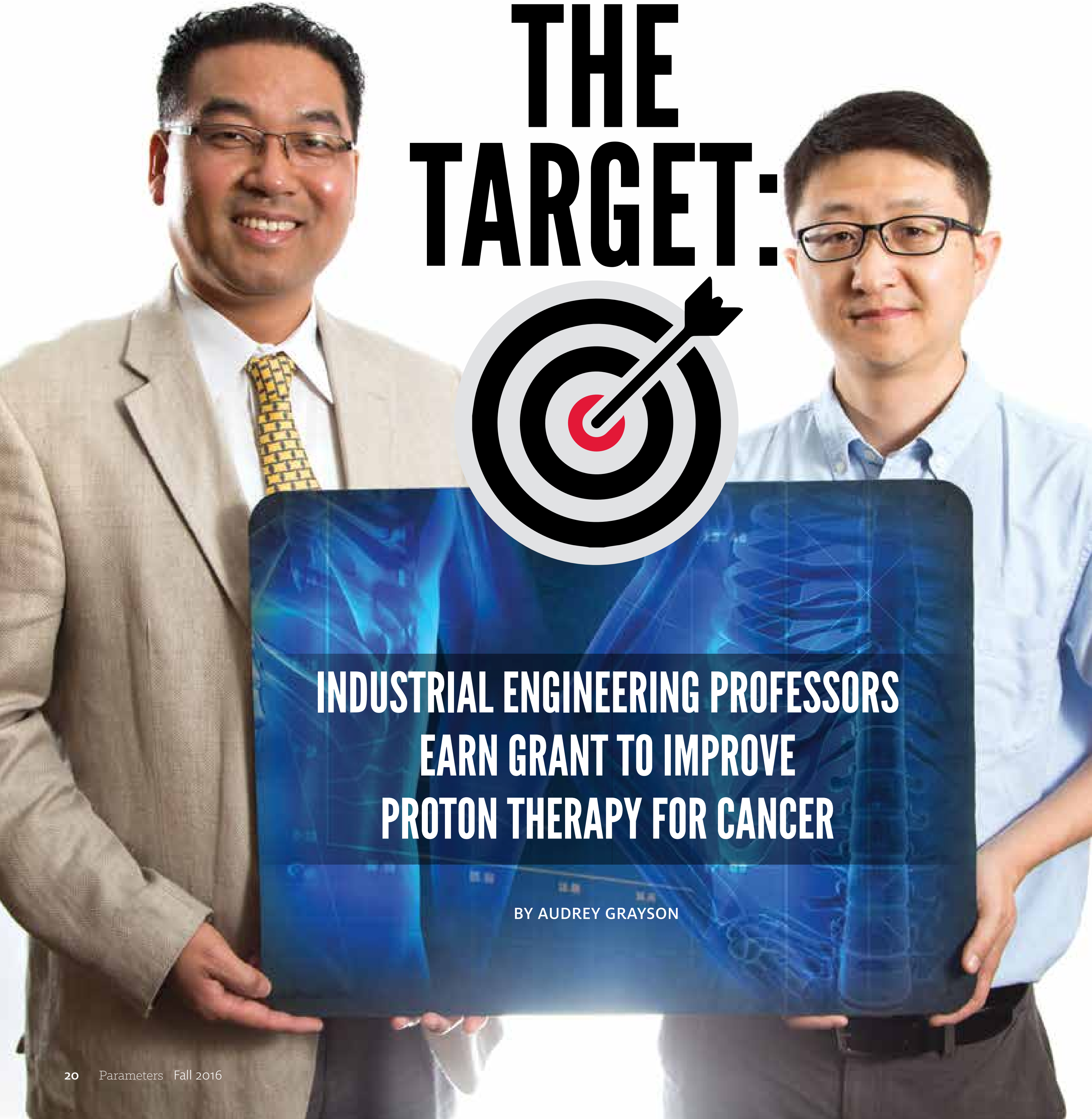
This new method of sterilization could revolutionize how we treat and avoid infections, said Shih. For example, hospitals could use the nanodisks as a catheter coating to improve sterilization and reduce the number of infections contracted through catheters. Currently, the majority of patients who undergo long-term catherization experience complications due to bacterial growth and contamination.

Shih said there is also potential for this method to be incorporated into future cancer treatments. Cancer cells are more fragile than E. coli bacteria and require a change of just 2 degrees Celsius to kill the cell. Shih said he envisions scientists using a “targeting” method to locate and attack a tumor within a patient’s body. In theory, a nanoparticle coated with an antibody would bind to the tumor cell surface and, once bound, scientists could attack the cancer cells by shining a light on the nanoparticle to increase its temperature.

“This article in *Optical Materials Express* discusses the application of this method to catheters, but the possibilities of future healthcare applications are exciting to us,” Shih said.

Since its publication, this work has been featured by *Forbes* and the Optical Society of America.

HITTING THE TARGET:



INDUSTRIAL ENGINEERING PROFESSORS EARN GRANT TO IMPROVE PROTON THERAPY FOR CANCER

BY AUDREY GRAYSON

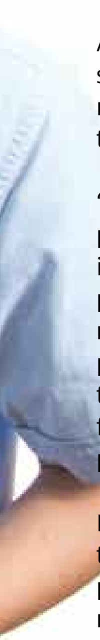
HEALTH & MEDICINE

Two industrial engineering professors at the UH Cullen College of Engineering received a grant from the Cancer Prevention & Research Institute of Texas (CPRIT) to optimize the clinical effectiveness of proton therapy for cancer patients.

The competitive three-year, $879,362 grant was awarded to research assistant professor **Wenhua Cao,** who will serve as principal investigator, and **Gino Lim,** Hari and Anjali Agrawal Faculty Fellow and chairman of the industrial engineering department. Researchers from two other Texas institutions – the University of Texas MD Anderson Cancer Center and Rice University – are included in the collaborative cancer research project.

Working with industrial engineering graduate students, Cao and Lim will investigate the biological and physical factors affecting patients' responses to proton therapy, a highly-effective form of advanced radiation therapy.

Proton therapy works by precisely delivering a prescribed amount of radiation to a tumor site inside of the body, while minimizing the radiation exposure to nearby healthy tissues.



Although proton therapy is generally considered a superior form of radiation therapy, not all cancer patients respond equally to the treatment.

"A review of nearly 20 years of research into proton therapy has claimed that the treatment is 10 percent more effective than a traditional photon therapy, such as intensity modulated radiation therapy [IMRT]. However, our preliminary research revealed that's really not the case," Cao said. "This percentage of effectiveness of proton therapy varies a lot from patient to patient. It's not across the board."

Preliminary results have shown that biological tissues respond very differently to radiation particles; some tissues are more resistant to radiation, while other tissues readily absorb the radiation particles.

"It all depends on the kind of patient and the biological tissue response to radiation," Cao said.

In his own research, Cao observed that for some cancer patients proton therapy was only 5 percent more effective than standard photon therapy, while in other patients it was 20 percent more effective. Cao and Lim said they are determined to find out why the treatment is so much more effective in some patients than others.

"We need to move away from cookie-cutter approaches and toward personalized medicine, which is very important for the future of cancer therapies," Cao said. "You can't assume just because two people have a similar background, ethnicity or age that the same treatment approach will work for both patients."

In order to move toward more personalized treatments for cancer patients, researchers must first learn how to optimize proton therapy for each patient.

> **"WE NEED TO MOVE AWAY FROM COOKIE-CUTTER APPROACHES AND TOWARD PERSONALIZED MEDICINE."**
>
> - WENHUA CAO

"With proton therapy, precision is key," said Cao. "If the protons aren't delivered to the exact site of the tumor every single time, then it can drastically compromise the effectiveness of the therapy."

Proton particles are heavier than photon particles. When proton particles hit their target inside of the body, they stop immediately. If the proton therapy is delivered with precision to the tumor site, no damage is caused to surrounding healthy tissues and patients experience far less side effects as a result of the radiation.

But determining how to deliver the protons to the site of the tumor in the most effective way requires solving a massive optimization problem. For starters, patients must be positioned in the exact same way each time they receive the proton-delivered radiation, which can be up to five days a week for several weeks. During this time, if the patient loses or gains weight, the changes in their tissue can alter the location of the tumor and require changes to how the radiation is delivered.

And even if the patient is correctly positioned for each session, providers must take into account all of their involuntary movements, such as the rise and fall of the chest while breathing, that can shift the location of the tumor and result in an incomplete dose of radiation.

Then there's the angle at which the proton beams are delivered to the tumor. If there are 36 possible angles to deliver radiation to the tumor site and physicians must choose somewhere between two and four angles that combine to provide the best treatment, that leaves them with 72 million combinations to choose from. This problem is so complex that a supercomputer would be required to solve it.

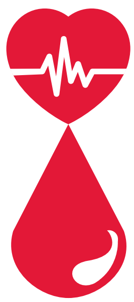
"It's very difficult to simulate the interactions between the radiation particles and body tissues computationally," Lim said.

Cao and Lim, then, are developing a new method called the "Advanced Monte Carlo simulation approach," which will allow any doctor with a graphical processing unit (GPU) to enter in basic information on a patient and receive a detailed analysis on how to deliver the proton therapy to achieve the best possible clinical outcomes.

"We want to try to understand the biological effects of proton beams. Once we have a better understanding of the tissue response to proton beams, then I'm sure we'll do a much better job with proton therapy, far beyond the current practice of using photon beams," Cao said.

The CPRIT was authorized by Texas voters in 2007 to issue $3 billion in bonds to fund groundbreaking cancer research and prevention programs and services in the state. CPRIT's goal is to expedite innovation in cancer research and product development and to enhance access to evidence-based prevention programs throughout the state.

RESEARCH IDENTIFIES NEW BLOOD BIOMARKERS FOR LUPUS



“WE HAVE HOPE TO PREDICT WHAT’S HAPPENING IN THE KIDNEYS SIMPLY BY MEASURING THESE THREE PROTEINS IN THE BLOOD.” - CHANDRA MOHAN

BY AUDREY GRAYSON

Biomedical engineers at the UH Cullen College of Engineering have identified several new blood biomarkers that can help to predict which lupus patients will progress towards more severe forms of the disease.

Tianfu Wu, assistant professor of biomedical engineering, and **Chandra Mohan,** Hugh Roy and Lillie Cranz Cullen Endowed Professor of biomedical engineering, published their findings last May in the *Journal of Proteome Research*.

“Our hope is that this research brings the medical field one step closer to screening lupus patients’ blood for biomarkers that can predict which patients are more likely to progress towards renal disease,” Mohan said.

Systemic lupus erythematosus (SLE) is a chronic autoimmune disease that affects multiple organs including the kidneys, skin, joints and heart. Roughly 60 percent of all SLE patients experience inflammation of the kidneys, called lupus nephritis. Kidney disease is a leading cause of death among SLE patients – roughly a quarter of all lupus patients succumb to end-stage renal disease.

Early detection and management of lupus nephritis can significantly increase a patient’s quality of life and chances of survival. Currently, clinicians have no way to predict which lupus patients will progress towards kidney disease.

Renal biopsies – a procedure in which the kidney is punctured and a tissue sample is extracted for further analysis – are the gold standard for diagnosing kidney disease. However, the procedure is invasive and can’t be repeated serially because of potential complications.

“There is an urgent need to identify biomarkers for lupus nephritis that enable early detection, intervention and follow-up of the disease,” Mohan said.

To identify new biomarkers for the disease, Mohan and Wu studied blood samples collected from 22 SLE patients and 22 healthy controls using antibody-coated glass slide assays, a novel technique for analyzing proteins in human blood samples. The glass slide assays allowed the researchers to analyze 274 proteins in the blood at once, where standard assays could only analyze a handful of proteins at a time.

“This is one of the largest screens ever conducted for lupus in one single shot,” Mohan said.

Results from the screening showed 48 possible proteins that were elevated in the lupus patients’ blood.

To validate these findings, the researchers used an ELISA assay – a well-accepted biochemical technique for detecting the presence of molecules in a sample – to study the blood samples of an independent cohort of 28 SLE patients and 28 healthy controls.

Results from the ELISA assays revealed the top 12 proteins that were elevated in the blood of lupus patients compared to healthy patients. Furthermore, the researchers identified several proteins that were elevated in patients’ blood with active lupus nephritis.

Lupus is a puzzling disease, characterized by disease flares and remissions. During an active state of the disease – also known as a flare – the body’s immune system begins attacking its own organs and tissues, sometimes causing a patient’s renal function to deteriorate.

“We found that levels of several molecules are increased, especially in patients with active kidney disease, suggesting that these proteins could potentially be markers for identifying patients that will go into disease flares or kidney function deterioration,” Mohan said.

Mohan and Wu further validated these results by collecting blood samples from another independent cohort of 45 patients with active lupus nephritis at the time they were undergoing a kidney biopsy. The idea behind this phase of the study was to “correlate the levels of the proteins found in the patients’ blood with exactly what was going on in their kidneys at that time,” Mohan said.

After a renal biopsy is conducted, the physician assigns two important scores to quantify kidney function: a chronicity index and an activity index. Mohan and Wu found that elevated levels of three blood proteins in particular were correlated with impaired kidney function scores on the chronicity index, activity index or both.

"This means we have hope to try to predict what's happening in the kidney simply by measuring these three proteins in the blood, which would allow patients to avoid invasive renal biopsies," Mohan said.

Finally, the researchers tracked seven lupus patients over the course of one year, collecting their blood samples at three consecutive check-ups with their physicians. The goal of the final phase of the study was to monitor the potential blood biomarkers over time to see if the severity and activity of each patient's disease correlated with elevated levels of the identified proteins in the patients' blood samples.

Mohan and Wu discovered several proteins that correlated with the patients' disease activity over time to different degrees. However, no single marker was connected to lupus activity in all of the patients or in all of the screenings conducted.

These findings are consistent with what researchers have managed to learn so far about the complex and mysterious disease, which has been shown to present differently from patient to patient.

"We see lots of variability between lupus patients," Mohan said, adding that identifying more markers for the disease could lead to greater understanding of its causes. "One take home message here is that we can possibly begin to subset lupus patients based on what blood biomarkers they express."

The researchers will be expanding their research to analyze more than 1,000 biomarkers for lupus in the blood and the urine to identify patterns of biomarkers that can be used to subset the many different types of lupus patients.

Further validation through longitudinal clinical studies involving many more lupus patients is required, Mohan and Wu said, but the research is an important first step towards predicting health outcomes for lupus patients.

This research was supported by grants from the National Institutes of Health and the Lupus Research Institute.

UH ENGINEER TARGETS CORNEAL DISEASE THROUGH IMAGING AND ANALYSIS

BY JEANNIE KEVER

A biomedical engineer at the University of Houston is developing new techniques to map the structural integrity of the human cornea, work that could lead to more effective therapies for degenerative corneal disease.

Kirill Larin, professor of biomedical engineering at UH, will use a $1.7 million grant from the National Institutes of Health to pursue the research, building upon his previous work that established proof-of-concept for the corneal imaging and analysis. The cornea is the clear, dome-shaped surface covering the front of the eye and plays an important role in focusing vision.

Larin, director of the Biomedical Optics Laboratory in the UH Cullen College of Engineering, developed the technique, which employs high-resolution imaging and mechanical mapping of the cornea and can gauge the structural integrity of corneal tissue.

The emerging field, known as optical elastography, involves optical imaging and analysis of tissue response to deformation. Larin is chair of an annual conference on the topic, held every February in San Francisco in conjunction with Photonics West, sponsored by the International Society for Optics and Photonics.

Biomedical optics is a fast-growing field in medicine, and Larin's work is focused on developing new methods and techniques for structural and functional imaging and biosensing of tissues and cells. His lab is involved in two current clinical trials to measure therapies used in the treatment of systemic sclerosis, an autoimmune disease affecting the skin, the gastrointestinal tract and other organs.

"This work started with a simple idea, just thinking we could do it," Larin said. His earlier work involved animal models; he now will adapt it to use in the human eye, ultimately moving to clinical trials.

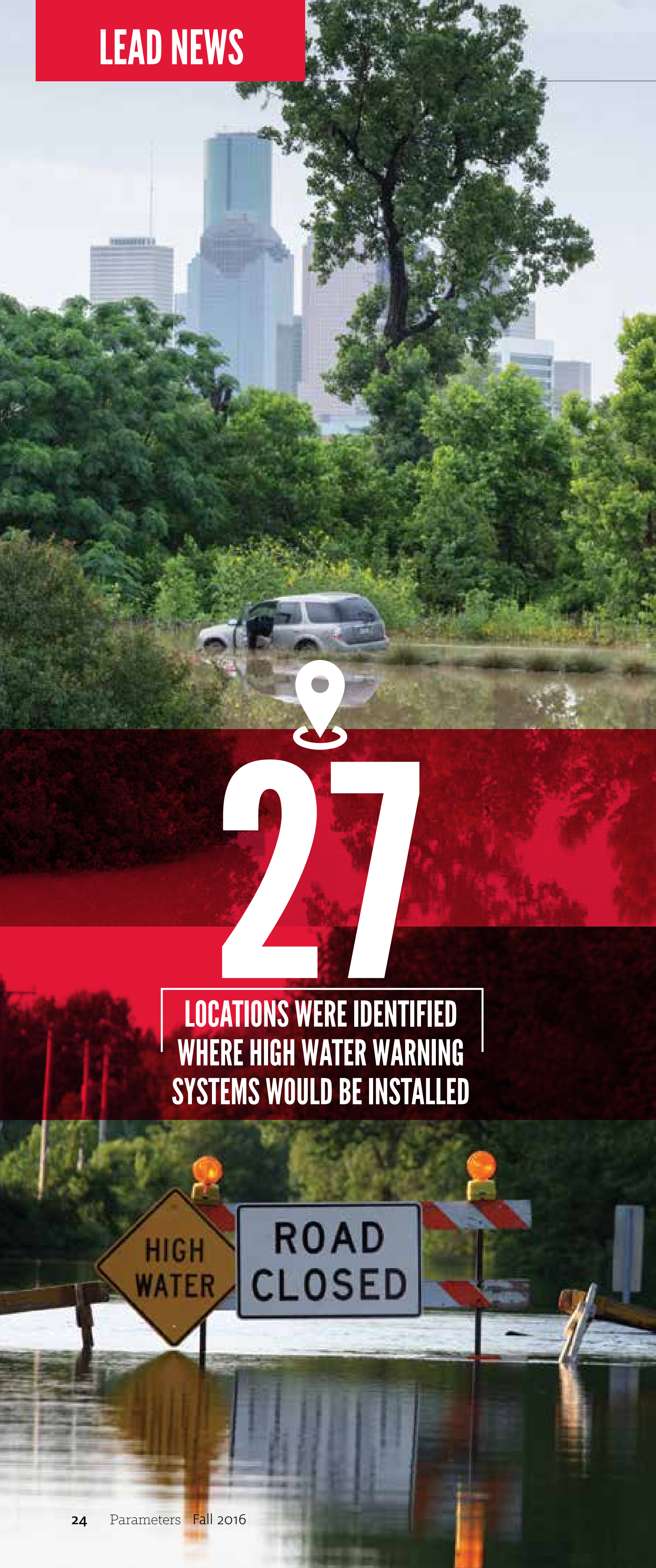
Better – and earlier – diagnosis of deformities of the cornea could solve several problems, offering hope for people with kerataconus, a progressive thinning of the cornea that is the most common corneal disorder in the United States, affecting about one in every 2,000 people. It usually affects both eyes.

Optical elastography involves using a light puff of air – far less forceful than the test commonly used to diagnose glaucoma – to capture very small changes in the cornea's structure, Larin said. These changes are measured in micrometers, rather than millimeters.

"We have highly sensitive equipment," Larin said. "We can reconstruct the mechanical properties of the cornea in three dimensions." Once a problem is detected, the technique could be helpful in developing personalized therapies for people with kerataconus, including determining the optimal duration of treatment, he said.

The technique also could allow ophthalmic surgeons to test for early stage corneal degeneration before performing LASIK surgery to correct near-sightedness, he said. Without a way to do so currently, people may experience serious and unexpected side effects from the surgery.

Larin said future plans include expanding the technique to target the structure of the retina, a key to developing better treatments for glaucoma, and to the eye's lens, which will allow a better understanding of changes in vision.



INFRASTRUCTURES

UH ENGINEER HELPS HOUSTON'S DRIVERS STAY SAFE DURING FLASH FLOODS

BY NATALIE THAYER

The City of Houston experienced historic flash flooding over the Memorial Day weekend last April, with areas of the city receiving nearly 18 inches of rain. There were eight fatalities caused by the floods, including three motorists who drove into floodwater.

Gino Lim, chair of the industrial engineering department at the Cullen College, has been working with Houston city officials to increase drivers' safety during flash flooding. He developed early warning sensors that have been installed throughout the city in flood-prone areas and is working to install electronic gates at flood-prone underpasses and crossings.

Lim's research was featured in the *Houston Chronicle* last April in an article titled, "Officials pledge action after flooded roadway deaths."

"Sometimes it is very difficult to see the water levels when someone is not used to the area," Lim said. "Based on what we know, which location was flooded often, we can set the priority and put gates in those locations."

Following last year's Memorial Day floods, Houston officials identified 27 locations where warning systems would be installed so drivers could avoid high water. As of last April, warning systems had been installed at 19 of those locations.

The sensors installed throughout the Greater Houston area feed information on water levels to a flood-monitoring database created by Lim in 2010. Algorithms written by Lim then analyze and display the data on real-time, web-based flood maps. The user-friendly flood maps resemble Google maps, and intuitively display information on water levels at specific points throughout Houston.

READ THE FULL ARTICLE AT www.houstonchronicle.com/news/transportation/article/Officials-pledge-action-after-flooded-roadway-7280948.php.

MATERIALS

SHEDDING NEW LIGHT ON THE BEHAVIOR OF NANOMATERIALS

BY AUDREY GRAYSON

In a paper recently published in the journal *Nano Letters*, mechanical engineers at the UH Cullen College of Engineering describe a novel method for characterizing and understanding the behavior of nanomaterials.

The invention of methods and tools to better understand the behavior of materials is partially responsible for the technological revolution of the 21st century. Understanding the electronic properties of semiconductors, for instance, led to their utilization as the "brains" of computers, and determining the mechanical behavior of metal alloys made modern aircraft construction possible.

In order to understand the behavior of materials, researchers recently have taken to using atomistic simulations – that is, modeling a material one atom at a time – to unravel the fundamental mechanisms underpinning its physical or chemical behaviors.

But such simulations can only account for phenomena that take place in under a few nanoseconds. By comparison, the blink of your eyes takes about a second, or roughly 1 million nanoseconds. This time-scale limitation precludes atomistic simulations from revealing what's happening when a material is stretched or deformed slowly, among many more phenomena. Studying how materials – especially nano-sized materials – will react under mechanical stress in real-life applications or even during laboratory tests was impossible until now.

Doctoral student **Xin Yan** used a suite of algorithms that collectively provide some resolution to the time limitations of atomistic simulations. Guided by intuition and "an enormous body of excellent past work," Yan said she deployed an algorithm suite to simulate what happens at the microscopic level when a nanomaterial is slowly compressed. Under the guidance of her adviser **Pradeep Sharma,** professor and chair of the mechanical engineering department at the Cullen College, Yan studied the behavior of nano-sized pillars of nickel made up of only a few hundred atoms.

Traditional atomistic simulations have shown that when nickel nano-pillars experience a fast application of force, the length of the pillar will simply shorten, much like a rubber eraser would if you pushed down on it. When studied using Yan's models, her simulations revealed that the nano-pillars actually behave more like a liquid when slowly squeezed.

"The nano-pillar behaved like a soft, mushy blob being squished, with material oozing out in ugly spirals – or beautiful spirals, depending on your point-of-view," said Yan.

Experiments using electron microscopes to observe the behavior of nanostructures have confirmed the same liquid-like deformation when the materials undergo slow mechanical stress.

"Time-scaling is a very hard problem and may be considered the 'Holy Grail' of computational materials science," Yan said.

Although the computational methodology that Yan and Sharma deployed provides interesting insights into the behavior of nanostructures undergoing slow mechanical deformation, the researchers said a complete resolution to the time-scale bottleneck remains elusive. However, the novel method represents another step towards the creation of materials with never-before-seen applications.

"Such computer simulations provide a unique window into the behavior of materials at the microscopic level and provides us with clues for how to design next-generation materials with brand new applications," said Yan.

The research published in *Nano Letters* was initially funded by a grant from the Air Force Office of Scientific Research and is partially funded by the National Science Foundation.

TO VIEW THE FULL PAPER, PLEASE VISIT http://pubs.acs.org/doi/abs/10.1021/acs.nanolett.6b00117

SPACE

UNDERGRADS HELP NASA'S SMALL SATELLITES COMPLETE BIGGER MISSIONS

MEET THE LADIES


ABBY ZINECKER


TIFFANY YAO


JULIA LONDON

BY NATALIE THAYER

Three UH Engineering undergraduate students are improving NASA's CubeSat missions by programming the small satellites to orient and stabilize themselves based on the position of the sun.

The code developed by mechanical engineering student **Abby Zinecker** and electrical and computer engineering students **Julia London** and **Tiffany Yao** will solve one of the biggest obstacles to successfully completing CubeSat missions: the inability to stabilize a small satellite after it's launched into space.

"When CubeSats are launched, at first they're just tumbling and spinning in space," said London. "They need to stabilize before they can take readings and collect data."

With standard-sized satellites, the angular velocity, or the direction and speed of the spinning satellite, is often calculated using a device called an accelerometer. But the added weight and power requirements of these devices render them impractical for CubeSats.

The size, weight and power constraints of CubeSats drove the innovation process for Zinecker, London and Yao. Their goal was to develop an alternative method for calculating angular velocity in CubeSats without increasing their size, weight or power consumption. To achieve their mission, the undergrads had to find cost-effective ways to use and repurpose the components of a standard CubeSat to execute tasks more efficiently and perform altogether new functions.

CubeSats are made up of 4x4x4-inch cubes called units and can be as small as one unit (1U) or as large as six units (6U). Each unit weighs approximately 3 pounds and is covered in solar panels for energy collection. Once the solar energy is collected, it is stored in batteries inside the satellite. The entire process is managed by a microprocessor, which serves as the "brain" of the satellite.

Under the guidance of Len Trombetta, the associate chair of the Cullen College's electrical and computer engineering (ECE) department, and Steve Provence, a NASA engineer and alumnus of the Cullen College's ECE department, the team wrote code that employs a CubeSat's built-in solar panels and microprocessor to orient the satellite according to a light source, such as the sun, and stabilize the satellite in space by determining its angular velocity.

The model simulated the CubeSat's rotation using servomotors – small, energy-efficient motors often used in robotic and industrial applications – and was lined with clear acrylic walls to make the internal wiring and microprocessor visible. The students said that being able to see the internal components proved invaluable throughout the design process.

"We could see how everything connected, which was really helpful for debugging and testing," said Zinecker.

With the team's code, CubeSats can be stabilized after launch by using the sun as a reference point to determine its location and calculating the satellite's angular velocity.

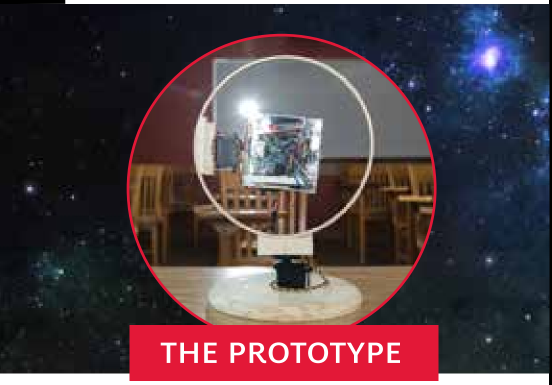
"Calculating the angular velocity is important because we have to find out how fast the satellite is going to be able to accurately reverse the spin and slow it down," said Yao.

> "CODING IS A LOT LIKE PAINTING OR DRAWING... IT'S NEVER QUITE DONE. IT'S ALWAYS EVOLVING."
>
> - JULIA LONDON

The team built the CubeSat model during the fall 2015 semester and spent the following spring semester fine-tuning the algorithms and formulas used in the code. While many engineering projects can have clearly defined solutions, Zinecker, London and Yao said they encountered several challenges during this project unique to the complex and creative process of coding.

"Coding is a lot like painting or drawing, because it's never quite done," said London. "It's always evolving."

But the project also provided unique rewards. The ability to determine angular velocity in a CubeSat is a challenge currently faced by NASA and others interested in the small satellites. With their code, the team provided a novel and practical



THE PROTOTYPE

solution to a current, real-world challenge.

"My favorite part of this project is knowing that we were able to accomplish something new," said Zinecker.

To further the potential applications of their code, the team created a user interface designed so that even non-scientists could interpret the data.

"We wanted to make something with a very user-friendly display, so that anyone with a computer could open the interface and easily read the data collected from satellites," said Yao.

The team presented the CubeSat model, code and user interface at the Graduate Research and Capstone Design Conference hosted by the ECE department on April 29, 2016.

ENGINEERS DISCOVER LOW-COST MANUFACTURING PROCESS FOR LEDS

BY NATALIE THAYER

Researchers at the UH Cullen College discovered a new, low-cost approach to manufacturing color-changing light-emitting diodes, or LEDs.

The March 2016 cover of *ACS Photonics* features the theoretical study authored by **Jae-Hyun Ryou,** assistant professor of mechanical engineering, and **Shahab Shervin**, a materials science and engineering doctoral student.

The study, titled "Bendable III-N Visible Light-Emitting Diodes Beyond Mechanical Flexibility," explored the potential for low-cost, flexible and color-changing LEDs. Ryou and Shervin's co-authors included Cullen College doctoral student Mojtaba Asadirad, Seung-Hwan Kim from the Metamaterial Electronic Device Research Center at Hongik University, Sergey Karpov of STR Group and Daria Zimina of STR US, Inc.

LEDs are energy-efficient light sources with a wide array of potential applications. LEDs convert electrical current to light approximately 10 times more efficiently than incandescent lamps and approximately two to three times more efficiently than fluorescent lamps. By converting electrical current more efficiently, they offer the potential to reduce green house gas emissions caused by electricity use.

LEDs have become more prevalent in households, automobiles and even large-scale stadium displays in recent years, but they are still less commonly used than incandescent and fluorescent light sources.

One of the major barriers to market penetration and widespread household use is the relatively high cost of LED bulbs compared to compact fluorescent light bulbs, or CFLs, said Ryou. LEDs cost more to purchase because they are more expensive to mass-produce. The substrate currently used for LED production is more expensive than those used for traditional CFLs – and it can only be used in relatively small quantities, further driving up the costs of large-scale manufacturing.

"We need a cheaper option," said Ryou.

Shervin, who served as first author on the study, researches the potential for flexible LEDs on inorganic material to reduce mass-production costs and increase reliability and efficiency. He said that the theoretical ability to create color-changing LEDs was an unexpected and surprising bonus.

"Through our calculations, we've shown that bending or applying strain to an LED structure can improve its efficiency," he said. "We also demonstrated that bending an LED structure can cause it to emit different colors of light without changing the composition."

Current LED technology uses phosphorous, which is a non-environmentally-friendly material, to produce white light emission. Ryou and Shervin achieved white light emission without the use of phosphorous by combining green, red and blue light emissions from a single flexible LED. The researchers said they hope their study promotes the use of eco-friendly alternative materials.

Shervin said he envisions future roll-to-roll LED fabrication using amorphous or polymorphous substrates, enabling cost-efficient mass production.

"We are taking a totally new approach to LED manufacturing," said Ryou. With this research, he and Shervin hope to provide the foundation for the future of LED technology and contribute to its increased everyday use.

ACS Photonics is a monthly journal dedicated to research articles, letters, perspectives, and reviews, encompassing the full scope of published research in the photonics field.

UH ENGINEERS DISCOVER NEW CHEMICAL SENSING TECHNIQUE

BY JEANNIE KEVER

University of Houston engineers have reported a new technique to determine the chemical composition of materials using near-infrared light.

The work could have a number of potential applications, including improving downhole drilling analysis in the oil and gas industry and broadening the spectrum of solar light that can be harvested and converted to electricity, said **Wei-Chuan Shih,** associate professor of electrical and computer engineering. Shih is the lead author of a paper describing the discovery published last June in *Nano Letters*.

"From a scientific point of view, it's quite a novel discovery to excite plasmonic resonance at near-infrared and make it work for us," he said.

That means substances, which can't be accurately measured by sensors operating on the infrared spectrum, can now be studied in far more detail than that provided by current techniques using the near-infrared spectrum.

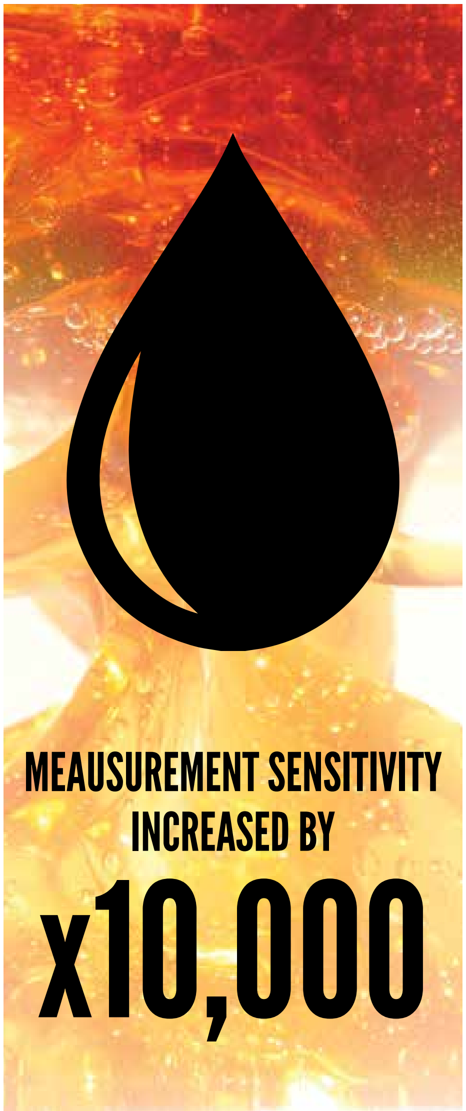
In addition to Shih, the other authors include post-doctoral researchers Greggy M. Santos and Oussama Zenasni and graduate students Fusheng Zhao and Md Masud Parvez Arnob.

Spectroscopy using the infrared spectrum – an analytical technique using infrared light to scan and identify the chemical composition of organic, polymeric and some inorganic materials – is an important tool, but it has limitations. Infrared light is absorbed by water, so the technique doesn't work with water-based samples.

Near-infrared light scanning is compatible with water, but current techniques are less sensitive than those using other wavelengths.

"To overcome these barriers, we have developed a novel technique to simultaneously obtain chemical and refractive index sensing in 1-2.5 μm NIR (near infrared) wavelength range on nanoporous gold (NPG) disks, which feature high-density plasmonic hot-spots of localized electric field enhancement," the researchers wrote. "For the first time, surface-enhanced near-infrared absorption (SENIRA) spectroscopy has been demonstrated for high sensitivity chemical detection."

Shih said working with near infrared light is usually "a double-edged sword," as it can be used with water-based samples but doesn't provide the needed detail. "We showed water is not an issue, but we can also increase the sensitivity of what we want to measure by 10,000 times," he said.



He and members of his lab have worked with nanoporous gold disks since discovering the structure in 2013. For this project, he said they "tuned," or designed, the nanodisks to react when exposed to specific wavelengths, making it possible to develop a sensing technique with the advantages of both infrared and near infrared scanning.

The technique was tested with various crude oil and other hydrocarbon samples, and Shih said it could be helpful in downhole fluid analysis, which uses near infrared spectroscopy to analyze material found deep in a well. The technique allows drillers to know quickly what's below the ground or seabed, but he said the new technique could simplify the process because it requires a smaller sample for analysis, an obvious advantage in laboratory characterization.

Oliver C. Mullins, a scientific advisor at Schlumberger and the primary originator of downhole fluid analysis, said the discovery holds potential for both the lab and the field.

"Optical spectroscopy has made significant contributions in the oil and gas industry beyond laboratory characterization," he said. "In particular, in situ fluid analysis in oil wells based on vibrational overtones and electronic absorption in the visible and near-infrared wavelengths has become an industry standard in wireline well logging. SENIRA brings in an exciting prospect for potential better sensor technology in both field and laboratory settings."

Shih said researchers are thinking about new ways to do things using the technique. "We can do a lot of oil typing with tiny amounts of oil."

Although the paper uses hydrocarbon composition analysis as an example of how the technique could be deployed, Shih said it can be applied to any molecular species. That broad potential use, in addition to the novelty of the technique, is why *Nano Letters* published the paper, he said.

TO VIEW THE FULL PAPER, PLEASE VISIT http://pubs.acs.org/doi/abs/10.1021/acs.nanolett.6b01959

UH ENGINEER EARNS NSF GRANT TO IMPROVE CELL PHONE USER EXPERIENCE

BY ASHLEY SCHWARTZ

Xin Fu, assistant professor in the UH Cullen College of Engineering's electrical and computer engineering department, earned a $410,000 award from the National Science Foundation (NSF) to customize smartphone designs and processors to better suit the needs of its vast array of users.

Smartphone manufacturers have traditionally expected their customers to adapt to their devices. But with the diverse group of smartphone users now ranging from toddlers to retirees, manufacturers are exploring ways to adapt smartphone technology to meet the needs of all its users.

"Currently, our smartphones are uniform to everyone," said Fu. "The goal of this research is to improve the user experience by learning individual users' preferences."

To learn these preferences, Fu is focusing on two major factors: the user's personality and their environment or circumstances.

"A user's personality can be conservative or aggressive. A conservative user's priority may be the battery life of the phone, whereas a more aggressive user cares about the speed of the device or the quality of the screen," said Fu.

Fu also explained that a user's circumstance could have an effect on their priorities.

"A conservative person may only care about the battery life until they find themselves in an emergency. In that case, the phone's response time and accuracy becomes more important," she said.

Fu, along with electrical and computer engineering students Kaige Yan, Chenhao Xie and Xingyao Zhang, will consider these factors to create computer systems that are able to intelligently and automatically customize their configurations to satisfy each individual user.

Fu said she believes this research has the potential to go beyond improving smartphone users' experiences and could be applied in healthcare and education fields.

"This technology could be used in healthcare to adjust to the needs of patients with various illnesses or disabilities," Fu said. "It could also be applied to education by helping to engage students, because they are likely to become more interested in what they are learning if they are using a technology that's tailored just for them."

Fu is the director of the Efficient Computer Systems (ECOMS) Lab at the Cullen College, which is dedicated to exploring cross-disciplinary approaches to construct high-performance, low power and reliable computer systems.

Once upon a time you got your best action and science fiction fix from the movies.

"2001: A Space Odyssey" showed us how pedestrian structures on the moon might seem; Walt Disney brought us tiny robots called microbots in "Big Hero 6"; Robert Zemeckis convinced us we wouldn't need roads when he created Marty McFly's hoverboard in "Back to the Future II"; and, "The Fast and The Furious" showed us what it would be like to fly like the wind while staying on track.

Those movies gave us a precursor to what history could be. Now, the Cullen College of Engineering is making those predecessors leap off the big screen and come to life.

Yes, swarms of micro-robots are performing jobs, hoverboards are being launched, space habitats are being designed and racecars are being built – all in the Cullen College's labs.

So pop some corn, take a seat, and be prepared to be entertained and fascinated as you read how the UH Cullen College of Engineering is creating realities that seem

STRAIGHT FROM THE MOVIES

by Audrey Grayson, Laurie Fickman and Natalie Thayer

CANAAN
MARTIN

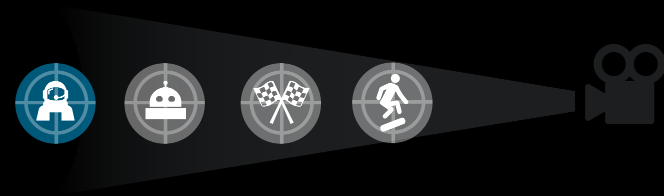
ANCHAL
BHASKAR

UH SPACE ARCHITECTS REDEFINE WHAT AND WHERE WE CALL "HOME"

2001: A SPACE ODYSSEY

RESEARCH CONDUCTED AT THE UNIVERSITY OF HOUSTON CULLEN COLLEGE OF ENGINEERING SPACE ARCHITECTURE PROGRAM AND NASA.
TITLE ART CREDIT - METRO-GOLDWYN-MAYER

IN DEVELOPMENT NOW



Stanley Kubrick's epic science fiction film "2001: A Space Odyssey" asks its audience to explore what it means to be human. What is mankind's place within the universe? Who are we when our human comforts, habitats, friends and family are stripped away? Are we just flesh and bone, or are we something greater than the sum of our parts; are we intelligence?

Canaan Martin, an industrial engineer practicing space architecture at NASA's Johnson Space Center, asks himself these questions quite a lot throughout the day.

WHAT IS IT, EXACTLY, THAT MAKES US HUMAN?

For Martin, it's a burning question. Much like it did for Kubrick, the question ignites his imagination and inspires his work.

Martin graduated from the Cullen College last year with a master's degree in space architecture, a field that blends architecture and engineering to design human habitats in extreme environments such as outer space.

"We're moving farther away from spacecraft that were, honestly, engineered tin cans that orbited the Earth," Martin said. "In a lot of the projects I'm working on at NASA, we look at the human first and engineer for him or her."

Graduates of the UH Cullen College's space architecture program are taught to engineer for, not around, humans. In doing so, their training extends beyond engineering and architecture to include psychology, psychiatry, philosophy, physiology, physics and even the arts.

As a student, Martin designed human settlements that could be used on the moon and Mars by repurposing existing NASA hardware and software to reduce costs and time needed for development. Fitting the pieces together was a challenge that required additional engineering each step along the way.

But one of the biggest challenges, he said, was grappling with what it means to be a human earthling, and how that translates into living happily on Mars, hundreds of thousands of miles away from the comforts of the big blue marble we call home, for months or even years.

TRAVELING LIGHT

When designing human habitats for outer space, size and weight limitations drive the engineering process. If the components of a habitat are too large or too heavy, there's no way to launch it into space.

"We have to strip down what it is, at the very core, that makes us humans. What makes us tick? What do we need to have in order to feel like ourselves, like humans? Once we answer those questions, we can begin to design habitats that allow astronauts to live as happily and healthily as possible while they're living and working inside a confined space for a very long period of time," Martin said.

THE HEIGHT OF BOREDOM

Anchal Bhaskar, a current space architecture graduate student, is combing through astronauts' reviews of previous missions to design multi-use modules for spacecraft that would address both physical and psychological health conditions experienced during a long spaceflight.

Astronauts are people, after all, and their gripes with living on a confined, orbiting spacecraft are just what you might expect: homesickness, isolation, depression and boredom.

Astronauts aboard the International Space Station (ISS) are encouraged to run on a treadmill daily to combat feelings of loneliness, but many of the astronauts reported that the activity was boring and monotonous.

Bhaskar's solution is a user-centric, modular and multi-use habitat that engages astronauts physically, mentally and emotionally. Her design is built to the exact specs of an ISS module, can be easily assembled and disassembled and requires no electricity.

The habitat consists of a large inner circle made up of lightweight, fabric screens surrounded by a larger outer circle made up of panels – not dissimilar to a human hamster wheel in microgravity. Astronauts can walk or jog inside of the habitat while sensors on their body collect information on their physiological state, such as heart rate and body temperature. This data is then used to generate original works of art on the fabric screens inside of the habitat, each as unique as the astronauts' physical and mental states at that time.

Like Martin, Bhaskar considered existing hardware and software aboard the ISS that could be incorporated into her design without much additional cost or added weight. Her habitat would allow astronauts to video chat with family and friends back on Earth while they exercised, or share their art in real-time with students all over the world via live video stream.

"Design should make the spacecraft habitable, not just livable," Bhaskar said. "This offers the best choices for crew members to survive a long spaceflight, both mentally and physically, contained within a single module."

Or, in the words of HAL 9000, the self-aware computer in "2001": "I am putting myself to the fullest possible use, which is all I think that any conscious entity can ever hope to do."

Disney

BIG HERO 6

SHIVA **SHAHROKHI**, MABLE **WAN**, LILLIAN **LIN** AND MAHEK **MAHESHWARI**

UH ENGINEERING STUDENTS ENLIST TINY ROBOTS TO ACCOMPLISH HUGE MISSIONS

RESEARCH CONDUCTED AT THE UNIVERSITY OF HOUSTON CULLEN COLLEGE OF ENGINEERING, DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

TITLE ART AND BAYMAX IMAGE CREDIT - DISNEY

COMING TO A HOSPITAL NEAR YOU

In the laboratory of electrical and computer engineering professor Aaron T. Becker, three UH engineering students are huddled in complete darkness around a tabletop covered with 100 quarter-sized robots. In the early morning hours before sunrise, the students use a light source to steer the swarm of micro-robots to perform specific tasks.

No, this is not the 2014 Disney movie "Big Hero 6," in which the protagonist, Hiro, offers a profound view into the future by manufacturing a swarm of 105 micro-robots, controlling them to self-assemble, build structures and transport goods and materials. While eerily familiar, the coin-sized robots of the film are fantasy – Becker's robots are reality.

"Each of these tiny robots is somewhat useless on its own, but together, as a swarm, these robots can accomplish amazing things. Just like in 'Big Hero 6,' the swarm has the power to both create and destroy," said Ph.D. student **Shiva Shahrokhi,** who is leading the team's research efforts.

SCIENCE (NON)FICTION

Although the work is still early, the end-goal of this research sounds like a science fiction writer's dream come true: The team's vision is for large swarms of robots remotely guided through the human body to cure disease, heal tissue and prevent infection – and to assemble structures in parallel. In other words, instead of cutting a hole in the body to perform a surgery, patients could be healed from the inside by swallowing a pill filled with nano-robots that would perform the procedure.

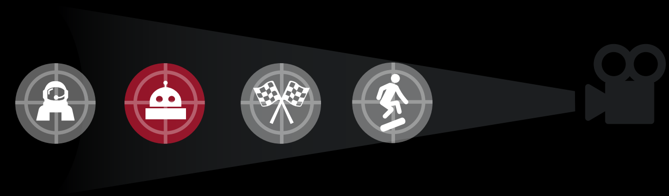
"One day, we'll be able to guide swarms of nano-robots through the human body to noninvasively cure disease, administer drugs or even build structures, like a stent for your heart," said **Mable Wan,** one of the undergraduate students on the team.

But controlling the big group of small bots has proven challenging.

"These robots are too small to fit a power source or computer inside of," said Becker. "That's why we're using external, global forces to steer the robots – like a single joystick that controls 100 remote control cars."

Shahrokhi and Wan also work together with undergraduate student **Lillian Lin** to test control laws and algorithms for steering the swarm of robots in Becker's laboratory each weekday morning. In one experiment, the students use a light source to steer the robots through a maze. In another, they simulate torque by steering the robots to push an object from one side of the table to the other.

The novelty of this work lies in its approach; many researchers are exploring ways to give intelligence to small swarms of robots to make them perform particular tasks in an environment. In contrast, Becker's team is looking for intelligent ways to exploit the environment to make large robot swarms perform specific tasks.



BREAKING THE MOLD

The cinematic nature of the research is true-to-life for these engineers, who readily admit the influence that movies, television and other popular media have in inspiring young minds – especially young girls' minds – to pursue science, technology, engineering and mathematics (STEM) careers.

"Movies and media play a very big role in portraying science to the general public," Lin said. "I don't think female scientists in movies are necessarily portrayed as competent as their male counterparts. It's not really fair, because girls need to know at a young age that engineering isn't just for the guys – it's an option for them, too."

But the times they are a-changin', as Bob Dylan and these young women are quick to point out: Wan was ecstatic to see Jessica Chastain play the stoic and brave mission commander in the Hollywood blockbuster, "The Martian"; Shahrokhi was delighted by the female protagonist in Walt Disney's "Zootopia" – a smart, caring and career-oriented bunny who dreams of professional success instead of Prince Charming; and **Mahek Maheshwari,** a high school student volunteering with the team, recently watched a documentary on Mary Kom, the first Indian woman to win a gold medal in the Asian Games in 2014, that made her feel like she could break molds, too.

Lin hopes the team's work might inspire some new movies one day – ones where women play the leading roles, and their strength and competence as engineers shines through all of the action.

"But can I play myself in the movie about our research? It would be more realistic," Lin said.

Hollywood may be a second career after she gets those little robots under control.

> "Each of these tiny robots is somewhat useless on its own, but together, as a swarm, these robots can accomplish amazing things."
>
> - SHIVA SHAHROKHI

THE CULLEN COLLEGE OF ENGINEERING

PRESENTS

THE UH FSAE TEAM

IN

THE FAST AND THE FURIOUS

UH ENGINEERS RACE INTO THE LIMELIGHT

FORMULA ONE RACECAR DESIGN BY UH SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

TITLE ART CREDIT – UNIVERSAL PICTURES

AT A RACETRACK NEAR YOU

A helmeted driver grips the steering wheel of a sleek, red racecar. The engine idles so powerfully the earth seems to quiver. A green flag waves; the driver slams the accelerator to the floor. The race is on.

It's a rush of adrenaline not out of place in any of "The Fast and the Furious" franchise films. But this particular driver isn't Paul Walker, and this scene isn't from a movie.

This is a true story of an underdog team from the University Of Houston Cullen College of Engineering who built a Formula One-style racecar from the ground up and sped into the limelight at one of the world's largest and most challenging design and racing competitions.

BACK IN THE FAST LANE

Last fall, the UH Society of Automotive Engineers (SAE) was just an idea – a topic of conversation between mechanical engineering undergrad students **Grant Mottershaw, Jacob Gallery** and **Shibly Abughazaleh.**

"UH used to have an SAE student group but hasn't for several years now," said Mottershaw. "We never understood why, because working on cars and engines is a great way to apply what we learn in the classroom."

The three students soon learned about the Formula SAE (FSAE), a competition that challenges collegiate teams from around the world to design and construct a single-seat, Formula-One style racecar. Each team's racecar is evaluated for design, construction and safety by automotive, motorsports and aerospace experts at an event in Lincoln, Nebraska. Only the best designed and constructed racecars advance to the event's final competition: the big race.

Inspired by the challenge, Mottershaw, Gallery and Abughazaleh decided to steer the long-dormant UH SAE group back into the fast lane by looking for other talented engineering students to join the team.

The way they figured, they had so many races going on: the students were racing against time to form the team just as they were racing against the odds to design and build a professional racecar from scratch.

In cinematic spirit, they had to do it fast. They had to do it furiously.

"You have a number of people at this school that have what many other universities' students don't – and that's life experience," Gallery said. "We knew we could make it to the big race."

CHEERING FOR THE UNDERDOG

Many of the teams competing in the FSAE use the same racecar for the annual competitions, Mottershaw said, tuning and re-engineering the vehicle to improve its look, speed and endurance each year. By comparison, the UH SAE team's car was little more than a sketch on a paper napkin last summer.

"We even had to build the table that we used to work on the car," Mottershaw said.

Since then, the team has accomplished everything they set out to: they attracted more than 40 UH students to join the SAE group, launched a website (www.uhfsae.com), earned a sponsorship from the Houston-area professional racetrack Motor Speedway Resort and garnered enough funding from local investors to design and construct their racecar.

"We were definitely an underdog team. It's pretty unbelievable for a first year team to even make it to the competition," said **Adrian Venegas,** a mechanical engineering student and vice president of UH SAE.

READY…SET…RACE!

Last June, all roads converged for the students and their new racecar at the FSAE competition in Nebraska. In the first round of the competition, they pitched their racecar to a panel of judges representing a fictional manufacturing company. The UH racecar was evaluated for its potential on the consumer market, specifically as a vehicle that would appeal to a non-professional weekend autocross racer.

Next, the team endured high pressure safety and technical inspections to determine whether the UH racecar was fit to advance to the big race. The tech inspections proved to be a roadblock for many of the FSAE competitors – nearly 20 teams didn't make it past this round – but the UH SAE team pulled an all-nighter to fix their racecar and cruised through to the next competition.

As the sun rose on race day, the UH team was one of only 86 teams that had advanced to the final event, a 30-minute endurance race.

The UH SAE group was the only first-year team to finish the big endurance race, and they finished alongside some of the FSAE's toughest competitors. When all the lines were crossed and scores tallied, UH placed 26th out of 102 teams – a feat practically unheard of for a first-year team.

MAKING IT LAST

With the thrill of the fast and furious endurance race behind them, the UH SAE team is focusing on the long drive of building a lasting legacy of the UH Society of Automotive Engineers.

"We're trying to make sure SAE lasts on the UH campus," said Venegas. "It all started here and we want to put UH back on the FSAE map."

It looks like a clear road ahead for the UH SAE students.


NOT A TIME MACHINE OUT OF A DELOREAN, BUT WE'RE CLOSE.
BACK TO THE FUTURE
RESEARCH CONDUCTED AT THE UNIVERSITY OF HOUSTON CULLEN COLLEGE OF ENGINEERING, DEPARTMENT OF MECHANICAL ENGINEERING
TITLE ART CREDIT - UNIVERSAL PICTURES
IN DEVELOPMENT NOW

Of course Marty McFly's hoverboard could fly – it was powered by director Robert Zemeckis, Hollywood special effects and a $40 million budget for "Back to the Future II."

Almost three decades after the fictional hoverboard propelled McFly past his enemies, creating movie magic is all in a day's work inside the UH Cullen College's superconductivity labs, where the floating, superconducting board is on the drawing board.

The technology behind the levitation is so exciting that **Julien Leclerc,** a postdoctoral fellow in mechanical engineering who gets to show off the magic behind the levitation is, himself, floating on air.

"I really like to do these levitation experiments – it's like magic and it's cool," said LeClerc, who mesmerizes students by playing with a toy car that can hover over a track. He added, "Levitation is very easy to do now."

Sure, maybe if you have a Ph.D. in engineering and specialization in superconductivity like LeClerc.

IT'S LIKE LIGHTENING STRIKING THE CLOCK TOWER

At extremely low temperatures (as low as cryogenic temperatures), superconductors allow current to flow without resistance and repel a magnet. That's the principle that allows LeClerc's toy car to float above the track and the hoverboard to eventually take flight.

To set the toy car airborne, LeClerc pours liquid nitrogen at minus 321 degrees Fahrenheit onto the tiny superconductor inside the little car, which causes the superconductor to initially repel the magnetic track. Then, with a little more pressure, the magnetic track and the superconductor both repel and attract each other, and as if Houdini was on the premises, stable magnetic levitation occurs. The car goes airborne about an inch above the track, around and around for roughly two minutes until it warms up and stops.

WE DON'T NEED ROADS

The hoverboard technology will literally take us to places, as Doc told McFly in "Back to the Future," "Where we're going, we don't need roads."

Venkat "Selva" Selvamanickam, M.D. Anderson Chair Professor of mechanical engineering and director of the Applied Research Hub Texas Center for Superconductivity, points to Japan, where a Maglev (from the words magnetic levitation) superconducting magnetic airborne train is being built to transport people above a track from Tokyo to Osaka. The floating train will be so fast it will cut down the commute time roughly by half, from 2.5 hours to one.

"On the bottom of the train they have a superconducting magnet and they magnetize the track, too, so it both lifts and propels the train. It's a moving magnetic field," said Selva. "It's very fast, and will go about 400 miles per hour because there's no friction and no wheels to cause friction on the track."

There is already a Maglev levitation train in Shanghai that transports people from the airport to downtown, at a top speed of 270 mph, but it is not based on superconductivity.

POWERFUL IDEAS

The same superconductor technology that will bring us the hoverboard and the future of travel may bring us no less than a modern American power grid, a rebuild of that old system built in the 1800s, the one that provides electricity to every single person living in the United States.

"The power grid loses 10 percent of the power it transmits," said Selva. "Replacing the wires with superconductors would make the lines more efficient and stop the losses."

Additionally, in very crowded downtown areas, where there is no room to add more power lines, 10-times the power can come from the same conduit with a superconductor. Not only is it physically smaller, it can carry 300-times more current than copper wire.

Listening to Selva talk about the technology behind creating the hoverboard and where it might lead, you are certain that everything current about electricity is flowing through the UH Cullen College of Engineering.

That's why the mechanical engineering department chair, **Pradeep Sharma,** came to him with the idea in the first place.

"I went to Selva because he can do it. He can make the hoverboard," said Sharma.

A HOLLYWOOD IDEA COMES TO LIFE IN HOUSTON

Sharma envisions a future where he rides the hoverboard into recruiting events, convincing hordes of middle and high school students to pursue mechanical engineering in college.

"I'll hoverboard in the air right in front of them and I think that will convince most of them to sign up for our engineering classes," said an excited Sharma.

But his flying recruitment entrance will have to hang on while the researchers seek funding to build the hoverboard. Luckily, Sharma is patient. He's waited since 1989 – that time in the past, when the future was first imagined on film.

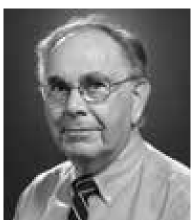
"I got this idea from 'Back to the Future.' I was a teenager when that movie came out, and it had an impression on me like you wouldn't believe! When I saw it, I said, 'That's never going to happen, but I wish it would.' Now I know that it can," said Sharma.

NEW FACULTY

20 New Faces and Brilliant Minds Join UH Engineering Faculty, Including ***Four National Academy of Engineering Members***

BY LAURIE FICKMAN

BIOMEDICAL ENGINEERING



Member of the National Academy of Engineering, **JEROME SCHULTZ,** joins UH in the spring of 2017 as a Distinguished Professor of biomedical engineering. His career spans five decades of research, teaching, awards, publishing and patents. He has been awarded more than $32.3M in research contracts and grants during his prestigious career.

Founding chairman of the department of bioengineering at the University of California, Riverside, Schultz's experience is unmatched. His research interests include biosensors, facilitated diffusion in membranes, restricted diffusion in membranes, transport processes in tissues, pharmacokinetics, immobilized enzymes and bioimaging. Schultz's research has been published in nearly 130 peer-reviewed articles.

Schultz received his Ph.D. in biochemistry from the University of Wisconsin in 1958 and earned both his M.S. and B.S. in chemical engineering from Columbia University in 1956 and 1954, respectively.

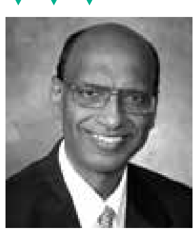
CIVIL & ENVIRONMENTAL ENGINEERING

▶ **KONRAD KRAKOWIAK**
ASSISTANT PROFESSOR OF CIVIL AND ENVIRONMENTAL ENGINEERING
Research interests: Improving civil infrastructure through synthesis, mechanics and durability of construction materials to address critical issues of our built-in environment.

▶ **ARTURO LEON**
ASSOCIATE PROFESSOR OF CIVIL AND ENVIRONMENTAL ENGINEERING
Research interests: Resilient approaches to flood control, optimal reservoir operation under uncertainty, sustainable storm water management and modeling, real-time control of complex hydraulic systems, computational hydraulics and physical modeling of hydraulic structures.

▶ **STACEY LOUIE**
ASSISTANT PROFESSOR OF CIVIL AND ENVIRONMENTAL ENGINEERING
Research interests: Natural macromolecules at surfaces of engineered and natural materials, including nanomaterials, natural colloids and reactive or catalytic materials.

ELECTRICAL & COMPUTER ENGINEERING



Member of the National Academy of Engineering, **KAUSHIK RAJASHEKARA** joins the Cullen College as a Distinguished Professor of electrical and computer engineering. He became an NAE member for contributions to electric power conversion systems in transportation in 2012.

A fellow of the Institute of Electrical and Electronics Engineers (IEEE) and of the U.S. National Academy of Inventors, Rajashekara comes to Houston from the University of Texas at Dallas where he served as Distinguished Professor and Endowed Chair in the Department of Electrical Engineering at the Erik Jonssen School of Engineering and Computer Science.

From 1989 to 2006, Rajashekara was technical fellow and chief scientist for advanced energy systems at Delphi Corporation/General Motors, where he provided a vision for future technology in the area of propulsion and power conversion systems for electric, hybrid, fuel cell vehicles and alternative fuel vehicles.

In 1984, Rajashekara received his Ph.D. in electrical engineering from the Indian Institute of Science in Bangalore, India and, in 1992, he completed a master's of business administration from Indiana Wesleyan University in Indianapolis.

▶ **ROSE FAGHIH**
ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING
Research interests: Control, estimation, system identification, and modeling neural and physiological systems in health and disease, personalized medicine and biomedical data science with a focus on neuroendocrine hormones.

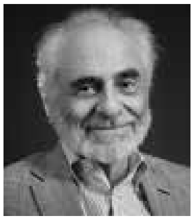
▶ **HIEN NGUYEN**
ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING
Research interests: Machine learning, medical imaging and healthcare technology.

▶ **XIAONAN SHAN**
ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING
Research interests: Developing novel plasmonic and photonic imaging and measurement techniques for energy and biology research.

INDUSTRIAL ENGINEERING

▶ **TAEWOO LEE**
ASSISTANT PROFESSOR OF INDUSTRIAL ENGINEERING
Research interests: Development of inverse optimization and machine learning techniques with applications to cancer therapy and medical decisionmaking in the field of organ transplantation and personalized medicine.

MECHANICAL ENGINEERING



ANDREA PROSPERETTI becomes a Distinguished Professor of mechanical engineering at the Cullen College. He is a member of the National Academy of Engineering for his work involving fluid mechanics, specifically multiphase flows.

In 2003, the American Physical Society honored him with the highest award in his field, the Fluid Dynamics Prize. Since 2008, he has served as editor-in-chief of the *International Journal of Multiphase Flow* and serves on the editorial board of the *Annual Review of Fluid Mechanics*.

Prosperetti comes from Johns Hopkins University, where he is the Charles A. Miller Jr. Professor of mechanical engineering. He also serves part time as the Gerrit Berkhoff Professor of applied physics at the University of Twente in The Netherlands.

He earned an M.S. in 1972 and a Ph.D. in engineering science in 1974 from the California Institute of Technology.

He is the single author of approximately 40 papers and co-author of over 160 others.

THEOCHARIS BAXEVANIS
ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
Research interests: Constitutive modeling and numerical implementation, finite element analysis, damage of geomaterials, creep failure of fiber-reinforced composites, high strain-rate response of metals, fracture of shape memory alloys and material instability and localization.

DANIEL ARAYA
ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING
Research interests: Vortex dynamics, free-shear flows, atmospheric boundary layer flows, hydrodynamic stability, flow visualization techniques, passive flow control, urban wind farming, multi-rotor drone aerodynamics, renewable energy storage, biologically driven flows and space exploration.

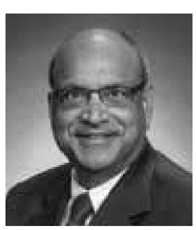
PETROLEUM ENGINEERING

MOHAMED SOLIMAN is professor and department chair of petroleum engineering at the Cullen College of Engineering. He is a distinguished member of the Society of Petroleum Engineers and a Fellow of the National Academy of Inventors.

Soliman has an illustrious career in reservoir completion and production engineering. He holds 27 patents on fracturing operations and analysis, testing and conformance applications. He is an author or co-author of over 200 technical papers and articles in areas of fracturing, reservoir engineering, well test analysis, conformance and numerical simulation.

He joins the Cullen College from Texas Tech University, where he has served as George P. Livermore Chair Professor and department chair from 2011 to 2013. From 1979 to 2011, Soliman had a distinguished career at Halliburton Energy Services leading technology development in areas including exploitation of unconventional gas reservoirs.

In 1978, Soliman received a Ph.D. in petroleum engineering from Stanford University in California. Three years earlier he received his master's in petroleum engineering at the same school.



National Academy of Engineering member **GANESH THAKUR** joins the Cullen College as a Distinguished Professor of petroleum engineering.

Thakur is recognized globally as a leader in reservoir engineering and water flood management and has written several Society of Petroleum Engineers (SPE) publications on the topic. He also has an impressive list of publications and teaching engagements conducted around the world.

During a career with Chevron that spanned four decades, Thakur served in various roles including vice president and global advisor and Chevron Fellow. He also served as the SPE President in 2012.

He earned his Ph.D. in petroleum and natural gas engineering from Pennsylvania State University in 1973 after receiving his M.S. in mathematics there one year earlier. He also holds a 1980 master's of business administration from Houston Baptist University.

DIMITRIOS HATZIGNATIOU
PROFESSOR OF PETROLEUM ENGINEERING
Research interests: Reservoir engineering, fluid flow in porous media, enhanced oil recovery, production enhancement and optimization, reservoir stimulation, mathematical modeling, reservoir characterization, reservoir management, CO_2 sequestration and geothermal energy.

GEORGE WONG
ASSOCIATE PROFESSOR OF PETROLEUM ENGINEERING
Research interests: Experimental and modeling works in the areas of completion design and evaluation, production operations and fracture mechanics.

INSTRUCTIONAL FACULTY

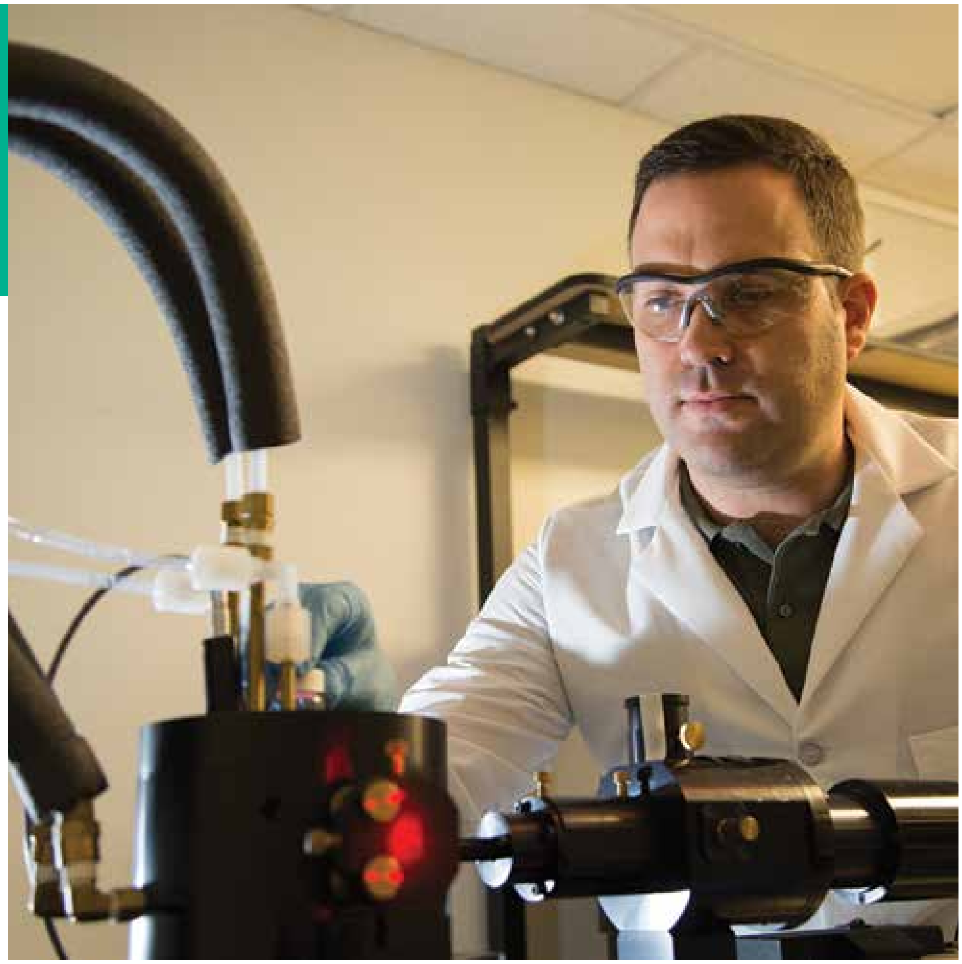
JERROD HENDERSON
INSTRUCTIONAL ASSISTANT PROFESSOR IN THE DIVISION OF UNDERGRADUATE PROGRAMS AND STUDENT SUCCESS

HOLLEY LOVE
INSTRUCTIONAL ASSISTANT PROFESSOR OF MECHANICAL ENGINEERING

RANDAL SITTON
INSTRUCTIONAL ASSOCIATE PROFESSOR IN INDUSTRIAL ENGINEERING

YAPING WANG
INSTRUCTIONAL ASSISTANT PROFESSOR OF INDUSTRIAL ENGINEERING

CHEMICAL ENGINEERING PROFESSOR HONORED WITH OWENS CORNING EARLY CAREER AWARD



BY NATALIE THAYER

Jeffrey Rimer, Ernest J. and Barbara M. Henley Associate Professor of chemical and biomolecular engineering at the Cullen College, received the 2016 Owens Corning Early Career Award from the American Institute of Chemical Engineers (AIChE) for his multifaceted research on crystallization.

The Owens Corning Early Career Award, administered by the Materials Engineering and Sciences Division (MESD) of AIChE, recognizes researchers under the age of 40 who have contributed outstanding work in the broad field of materials science and engineering. The award is given to only one individual each year. As the 2016 recipient, Rimer will receive a plaque and $1,500 honorarium in addition to presenting a plenary lecture at the 2016 AIChE Annual Meeting in San Francisco this November.

Rimer's research explores both classical and nonclassical crystallization, and his work has led to the development of drugs for kidney stones and malaria. Rimer's extensive research on zeolites, a crystalline material used in a variety of everyday products, led to the first in situ evidence of how zeolites grow, which was published in *Science* in 2014.

Rimer and his colleagues developed a novel technique to study the growth of zeolites using solvothermal atomic force microscopy, or AFM, which allows researchers to view crystal growth in real time and in realistic environments. With AFM, Rimer's research group was able to identify that zeolites grow by complex processes involving nonclassical crystallization. In 2015, he was among a group of 15 researchers to publish a review of nonclassical crystallization in *Science*.

Aside from zeolite crystallization, Rimer studies many types of biogenic crystals that grow classically, such as kidney stones.

According to the National Kidney Foundation, more than half a million people visit the emergency room for kidney stones each year and an estimated one in 10 people will develop a kidney stone during their lives. The most common type of kidney stone is formed when calcium and oxalate combine in urine due to inadequate calcium and fluid intake. By uncovering the fundamentals of crystal growth, Rimer's group identified a potential therapy for kidney stones using a natural supplement.

Knowledge of classical mechanisms of crystal growth allowed Rimer and his colleagues to determine how antimalarial drugs operate in cases of malaria. In collaboration with Peter Vekilov, John and Rebecca Moores Professor of chemical and biomolecular engineering, Rimer developed a platform to characterize and screen antimalarial drugs.

"There are many hypotheses [in the scientific community] about how antimalarial drugs work, and we've been able to develop a unique system to test and validate these hypotheses," said Rimer.

Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College of Engineering, said Rimer is highly regarded for his innovative teaching style and unwavering commitment to his students.

"From helping UH students commercialize his inventions to inviting undergraduates to conduct research in his laboratory, Dr. Rimer has always gone above and beyond expectations to enhance the education of his students," said Dean Tedesco.

Rimer said he's deeply grateful to all of the collaborators and students he's worked with to advance this research.

"I've been very fortunate to work with excellent students and postdocs over the years, and I think this award speaks to that," said Rimer. "I really owe a lot to my research group. They are the reason why many of our initial ideas have come to fruition."

UH RESEARCHER RECOGNIZED FOR WORK IN CLEAN ENERGY

BY JEANNIE KEVER

Debora Rodrigues, associate professor of civil and environmental engineering at the UH Cullen College of Engineering, received the 2016 Clean Energy Education and Empowerment (C3E) Research Award. Her work focuses on developing bio and nanotechnologies to reduce energy costs in water and wastewater treatment.

The C3E initiative, launched in 2010 by the U.S. Department of Energy (DOE) and led in collaboration with the MIT Energy Initiative and the Stanford Precourt Institute of Energy, aims to encourage women's participation and leadership in science, technology, engineering and math (STEM) by highlighting female leaders in STEM fields. C3E hosts an annual Women in Clean Energy Symposium to help women in the energy sector build professional networks.

“I LOVE RESEARCH AND I LOVE TO BE WITH MY STUDENTS. THIS IS HOW I THINK I CAN MAKE A DIFFERENCE.” - DEBORA RODRIGUES

Rodrigues received this award for her body of work, including patents, publications and her role in creating outreach programs, along with her extensive research in the nexus of water and energy. She said she was first drawn to this work because of health problems associated with microbial water contamination in her native country of Brazil.

“Making a difference, especially in the developing world, requires solutions to be simple and inexpensive,” she said.

Most available water treatment technologies require several steps, making them cost-prohibitive. Reverse osmosis, for example, effectively removes contaminants but requires huge amounts of energy.

“I am happy to see Dr. Rodrigues' work recognized by leaders in the energy field,” said Roberto Ballarini, Thomas and Laura Hsu Professor and chair of the civil and environmental engineering department. “Her innovative work holds great promise for water treatment in the developing world, but it also offers a way to greatly reduce water and wastewater treatment costs everywhere.”

Rodrigues has two technologies under development, both designed to be reusable and require little or no energy. The first is a nanocomposite coating, capable of removing heavy metals, radioactive materials and microorganisms. The second uses hydrogel polymer beads that can remove nitrogen and phosphorous from agricultural runoff.

Both have been licensed to a team of former UH business students who formed the startup company WAVVE Stream Inc. The name comes from the first letter for the word “water” in English, Spanish, Swedish, Russian and French, the native languages of the team's founding members.

Rodrigues serves as an advisor to WAVVE, although she has no plans to leave teaching and research for the business world.

“I love research and I love to be with my students,” she said. “This is how I think I can make a difference.”

Rodrigues received the inaugural Emerging Investigator Research Award from the Sustainable Nanotechnology Organization in 2014 and is the recipient of a National Science Foundation Faculty Early Career Development (CAREER) Program Award. She also runs an NSF-funded research experience for high school teachers and is the main advisor for the UH Women in Engineering program.

This year's symposium was held last May in Palo Alto, California. Rodrigues was one of eight awardees recognized at the conference.

NEUTRON SCATTERING SOCIETY OF AMERICA ELECTS UH ENGINEER AS 2016 FELLOW

BY NATALIE THAYER

Ramanan Krishnamoorti, professor of chemical and biomolecular engineering at the University of Houston Cullen College of Engineering, was recently elected as a Fellow of the Neutron Scattering Society of America (NSSA). He was one of only 11 NSSA Fellows elected this year.

The NSSA was formed in 1992 to advance neutron scattering research in the United States by identifying and bringing together the national neutron scattering community, identifying the needs of the community, promoting the broader use of neutron scattering technology and carrying out educational activities across the nation. The society is made up of leading researchers, scientists and others with an interest in neutron scattering research spanning a wide spectrum of disciplines.

Krishnamoorti was elected for his pioneering neutron scattering studies on soft materials and nanocomposites and for his sustained service to the neutron scattering community.

Krishnamoorti is highly active across the UH community. In addition to his role in the Cullen College, he serves as a professor of chemistry in the College of Natural Science and Mathematics, interim vice-president and vice-chancellor for Research and Technology Transfer, and the chief energy officer for UH. As the University's chief energy officer, he is responsible for leading the University's efforts to establish energy-centric partnerships to address the world's most pressing energy challenges.

AICHE ELECTS UH ENGINEER AS VICE CHAIR FOR CATALYSIS AND REACTION ENGINEERING DIVISION

BY NATALIE THAYER

Lars Grabow, assistant professor of chemical and biomolecular engineering at the UH Cullen College, was recently elected as second vice chair for the Catalysis and Reaction Engineering (CRE) division of the American Institute of Chemical Engineers (AIChE).

As a leading worldwide organization for chemical engineering professionals, AIChE's vision is to provide value to the field by promoting chemical engineers' professional and personal growth and by applying chemical expertise to meet global societal needs. AIChE boasts more than 50,000 members from over 100 countries. The CRE division, which focuses on catalysis, industrial and engineering chemistry, fuel chemistry and petroleum, is the largest division of AIChE.

In his role as second vice chair for the CRE division, Grabow will be responsible for the CRE Travel Awards, which provide graduate students with travel assistance to present their research at the annual AIChE meeting. He will select the judges to review applications, select the 20 strongest graduate students to receive the awards and present the awards to the winners at the 2016 CRE annual meeting in San Francisco, California.

Grabow will be committed to the AIChE leadership team for four years. After serving as second vice chair, he will move into the role of vice chair in 2017, followed by chair in 2018 and past-chair in 2019.

TO LEARN MORE ABOUT AICHE'S CRE DIVISION, PLEASE VISIT www.aiche.org/community/divisions/catalysis-and-reaction-engineering-division-cre

NATIONAL RADIO SCIENCE ORGANIZATION NAMES ECE PROFESSOR AS CHAIR

BY ASHLEY SCHWARTZ

The United States National Committee of the International Union of Radio Science (USNC-URSI) has named **David Jackson,** professor of electrical and computer engineering at the Cullen College, as its chair for 2015-2017.

The International Union of Radio Science (URSI) is a non-governmental and non-profit organization under the International Council for Science. It is responsible for stimulating and coordinating international studies, research, applications, scientific exchange and communication in the field of radio science. The organization is comprised of member committees representing over 40 countries including the United States. The United States National Committee (USNC) of URSI is appointed by the National Academy of Sciences to represent the United States to URSI.

"I am extremely honored to be appointed chair of USNC-URSI," said Jackson. "URSI is a very well known international organization that has a large impact on the radio science community."

Jackson has many responsibilities as chair, including the planning and coordinating of the annual National Radio Science Meeting (NRSM), which will be held next January in Boulder, Colorado. The annual meeting attracts radio scientists from across the globe and features paper competitions for students.

"My hope for the NRSM is to increase student involvement through travel fellowships and our new 'Early Career Representative' membership category," said Jackson. "I believe students are the future of the radio science field and it is important that they are involved in this organization."

Jackson also hopes to increase the diversification and amount of members of the organization.

"I am hopeful in our ability to attract new members of various professions that will have a positive impact on the reputation of the organization," he said.

While this appointment calls for a great deal of attention and dedication, Jackson is proud of the benefits it will have for the Cullen College's electrical and computer engineering department. "I believe that working with such a prestigious organization provides a great opportunity for the department and it is a responsibility I am very appreciative of," he said.

ECE PROFESSOR SERVES AS EDITOR OF ELECTROCHEMICAL JOURNAL SPECIAL ISSUE

BY ASHLEY SCHWARTZ

Stanko Brankovic, associate professor of electric and computer engineering at the Cullen College, was invited to serve as a guest editor for a special issue of the *Journal of the Electrochemical Society* (*JES*).

The special issue, titled "Electrochemical Deposition as Surface Controlled Phenomenon: Fundamentals and Applications," explores the topic of electrochemical deposition, a process by which a metal film is deposited onto a conductive surface from a metal ion containing solution.

Electrochemical deposition is used in the manufacturing of many products that are ubiquitous to everyday life, but researchers have yet to fully understand the process at an atomic level.

"Studies on electrochemical deposition at an atomic level continue to yield surprises," said Brankovic, who has been studying the phenomenon for over a decade.

Coatings created by electrochemical deposition range from purely aesthetic – such as a gold coating on a piece of jewelry – to performance and safety-enhancing – such as creating conductive pathways in circuit boards or adding a protective coating to the wings of an airplane. Researchers are now studying the fundamental underpinnings of electrochemical deposition at the nanoscale to both improve and expand applications of the process.

"These special editions allow us to gather exceptional research and breakthroughs that have the potential to grow the field in a considerable way," said Brankovic.

For the special issue, *JES* appointed a prestigious group of technical editors to advance the field of electrochemical science and technology by presenting valuable and innovative work.

Brankovic is director of the Cullen College's Electrochemical Nanofabrication and Nanomaterials Synthesis Group, a research group dedicated to understanding physical and chemical processes that occur at electrochemical interfaces. His research has been published in top-tier journals including *Surface Science*, *Advances in Electrochemical Science and Engineering* and the *Encyclopedia of Applied Electrochemistry*.

JES is one of the leading journals in the field of electrochemical science and technology. It is one of the most-cited journals in the fields of electrochemistry and materials science, coatings and films.

UH ENGINEER WINS AMERICAN CHEMICAL SOCIETY'S DOCTORAL NEW INVESTIGATOR AWARD

BY NATALIE THAYER

Cunjiang Yu, assistant professor of mechanical engineering at the UH Cullen College of Engineering, has been selected to receive an American Chemical Society Petroleum Research Fund (ACS-PRF) Doctoral New Investigator (DNI) award for his proposed research on "Electrically Responsive and Locally Programmable Hydrogel Composites."

Each year, the ACS-PRF holds a highly selective competition to award seed funding to top researchers in the petroleum field with a proven track record of producing innovative fundamental research. The DNI grant, which provides start-up funding for researchers who are within the first three years of an academic appointment as an assistant professor, aims to promote the careers of young faculty, support research of high scientific caliber and enhance the career opportunities of students through research experiences.

This award provides funding of $110,000 over two years and will support Yu's research on developing and studying the fundamental properties of a new class of "smart" material – an electrically-responsive hydrogel composite that can be locally actuated, or internally stimulated.

Hydrogels are soft, adaptable and highly absorbent polymers with various applications ranging from everyday materials, such as contact lenses, to advanced biomedical tools, such as skin wound dressings.

Some classes of responsive hydrogels, which are a type of "smart" material, are able to adapt to their environments by responding to external stimuli. But Yu wants to take this a step further by engineering a class of hydrogels that can also adapt to internal stimuli. Yu has proposed a strategy for creating a novel composite material made by integrating polymer-encapsulated, deformable nanoelectronics into responsive hydrogels.

With this grant, Yu and two of his Ph.D. students, Kyoseung Sim and LeiLei Shi, will conduct both experimental and theoretical investigations of the material.

Going forward, Yu said he looks forward to discovering potential applications for the hydrogel composite, particularly in the biomedical engineering field. In addition to advancing technology for tissue engineering and drug delivery, Yu said he envisions this material playing an important role in the development of soft robotics that can be used by surgeons in the operating room.

"Fundamental research is invaluable," said Yu. "We have to really understand the material before we can move forward and look into practical applications."

FACULTY AWARDS

Dean Joseph W. Tedesco and Yashashree Kulkarni, winner of the W.T. Kittinger Teaching Excellence Award

UH ENGINEERING HONORS FACULTY WITH OUTSTANDING SERVICE AWARDS

BY AUDREY GRAYSON

Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College, recognized faculty, staff and students for their outstanding performance in teaching, research and service last spring.

COLLEGE AWARDS

Gangbing Song (ME)
Fluor Corporation Faculty Excellence Award

Yashashree (Yash) Kulkarni (ME)
W.T. Kittinger Teaching Excellence Award

Micky (Miguel) Fleischer (ChBE)
Career Teaching Award

TEACHING EXCELLENCE AWARDS

Yandi Hu (CEE) — Teacher

Yan Yao (ECE) — Teacher

Hadi Ghasemi (ME) — Teacher

Eylem Tekin (IE) — Teacher

Michael Myers (PE) — Teacher

Elias Keedy (IE) — Lecturer

Sana Krichen (ME) — Teaching Assistant

Jaeyoung Cho (IE) — Teaching Assistant

RESEARCH EXCELLENCE AWARDS

Yan Yao (ECE)
Junior Faculty Research Award

Hyongki Lee (CEE)
Junior Faculty Research Award

Kirill Larin (BME)
Senior Faculty Research Award

UH HONORS TWO CULLEN COLLEGE PROFESSORS WITH TEACHING, RESEARCH AWARDS

BY AUDREY GRAYSON

Two Cullen College professors were recognized for their excellence as educators and researchers as recipients of the University of Houston's teaching and research awards last spring.

Karolos Grigoriadis, David Zimmerman Professor of mechanical engineering and associate director of the aerospace engineering program at the Cullen College, received the John and Rebecca Moores Professorship from the University. The five-year, renewable professorship is awarded to faculty in recognition of outstanding teaching, research and service. This latest award comes only two years after Grigoriadis earned both the Fluor Corporation Faculty Excellence award, the highest honor given by the Cullen College, as well as the W.T. Kittinger Teaching Excellence Award, the College's most prestigious teaching honor.

Fritz Claydon, professor of electrical and computer engineering and director of the division of student success at the Cullen College, received the Undergraduate Mentoring Research Award. Claydon is an active supporter of many of the college's ongoing National Science Foundation (NSF) STEM outreach efforts, including GRADE Camp, STEP Forward Camp and the GK-12 Program. Claydon also serves as program manager for both the NSF Research Experience for Undergraduates (REU) program and the NSF Research Experience for Teachers (RET) program. Claydon is also a co-director of the Honors Engineering Program at UH.

RISE OF

1 UH ENGINEERING ROBOTICS TEAMS SWEEP REGIONAL COMPETITIONS

BY ASHLEY SCHWARTZ

Last April, two Institute of Electrical and Electronics Engineers (IEEE) undergraduate robotics teams from the UH Cullen College of Engineering's electrical and computer engineering (ECE) department competed in the IEEE Region Five Student Robotics Contest in Kansas City, Missouri. Both teams placed in the competition, which challenged more than 27 teams to build search-and-rescue robots to complete specific tasks within an allotted timeframe.

The UH Engineering team made of up of undergraduate students Kain Dominguez, Michael Le, Trung Ngo and Phat Nguyen earned second place in the competition. The other UH Engineering team, made up of James Boswell, Gary O'Day and Michael Whatley, earned 12th place.

The students were challenged with creating a robot that could locate and transport four natural disaster victims to care facilities depending on their injuries within six minutes.

"For the competition, the students were building autonomous vehicles that could sense the environment and do intelligent things," said John Glover, electrical and computer engineering professor and advisor to both robotics teams.

While preparing for the competition, the students learned to embrace the various challenges that arose.

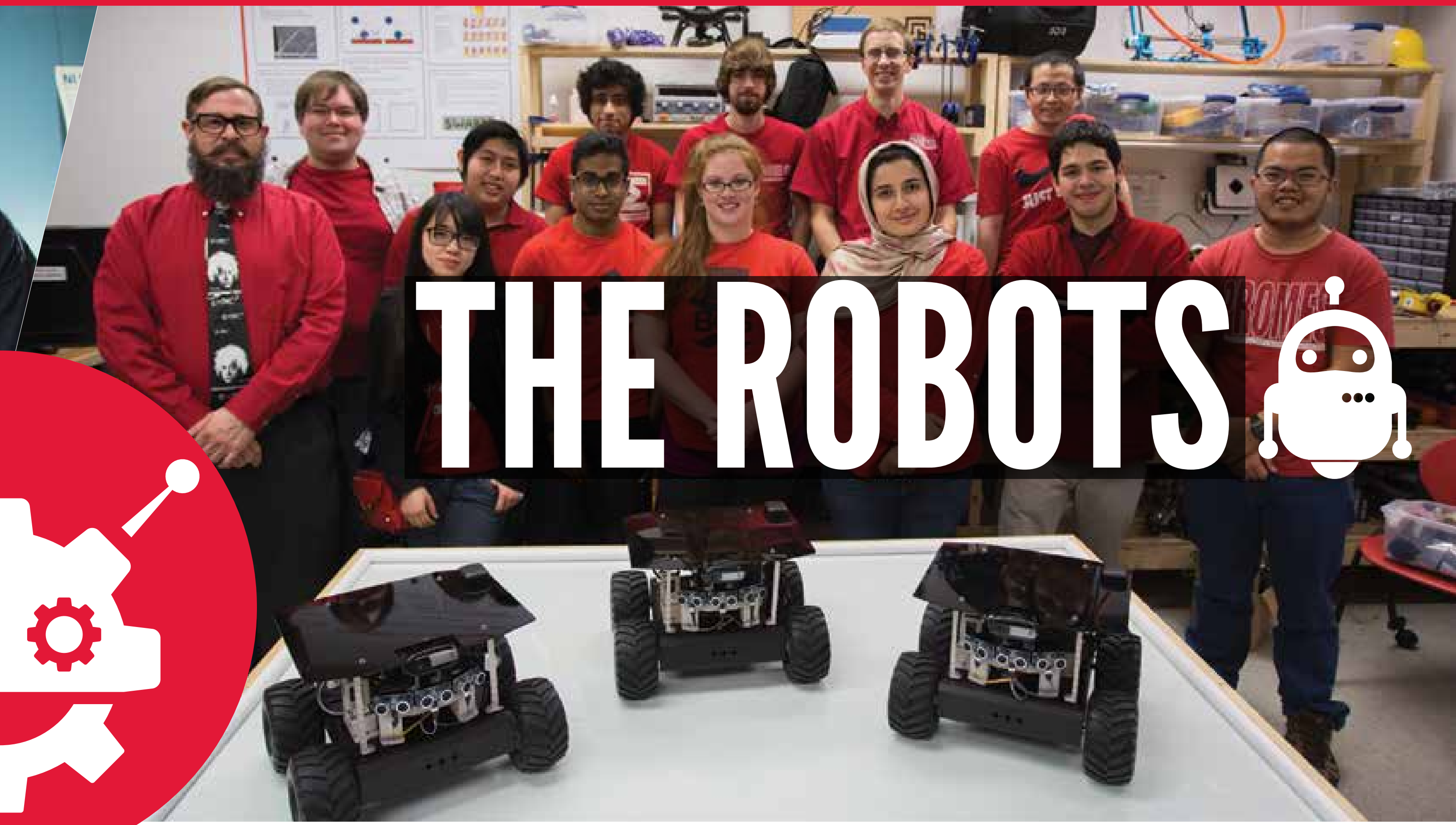
"Our team worked on our robot for anywhere from six to 14 hours a day, and every single day there was a new challenge or problem with the hardware or the software," said Le.

The teams approached each challenge as an opportunity to grow their skills as engineers.

"When we were working on this robot, we weren't just looking to make a robot that would win the competition – we wanted to challenge ourselves to make the best robot we were capable of making," said Ngo.

Glover said the most rewarding part of working with the robotics teams was watching the students work through the problems and grow in the process.

"I have high-level discussions with the students about how to tackle problems," said Glover. "I provide guidance to make sure they are doing things the right way throughout the design process, knowing that when they come out of it they will be better engineers."



2 STUDENTS STEER ROBOTIC SWARMS IN NASA COMPETITION

BY ASHLEY SCHWARTZ

Electrical and computer engineering professor Aaron Becker and students in his "Intro to Robotics" class were invited to "join the swarm" as selected participants in the first annual Swarmathon last April at the NASA Kennedy Space Center.

Students from minority-serving institutions were encouraged to apply to the Swarmathon competition, hosted by NASA and organized by the University of New Mexico. NASA selected 12 teams representing 14 schools to compete in the Swarmathon by developing search algorithms for robotic swarms.

Prior to the competition, each team was mailed three "swarmie" robots, small robotic vehicles that resemble a ruggedized version of an RC truck toy. Each swarmie is equipped with range sensors, accelerometers, a 3-axis magnetic compass, a webcam, a GPS system and a Wi-Fi antenna. They are controlled by the Robotic Operating System (ROS), a software used by robotics manufacturers all over the world that controls both the physical and virtual scenarios of these robots.

The students sent the code they developed to the Swarmathon, a remote competition that takes place in an environment meant to represent the surface of Mars. The code developed was used to control a swarm of robots with a goal of developing methods that improve resource retrieval rates for future exploration missions.

By participating in this competition, students have the opportunity to improve their skills in robotics and computer science and further advance technology for future NASA space exploration missions. This unique experience allows the participating students to go beyond the fundamental theorems and basic math taught in their classroom.

"My students want to go out and program self driving cars," said Becker. "By exposing them to both ends of the spectrum – the underlying math and the high-level operating system – they will have a deep understanding and exposure to cutting-edge software practices."

This project involves undergraduate and graduate students from the electrical and computer engineering department and the mechanical engineering department at the UH Cullen College of Engineering.

FOR MORE INFORMATION
on the NASA Swarmathon, please visit http://nasaswarmathon.com

MATERIALS RESEARCH SOCIETY ESTABLISHES UH CHAPTER

Last April, the Materials Research Society (MRS) Board of Directors approved the establishment of an MRS chapter at the University of Houston.

The UH MRS chapter focuses on diverse aspects of materials science and engineering, including high temperature superconductors, semiconductors, materials energy fabrication, batteries, photovoltaics, nanomaterials and more.

Venkat Selvamanickam, M.D. Anderson Chair Professor of mechanical engineering, and Pavel Dutta, a research assistant professor with Selvamanickam's research group, serve as faculty advisors for the professional group. Doctoral research assistants from the Cullen College's mechanical engineering department, materials engineering program, Advanced Manufacturing Institute (AMI) and Texas Center for Superconductivity will serve as core administrators for the new UH chapter.

Meysam Heydari Gharahcheshmeh, a mechanical engineering doctoral student and the UH MRS president, said his prior experiences with MRS motivated him to open a chapter at UH. He served as an MRS mentor for two years and gave oral presentations at MRS meetings in 2015 and 2016.

"We want to encourage materials science and engineering students to join us and build our network," said Heydari Gharahcheshmeh. "The UH MRS chapter will serve as a platform for its members to network and communicate with materials research scientists in academia, industry and government worldwide."

Heydari Gharahcheshmeh and UH MRS vice president **Ying Gao** represented the chapter at the 2016 MRS Spring Meeting in Phoenix, Arizona.

MRS university chapters are entitled to various benefits including special project grants, distinguished speaker support, travel assistance to attend MRS meeting, access to MRS publications and other in-kind support.

CIVIL ENGINEERING STUDENT EARNS COVETED MELOSH MEDAL

BY NATALIE THAYER

A civil and environmental engineering student from the UH Cullen College of Engineering was recently awarded the Robert J. Melosh Medal for his doctoral dissertation in the area of finite element methods and computational mechanics.

The Robert J. Melosh Medal Competition, named in honor of a civil engineering professor who pioneered research in the areas of finite element methods and computational mechanics, provides an international forum for students to present their dissertations and showcase their research.

To apply for the medal, doctoral students must submit extended abstracts on their doctoral research for a blind review by a panel of distinguished computational mechanics researchers from around the world. Each year, six finalists are selected by the panel to participate in a symposium at Duke University, where they give oral presentations on their abstracts and participate in a rigorous question and answer session before an expert panel.

This year, the Robert J. Melosh Medal recipient was **Maruti Kumar Mudunuru** who earned his doctoral degree in civil and environmental engineering from the Cullen College in the fall of 2015. As a student, Mudunuru worked with his faculty advisor Kalyana Nakshatrala to develop various numerical methodologies to address common subsurface challenges, such as hydraulic fracturing, contaminant transport and bioremediation, a waste management technique that uses organisms to remove or neutralize pollutants. His dissertation, for which he received the 2015 best dissertation award from the Cullen College, was titled "On Enforcing Maximum Principles and Element-wise Species Balance for Advective-Diffusive-Reactive Systems."

For the competition, Mudunuru elaborated on the finite element methods connected to this research in a talk titled "Structure-preserving Finite Element Formulations for Advective-Diffusive-Reactive Systems."

Though the application and selection process were extensive and high pressure, Mudunuru said that receiving the Melosh Medal encouraged him to continue pursuing his research career.

"There are no words to describe this achievement and success," said Mudunuru. He added that he was grateful to the engineering community at the University of Houston for providing him with invaluable guidance, support and the freedom to pursue his interests.

"Winning this award wouldn't have been possible without the help and feedback I received from professor Nakshatrala, my postdoc mentors, the dissertation committee, my other professors and my classmates," he said.

Since earning his doctoral degree from the Cullen College, Mudunuru has served as a postdoctoral research associate in the Earth and Environmental Sciences Division of the Computational Earth Science Group at Los Alamos National Laboratory (LANL). Mudunuru said that his doctoral research paved the way for his work at LANL, where he puts his UH Engineering education to work daily.

"I am using and improving the techniques I developed during my Ph.D. dissertation to solve practical problems related to energy security and the environmental impact of unconventional oil and gas extraction," he said.

Mudunuru's postdoctoral work revolves around developing robust models and inversion methods to advance research about chemical, thermal and mechanical processes for enhanced geothermal systems, gas migration, contaminant transport, fracture networks and induced seismicity.

CHEMICAL DOCTORAL STUDENT WINS AICHE RESEARCH AWARD

BY NATALIE THAYER

Katy Olafson, a chemical engineering doctoral student at the UH Cullen of Engineering, received a 2016 American Institute of Chemical Engineering (AIChE) Separations Division Graduate Student Research Award.

Working with her faculty advisor Jeffrey Rimer, Ernest J. and Barbara M. Henley Associate Professor, Olafson's research focuses on malaria pathophysiology from the aspect of hematin crystallization. She said she studies how how anti-malarial drugs affect crystallization in an effort to contribute to the development of new drugs to treat the disease.

Rimer, a leading researcher in the field of crystallization, said Olafson's dedication to the work makes her stand apart from the crowd.

"Katy is not only a promising researcher, but a rising star in her field" said Rimer.

The award will be presented to Olafson at the 2016 AIChE Annual Meeting in San Francisco, California. In addition to attending the meeting as the Separations Division's guest, she will receive a $200 cash prize and a plaque inscribed with her name.

"KATY IS NOT ONLY A PROMISING RESEARCHER, BUT A RISING STAR IN HER FIELD."

- JEFFREY RIMER

MEET

Yufeng Shen

Mengmeng Li

Quan Do

THREE UH ENGINEERS EARN POSTER AWARDS AT SOUTHWEST CATALYSIS SOCIETY SYMPOSIUM

BY NATALIE THAYER

The UH Cullen College of Engineering hosted this year's Southwest Catalysis Society (SWCS) Symposium on April 22, 2016. The symposium provides an opportunity for engineering students from across the region to present their research to an esteemed crowd of international researchers and industry professionals.

This year, three Ph.D. candidates from the Cullen College's chemical and biomedical engineering department won poster awards for outstanding presentations. From reducing auto emissions to developing alternative fuels, the winners showcased the array of groundbreaking research taking place inside UH's chemical and biomolecular laboratories.

Yufeng Shen, a third-year doctoral student and advisee of Ernest J. and Barbara M. Henley Associate Professor Jeffrey Rimer, researches catalysts that can convert methanol from natural gas to hydrocarbons, a compound essential to many everyday applications including plastics and gasoline.

Shen said he was interested in working in Rimer's laboratory at UH because of his focus on synthesizing catalysts.

"When I first joined [the group], I began building a reactor to test the performance of the catalysts we synthesized. That's the part I enjoy the most – running the experiments and testing," he said.

For the SWCS Symposium, Shen presented his work on the synthesized catalyst CSM-11 in his poster titled "The Effect of CSM-11 Crystal Size on Methanol to Hydrocarbon Reaction." Methanol, if efficiently converted to hydrocarbons through a catalyst such as CSM-11, could potentially be used as an alternative to crude oil for the production of various chemicals and fuel.

Shen said the symposium provided him an opportunity to gain new insights from leaders in the field and network with fellow graduate students.

"It's a good opportunity to broaden our horizons," Shen said. "Most of the time we're in the lab, we are so focused on our own research. But, at the symposium, we had a chance to learn what other people in the field are doing."

Under the guidance of Michael Harold, M.D. Anderson Professor and chair of chemical and biomolecular engineering, fourth-year doctoral student **Mengmeng Li** investigates the catalytic reduction of nitrogen oxide, or NOx, related to lean-burn vehicles.

Due to regulations set forth by the Environmental Protection Agency (EPA), automobile manufacturers are currently exploring methods to increase fuel economy while reducing the harmful gasses, such as NOx, that are emitted from vehicles.

With funding from an auto manufacturer, Li used a small-scale model catalyst to study the reaction mechanism – or the step-by-step sequence of reactions that lead to overall change – for NOx storage and reduction. The results of her research were presented in her posted titled “Reductant Effects During Fast NOx Storage and Reduction.”

Li said that Harold played an invaluable role in her research by providing her guidance and sharing his expertise along the way.

“I enjoy working in Dr. Harold’s lab because I can study environmental catalysis and he is such an expert in the field of chemical reaction engineering,” she said.

Exposure for this research is not new for Li. She has been published in several top research journals, including one publication in *Applied Catalysis B* and two publications in *Catalysis Today* just this year. Even though she has presented her work during many professional conferences, she said winning the SWCS poster award was a unique honor.

“At first, people might find it hard to understand your research when it’s in a different area, but with the poster presentation, I had the chance to introduce and explain my research to the audience,” she said.

Echoing Shen, Li said that the symposium provided her the chance to share and combine ideas with others beyond her own research area.

“Talking to other chemical engineers really enriched my knowledge and helped me think outside the box,” she said.

Quan Do, a second-year doctoral student working with assistant professor Lars Grabow, said he was drawn to the University of Houston by his interest in the oil and gas industry. At the Cullen College, he researches the potential for natural gas – or methane – to play a larger, more sustainable role in energy by forming chemical hydrocarbon derivatives, such as ethylene.

Do is looking for new ways to efficiently couple methane, which is a stable single-carbon molecule, to form ethane or ethylene, which are two-carbon molecules. Current methods rely on oxygen to facilitate the coupling process, but often result in undesirable byproducts, such as carbon monoxide and carbon dioxide.

To avoid creating these byproducts, Do is researching a “chemical looping process” using transition metals to break the hydrogen-carbon bonds in methane. In this novel process, the transition metal serves as the catalyst, pulling the hydrogen from the methane molecule to form a metal hydride. The metal hydride is then either heated or treated with oxygen in a reactor, which regenerates the original metal so that it can be reused as a catalyst. Ideally, this process would break one hydrogen from the methane, allowing the molecules to bond and form ethylene.

So far, however, the five transition metals Do has explored—scandium, titanium, yttrium, zirconium and hafnium—break all four of the hydrogen bonds in methane instead of just a single one. He said his next step is to test the chemical looping process using combined transition metals to achieve the desired result.

His poster, titled “The Catalytic Dehydrogenation of Methane Using Transition Metals as Hydrogen Storage Materials,” describes both his computational and experimental research, and elaborates on the next steps he plans to take in this work.

Though his research indicates more work ahead of him, Do said he felt confident about his presentation at the symposium. “I think the judges appreciated my presentation, overall – my explanation and enthusiasm for the work,” he said.

He also said that Grabow provides an important perspective as his faculty advisor, helping to keep him motivated and on track.

“I think a lot of grad students, especially engineering students, become so focused on their research that they can burn out,” he said. “[Grabow] is very encouraging. He recognizes that students need to push themselves but also explore their interests outside of the lab to produce good work.”

> “TALKING TO OTHER CHEMICAL ENGINEERS REALLY ENRICHED MY KNOWLEDGE AND HELPED ME THINK OUTSIDE THE BOX.”
>
> - MENGMENG LI

ONE UH CHEMICAL ENGINEERING STUDENT EARNS COVETED NSF RESEARCH FELLOWSHIP, ANOTHER RECEIVES HONORABLE MENTION

BY NATALIE THAYER

Chemical and biomolecular engineering graduate student Ricardo Sosa earned the coveted National Science Foundation (NSF) 2016 Graduate Research Fellowship.

The NSF Graduate Research Fellowship Program (GRFP) is a highly competitive and prestigious award open to undergraduate seniors and graduate students pursuing research-based master's and doctoral degrees in the STEM fields. It is the oldest graduate fellowship of its kind, and selected fellows receive an annual stipend for three years along with a tuition allowance and research and professional development opportunities.

Kyle Karinshak, a chemical engineering graduate student, received honorable mention for his application to the NSF GRFP. Honorable mention recipients are provided enhanced access to cyberinfrastructure resources, including supercomputing time, to support the completion of a research-based graduate degree.

This year, the NSF received nearly 17,000 applications and made only 2,000 award offers to students from across the nation representing a diverse array of scientific disciplines.

Joan Ferrini-Mundy, assistant director for education and human resources at the NSF, said that the GRFP is a vital part of the NSF's efforts to foster and promote excellence in the STEM fields. "These awards are provided to individuals who have demonstrated their potential for significant research achievements, and they are investments that will help propel this country's future innovations and economic growth," she said.

Ricardo Sosa – NSF GRF Recipient

Sosa, a native Houstonian, was first introduced to chemical engineering during his senior year of high school when Jeffrey Rimer, Ernest J. and Barbara M. Henley Associate Professor of chemical and biomolecular engineering at the Cullen College, was invited to his AP research and design class. The presentation ignited Sosa's interest in engineering and helped shape his future academic pursuits.

Sosa contacted Rimer the summer after his senior year of high school, which led to a position as a research assistant in Rimer's lab during his first semester at the Cullen College. Since then, Sosa has worked with Rimer to explore surface science and intermolecular interactions in relation to kidney stone formation.

Sosa said he was drawn to the research in Rimer's lab because of the interdisciplinary approach to engineering. "This project interested me because we are applying chemical engineering principles to the biomedical field," he said.

Outside the lab, Sosa serves on the Outreach Committee for the UH American Institute of Chemical Engineers (AIChE) student chapter. As co-chair of the committee, Sosa has coordinated outreach events in local high schools to introduce students to STEM disciplines. He said he feels like he's come full circle by sharing his experiences in order to encourage high school students to pursue engineering.

"I think it's important to get high school students interested in the STEM fields," he said. "When I was in high school, I didn't fully understand what I was getting myself into [by studying engineering]. Now I want to use my experiences to help make students aware and prepared."

Sosa began his graduate chemical engineering studies at the Cullen College this fall.

Kyle Karinshak – NSF GRF Honorable Mention

Before pursuing his doctoral studies at the UH Cullen College of Engineering, Karinshak attended a Research Experience for Undergraduates (REU) program at the University of Houston, which provides undergraduate students the opportunity to conduct hands-on research under direct supervision of a faculty member. Karinshak spent the summer working alongside William Epling, professor of chemical and biomolecular engineering at the Cullen College, to study nanoparticle catalysts and their reactivity.

Karinshak said that although the research he conducted during the REU program was quite challenging, he was impressed with the guidance and advice provided by Epling. Karinshak now works in Epling's lab exploring catalysis and reaction engineering, and is currently investigating the mechanism of sulfur poisoning in catalysis.

Karinshak also held a summer internship at NASA researching methods to improve the thermal propagation safety of space suit batteries. He said his REU experience was instrumental in securing his internship.

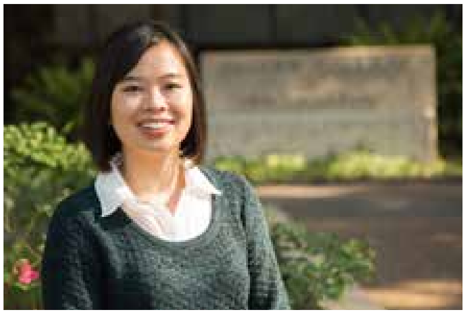
"I got the internship at NASA through contacts I made [at the Cullen College]," he said. "Being at the College has definitely opened up some interesting doors."

Karinshak received his bachelor's degree in chemical engineering from the University of Oklahoma and began his doctoral studies at UH in 2015.

"BEING AT THE CULLEN COLLEGE HAS DEFINITELY OPENED UP SOME INTERESTING DOORS."

- KYLE KARINSHAK

Opposite page: Ricardo Sosa | *This page: Kyle Karinshak*



UNDERGRAD STUDENT EARNS BARRY M. GOLDWATER SCHOLARSHIP HONORABLE MENTION

BY NATALIE THAYER

The Barry M. Goldwater Scholarship, created in honor of Senator Barry M. Goldwater, recognizes undergraduate students for outstanding research achievements. This year **Tam Nguyen**, a mechanical engineering undergraduate student at the Cullen College, received honorable mention for the scholarship.

Driven by her passion for solving complex problems and working with mechanical systems, Nguyen began pursuing her bachelor's degree in mechanical engineering at the Cullen College in 2014.

"When I see a problem with something in daily life, I often think about ways to solve or improve it," she said. "I find the process of finding a solution very gratifying."

As a research assistant for Haleh Ardebili, Bill D. Cook Assistant Professor of mechanical engineering, Nguyen studies the stretchability and ionic conductivity of porous solid polymer electrolytes for lithium-ion batteries. She said her research goals are to improve the safety and storage functions of lithium-ion batteries and to make them more affordable and accessible.

Nguyen is active on the UH campus, both in the lab and beyond. Earlier this year, she was recognized as the Cullen College's outstanding junior for her academic achievements. She was a recipient of the 2015 Summer Undergraduate Research Fellowship (SURF) at UH. During the fellowship, she studied how chaos theory causes inaccuracies in weather prediction under the guidance of Cullen College professor of mechanical engineering Ralph Metcalfe. She is also a member of the Honors College and the UH Society of Asian Scientists and Engineers (SASE) student organization.

After completing her undergraduate degree, Nguyen plans to pursue a doctoral degree in mechanical engineering with an emphasis on nanomaterials.

The annual list of scholarship and honorable mention recipients is publicized by the Goldwater Scholarship and Excellence in Education Foundation.

LEARN MORE ABOUT THE FOUNDATION AT https://goldwater.scholarsapply.org/.

HARVARD-AMGEN SUMMER PROGRAM FOR BIOTECHNOLOGY ADMITS UH ENGINEERING UNDERGRAD

BY NATALIE THAYER

This summer, a chemical and biomolecular engineering undergraduate student from the University of Houston Cullen College attended the 2016 Harvard-Amgen Scholars Program in Cambridge, Massachusetts.

The Harvard-Amgen Scholars Program is an immersive 10-week residential program for students pursuing research in biotechnology. Students admitted to the highly selective program are paired with world-renowned faculty mentors and postdoctoral scholars or graduate students who serve as director supervisors in the laboratory. Students participating in the program also have the opportunity to attend the 2016 National Amgen Symposium at the University of California, Los Angeles.

Rawan Almallahi, a junior at the UH Cullen College of Engineering, was invited to attend the Harvard-based program from a pool of top-notch students from across the nation. She was selected due to demonstrated academic success, an interest in biotechnology research and a commitment to the pursuit of a scientific career.

Under the guidance of her faculty advisor Megan Robertson, Almallahi researches the biodegradation of epoxy resins, a class of reactive prepolymers and polymers. Epoxy resins have a wide range of applications, including electronics, coatings, automobiles, and renewable and non-renewable energy sources. In particular, epoxy resins play an integral role in wind turbines used to generate energy.

But despite the widespread use of epoxy resins in the renewable energy sector, they often contain harmful chemicals and are not biodegradable. Almallahi is investigating ways to incorporate vegetable oil into these polymers to reduce their harmful effects on both human health and the environment. She began this research in Robertson's lab last fall and received a UH Provost's Undergraduate Research Scholarship (PURS) to continue the research in the spring of 2016.

Almallahi is also active on the University of Houston campus outside the laboratory. She holds an officer position with the Cullen College's Engineering Honor Society, Tau Beta Pi, and is actively involved with the organization's STEM educational outreach efforts.

Last summer, Almallahi worked on a project exploring graphene oxides for water treatment through the Harvard-Amgen Scholars Program. She said she was excited to be part of a new research community and learn about different aspects of the biotechnology field.

"I'm really interested in meeting new people, new faculty members, and seeing what projects others [in this research area] are working on," she said.

SPACE ARCHITECTURE STUDENTS WIN INTERIOR SPACECRAFT DESIGN COMPETITION

Canaan Martin

BY NATALIE THAYER

Brett Montoya and **Canaan Martin,** both space architecture graduate students from UH Cullen College of Engineering, won the Genesis Engineering Solutions (GES) Superior Design Award for their interior operational systems and layout design of a single-person spacecraft (SPS).

GES, an aerospace and technology company, sponsored the three-month national competition to encourage and integrate student creativity in the development of their SPS technology.

Students from an array of disciplines, including engineering, industrial design, human factors and space architecture, were challenged with developing creative internal designs for GES's SPS that included both functional elements, such as displays and controls, and "creature comforts" using only existing technologies.

A panel of esteemed judges, which included a former NASA astronaut and leaders in engineering and design from GSE, reviewed the design entries.

The judges awarded Montoya and Martin the superior design prize for their unique solution to the design challenges. Joe Fittipaldi, one of NASA's human factors experts who served as a competition judge, said he was particularly impressed by the attention Montoya and Martin paid to the human factors of their design.

"[They] paid careful attention to [ensure] a common viewpoint across the anthropometric scale," said Fittipaldi.

Though the competition focused on the interior layout and components of the SPS, Montoya said he had to consider the spacecraft holistically, as the sum of its parts, to successfully design the interior.

"In order to map the layout, I had to understand the control requirements for each system," he said. "As a result, my understanding of spacecraft systems [grew] immensely. I have Genesis Engineering to thank for that."

Montoya and Martin each took home $1,500 as recipients of the superior design prize. A team from Florida Institute of Technology took home the $2,500 Grand Prize.

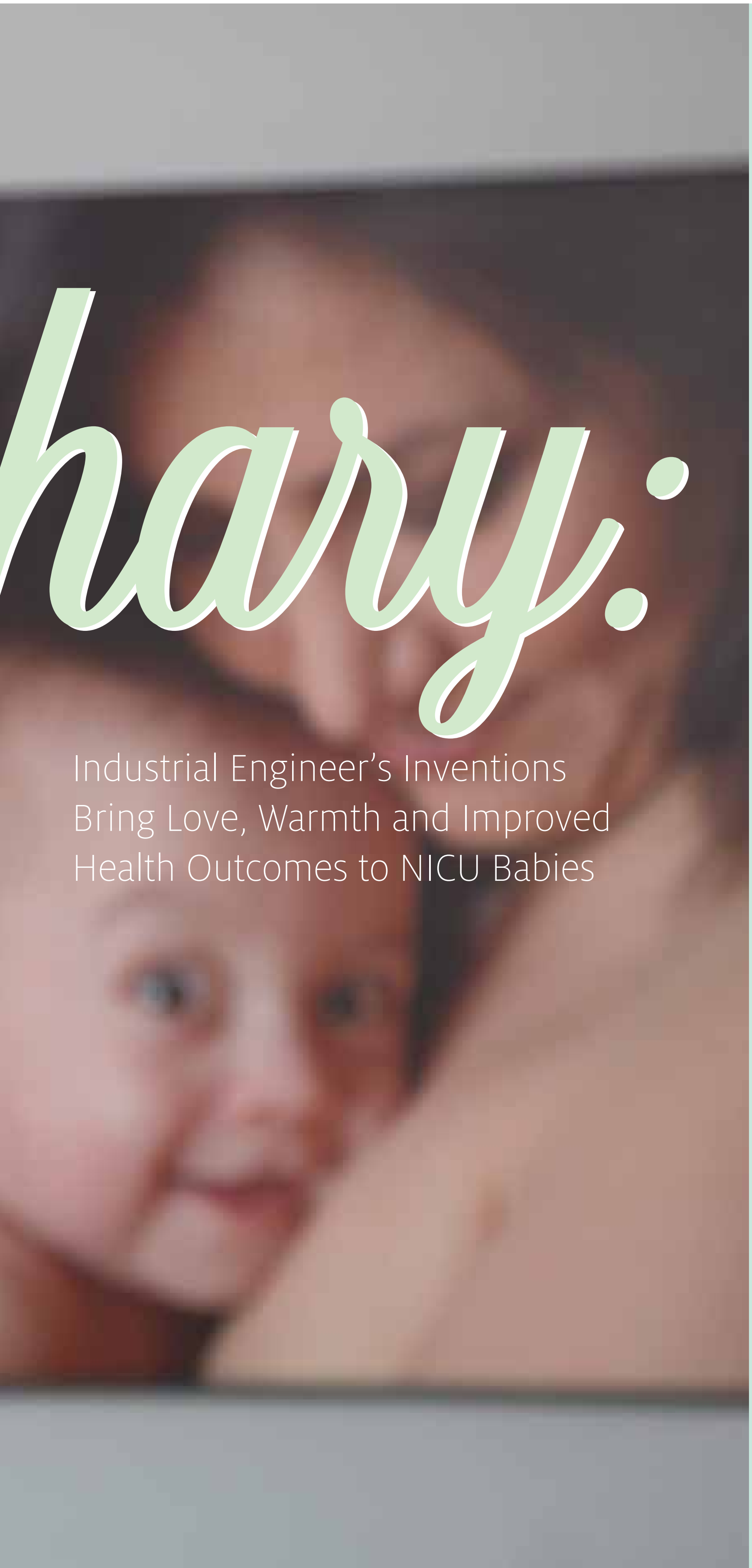
GES is based in Landham, Maryland. Since it was founded in 1993, GES has supported various NASA projects, including the Hubble Servicing Missions and the James Webb Space Telescope.

The UH Sasakawa International Center for Space Architecture (SICSA) offers the world's only master's degree in space architecture and provides students with an advanced interdisciplinary research, design and teaching center.

TO LEARN MORE
about the space architecture program at the UH Cullen College of Engineering, please visit sicsa.egr.uh.edu

ALUMNI FEATURE

On Behalf of Zac



hary:

Industrial Engineer's Inventions Bring Love, Warmth and Improved Health Outcomes to NICU Babies

- by Audrey Grayson -

It's no secret that having a baby is a life-changer. But in 2001, when **Yamile Jackson's** (BSIE '91, MSIE '94, Ph.D. IE '00) son, Zachary, was born 12 weeks prematurely, it changed her professional and personal life in ways she never imagined.

Before Zachary's birth, Jackson worked as an engineering management consultant in the oil and gas industry. In 1998, she opened her own consulting firm, Ringstones Consulting International, Inc., serving energy-giant clients including BP, Exxon and Chevron.

A few years later, Jackson became pregnant with Zachary.

During a routine prenatal check-up, doctors told Jackson she was suffering from severe preeclampsia, a dangerous complication that causes high blood pressure and organ damage in pregnant women. Jackson's condition was so serious that doctors recommended she immediately terminate the pregnancy to save her own life.

Two hours later, Zachary was born in Houston, Texas, weighing less than 2 pounds. Before the new mom could even touch her son for the first time, the newborn was rushed to the neonatal intensive care unit (NICU).

"It was a tragic moment. My son was born to save my life and I had to find ways to help save his," Jackson said.

For the next five months, Jackson remained at Zachary's side for 12 to 14 hours a day in the NICU – a place she said she didn't know existed before Zachary spent his first months in this world inside of one.

The pain and power of touch

It's difficult to imagine how unnatural a baby looks inside of an incubator before you see it yourself, Jackson said as she turned the pages of a large, homemade scrapbook. She stopped at a page with a photo of Zachary inside of an incubator, tubes covering his tiny chest.

Many of Zachary's first experiences with human touch were not warm and loving – they brought the pinch of a needle or the poke of a tube. Babies like Zachary who have prolonged stays in the NICU often develop an aversion to touch as a result of these distressing experiences. Knowing this, Jackson spent as much time as possible holding and touching Zachary, hoping he would learn that touch doesn't always bring pain – it can bring warmth, love and healing, too.

"To me, unless the parent is very involved in comforting the baby, the NICU must feel more like a prison to the newborn. They are in complete isolation, away from any positive stimulation, confined to a glass box, and often swaddled without the possibility of moving," Jackson said.

As a scientist, Jackson wondered how a baby as small as Zachary could survive, grow and thrive in such a harsh environment, so unlike the comfort of a womb. As an engineer, she was determined to find the answers to her questions and to provide Zachary with the warmth of knowing she was there and she loved him.

"I had a lot of tools in me that I acquired in my life and my profession in industrial engineering. I had to tap into everything I knew, everything I had," Jackson said.

So while Zachary began healing, Jackson began drawing on her industrial engineering background, ergonomics theories, data and methods to find ways to optimize human well-being. Traditionally, industrial engineers apply ergonomics to adults and adult processes, equipment and systems, but Jackson dreamed of tailoring it for Zachary.

"I saw ergonomics all around the NICU – in the equipment and devices that medical staff would use to help the babies. But I didn't see ergonomics applied specifically to help with the development, nurturing and growth of the babies," Jackson said.

On behalf of Zachary

"My professors said that the best engineers and ergonomists were those who experienced and understood a problem firsthand before they attempted to find a solution," Jackson said. "I was determined to apply my skills and my background in ergonomics and human factors to make Zachary's life in the NICU as full of love, warmth and nurturing as possible. Only I could do that for Zachary."

Three weeks into Zachary's stay at the NICU, Jackson's resolve was put to the test when Tropical Storm Allison hit the Texas Gulf Coast, causing devastating flooding throughout the Houston region and shutting down all power to the hospital. Zachary's life-support systems were disconnected and the hospital staff tried desperately to evacuate him and the other 78 NICU babies to other hospitals.

The NICU staff, Jackson and her husband, Larry, worked for 9 hours to keep their critically ill son alive. Jackson held Zachary to her bare chest to keep him warm while her husband and the medical staff took turns pumping oxygen into his lungs by squeezing a small rubber bag.

"I promised Zachary that his fight to survive would not be in vain," Jackson said. "I promised him that I would do something to help other babies like him – not in his memory, but on his behalf."

After experiencing firsthand the importance of skin-to-skin contact and family involvement in neonatal care practices, Jackson began researching how she could use the warmth of her touch to nurture Zachary – even after visitors' hours ended at the hospital and she was forced to leave her son overnight.

"A mother's hands, a mother's touch – these are so vital to premature babies," Jackson said. "Leaving Zachary alone and going home without him each night was pure agony. As a mother, I knew my hands held the power to heal my son. As an engineer, I was determined to use that knowledge to save Zachary and help other premature babies and their parents."

she was holding him.

"Even though I had to leave him, he could still smell me, he could still feel my touch and warmth," Jackson said.

Zachary was 5 months old when he was discharged from the hospital. Soon after, nurses in the NICU began asking Jackson about the homemade glove that gave Zachary so much comfort. Within a few weeks, Jackson made 100 more pairs and left them with the NICU staff.

Instead of returning full-time to her career as an energy industry consultant, Jackson decided to apply her industrial engineering skills to researching, testing and developing a new, more ergonomic prototype of The Zaky that would help with positioning, transitions and bonding for every baby, regardless of size,

Over the years, Jackson's story has served as the subject of newspaper and magazine articles, documentaries and even a made-for-TV movie. But the best vote of confidence for her work, Jackson said, has come from e-mails and phone calls from parents wanting to thank the woman who engineered a more loving world for their child to enter into.

"I hear from mothers, fathers, nurses and medical staff from all over the world who tell

> *"I promised [Zachary] that I would do something to help other babies like him – not in his memory, but on his behalf."*
>
> - YAMILE JACKSON

And so, a few days after Zachary was born, so was "The Zaky."

The Zaky

The first prototype of The Zaky was a gardening glove filled with soft beads and infused with Jackson's scent. When she was able to hold her son in the hospital, Jackson held his tiny body in The Zaky glove. When she had to leave him in the evening, she would place Zachary in the glove just as he had been when

medical condition or developmental stage.

After three years of research and development, Jackson launched her company, Nurtured by Design, and began selling The Zaky, the world's only evidence-based, ergonomic and multifunctional tool for providing nurturing developmental care to babies. The company has launched more products since then, including The Kangaroo Zak, a safe and ergonomic device to facilitate skin-to-skin contact between parents and newborns. Both The Zaky and The Kangaroo Zak are used in over 300 hospitals and thousands of homes across the world.

Within months of launching the company, Jackson began winning national and international awards for her invention. In 2010, Jackson won the Blazing Star Award from the Women's Chamber of Commerce of Texas, and she was named one of the top 20 Latino innovators of 2012 by NBC Latino. Two years later, Jackson and Zachary accepted a Standing O-Vation Award from Toyota and Oprah Winfrey, which included a $25,000 grant to continue Nurtured by Design's mission.

me how our products changed their babies' lives for the better. That is my motivation to keep going – that and, of course, Zachary," Jackson said.

Today, Zachary is a happy, healthy and active 15-year-old with an impressive title – Chief Inspirational Officer (CIO) of Nurtured by Design. Like his mother, Zachary is inspired to pursue engineering as a career and said he wants to attend the University of Houston.

Jackson hopes that her story will also inspire more women to pursue engineering as a career, and for more engineers to apply their talents to help women and children all over the world.

"We need more engineers working for mothers and children. We need more women to pursue engineering, because we can view, analyze and solve problems from a different perspective," Jackson said. "I am glad that I use my ergonomics and human factors background to make a difference in the lives of the most vulnerable members of our society – on behalf of Zachary."

ENGINEERING ALUMNI ASSOCIATION AWARDS $45K TO STUDENTS DURING E-WEEK

BY NATALIE THAYER

On February 23, the Cullen College's Engineering Alumni Association (EAA) hosted the 12th annual E-Week reception in honor of National Engineers Week. More than 200 people attended the reception held in the UH Hilton's Waldorf Astoria Ballroom.

This year, the EAA raised $45,000 in scholarships for Cullen College students and student organizations. At the reception, 66 students and several student organizations received scholarships and awards for academic excellence, community outreach and leadership, among other distinctions.

The UH Petroleum Engineering Advisory Board was this year's top sponsor with a donation of over $10,000. Several other companies, organizations and individuals contributed to the scholarship and award fund, including the American Association of Drilling Engineers Houston Chapter, American Society of Indian Engineers, Black Cougar Engineers, BP, Cameron, Civil Engineering Cougars, CobbFendley and Associates, Energy Women Engineers, ExxonMobil Women Cougar Engineers, Fluor Corporation, Friends of Cougar Biomedical Engineering, Phillips 66, Ryder Scott Company, Friends of UH PE, Shell Oil Company, UH Society of Women Engineers, UH Petroleum Engineering Advisory Board, UH PROMES Alumni and the UH EAA.

Since its inception, the EAA has raised more than $428,000 in scholarships to support students of the Cullen College.

LEARN MORE
about the UH Engineering Alumni Association at https://www.egr.uh.edu/eaa/welcome

LEARN MORE
about the EAA's E-Week reception at www.egr.uh.edu/eaa/activities/eweek

MARATHON OIL DONATES $35K MODEL SHIP TO THE CULLEN COLLEGE

BY NATALIE THAYER


Tom Holley (left) accepts model ship from Marathon Oil

Marathon Oil gifted a model Alvheim floating production, storage and offloading (FPSO) ship to the petroleum engineering department at the UH Cullen College of Engineering.

Last year, the energy giant put out an open call to all Texas universities to compete to win the model ship. To enter the competition, schools were required to submit proposals that detailed their connection to the company and how they would utilize the model. The University of Houston was announced as the winner in early 2016 and the model was installed on the campus last February.

The model, elaborately detailed and valued at $35,000, is on display in front of the petroleum engineering academic advising offices inside of Building 9 at the Energy Research Park.

This gift is the latest milestone in a longstanding partnership between Marathon Oil and the UH Cullen College of Engineering. The company played an integral role in the relaunch of the bachelor's program in petroleum engineering at UH, and has remained a major proponent of the program ever since. Marathon Oil was one of the program's first donors, contributing $600,000 at the program's inception in 2009. Representatives from the company also serve as members of the Petroleum Engineering Industry Advisory Board (IAB), which offers feedback and advice on the program's curriculum from the perspective of industry professionals.

Cathy Krajicek, vice president of technology and innovation at Marathon Oil, is the newest Marathon Oil representative to join the Petroleum IAB. Krajicek works closely with Bryan Wallace, the project manager for the actual Alvheim FPSO ship, which is stationed off the coast of Norway. Wallace said he is proud to represent the team that made the Alvheim FPSO ship a reality from concept to operation with this donation.

"This model provides students with an excellent visual of a world-class FPSO facility and subsea development," Wallace said.

Thomas Holley, former interim chair of the petroleum engineering department at the Cullen College, added that the model serves as a valuable educational tool.

> "WE VALUE OUR RELATIONSHIPS WITH UH AND ITS FACULTY AND STUDENTS. TODAY'S STUDENTS ARE OUR FUTURE TALENT." - CATHY KRAJICEK

"Students learn in different ways, so seeing something in three dimensions can be very beneficial," he said. "[A model] also helps students understand scale."

When an oil well is located far from shore or in ultra-deep water, a traditional pipeline may not be practical, efficient or cost effective. FPSO ships provide an alternative for storing and transferring oil and gas in such circumstances. These FPSO ships store oil and gas pumped from the oil well while smaller ships transport the oil and gas from the FPSO ship to the shore.

Marathon Oil continues to invest in the Cullen College's petroleum engineering department and students by donating money for undergraduate scholarships and developing research agreements for graduate students.

Holley said he believes Marathon Oil sees such investments pay off in the quality of Cullen College graduates.

"I know that managers look for employees who are flexible and willing to work – and our students are," he said. "They're willing to jump in and do whatever's necessary."

During periods of downturn in the oil and gas industry, it is especially important to continue inspiring students across the nation to pursue STEM paths in college, Krajicek said.

"We value our relationships with UH and its faculty and students. Even through the current market down-cycle, we continue to seek out creative ways to help inspire students to pursue careers in science, technology, engineering and math. Today's students are our future talent," she said.

Holley said the petroleum engineering department is deeply grateful to Marathon Oil for their continued support.

"We wouldn't have gotten where we are today without their support from the beginning," he said.

Marathon Oil Corporation is a global petroleum and natural gas exploration and production company headquartered in downtown Houston, Texas.

ALUMNUS ESTABLISHES $50K ENDOWED SCHOLARSHIP FOR UH CHEMICAL ENGINEERING STUDENTS

BY NATALIE THAYER

Chemical engineering alumnus **Mike Piwetz** and his wife **Mary Jo Piwetz** will establish a $50,000 endowed scholarship for chemical engineering students at the UH Cullen College of Engineering in 2017. This endowment follows a similar one established this year for the College of Technology Construction Management Program.

The Piwetz's ties to the University of Houston run deep. Mike's father, Florian W. Piwetz, graduated from the UH Cullen College of Engineering in 1950 with a bachelor's degree in industrial engineering. Florian married his wife Effie during his undergraduate education at UH, and was the first in his family to earn a college degree.

Mike and Mary Jo met at the University in 1969, when Mike was pursuing his undergraduate degree in chemical engineering from the Cullen College and Mary Jo was pursuing her undergraduate studies in special education. Three years later, the couple married on campus at the University Chapel.

Much like his father before him, Mike said that he and Mary Jo pursued their college courses with very limited funds. Mike and Mary Jo said they were inspired to establish their endowed scholarship to help ease the financial burden of current UH Engineering students. Moreover, the couple said they were moved to support the University to honor the Piwetz family legacy at UH started by Florian.

"My engineering education led to a very satisfying career, and [with this scholarship] I want to help give other people that opportunity," Mike said.

Mary Jo added that the University has played a big part in their lives and has contributed to them being where they are today.

"We feel blessed to be able to contribute in this way," she said.

Upon graduation from the Cullen College, Mike began an extensive career with the global engineering construction company Fluor. He remained actively involved with UH throughout his career, playing a major role in the development of academic programs at both the Cullen College of Engineering and the College of Technology.

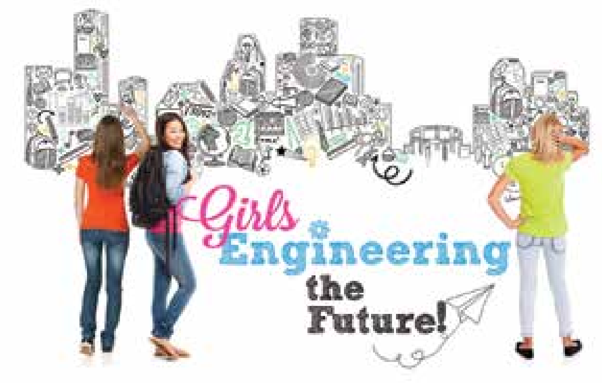
Over the years, Mike has served on the Chemical Engineering Industry Advisory Board (IAB) and the Engineering Leadership Board at the Cullen College, as well as on the IAB for the College of Technology. He also served as Fluor's executive sponsor to UH, responsible for the administration of grants to the University, and was the chairman of the committee responsible for fundraising over $10 million for UH's Sugar Land expansion.

Mike retired from Fluor in 2009 as the Vice President of Process Engineering, but remains dedicated to the future of engineering and construction careers through education. He said he recognizes that many UH students face unique challenges pursuing their education, especially students who work full time and attend classes simultaneously.

"It can be a struggle to work and go to college at the same time," he said. "We want to help ensure these students' success."

To be eligible for the Piwetz Family Engineering Scholarship Endowment, students must major in chemical engineering, have a minimum GPA of 3.25 and be enrolled full-time in either junior or senior level courses. Students' demonstrated leadership qualities will also be considered for this scholarship.

TO VIEW ALL OF THE ENDOWED SCHOLARSHIPS AT THE CULLEN COLLEGE, PLEASE VISIT http://advancement.egr.uh.edu/giving-opportunities/ways-give.



CHEVRON INSPIRES GIRLS TO ENGINEER THE FUTURE AT UH

The inaugural "Girls Engineering the Future!" event, sponsored by Chevron and hosted by the Cullen College last April, introduced over 300 girls in grades 4th through 8th to engineering principles through fun, hands-on activities on campus.

2016 G.R.A.D.E. CAMP

In an effort to address the critical shortage of women in STEM (science, technology, engineering and math) fields, the UH Cullen College of Engineering hosts G.R.A.D.E. (Girls Reaching and Demonstrating Excellence) Camps each summer to introduce female high school and middle school students to the field of engineering. Last summer, the college hosted two week-long G.R.A.D.E. Camp sessions for girls in 8th-12th grade.

2016 ENGINEERING ALUMNI ASSOCIATION GALA

The Engineering Alumni Association (EAA) hosted its annual Alumni Awards Gala on June 9 at the Hilton Americas in downtown Houston. The EAA Gala was established in 1987 to recognize alumni, faculty and friends of the UH Cullen College of Engineering for significant contributions to society and the profession. Proceeds from the event are used by the EAA to help further the goals of the Cullen College and its students.

2016 SPRING CONVOCATION AND GRADUATION

Nearly 500 Cougar engineers celebrated with their families and friends at the Cullen College of Engineering convocation and University-wide graduation ceremony last May.





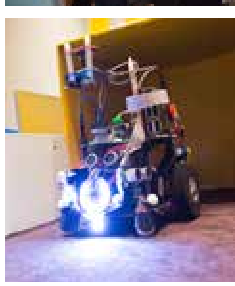



12TH ANNUAL GRADUATE RESEARCH AND CAPSTONE DESIGN CONFERENCE

The UH department of electrical and computer engineering hosted the Graduate Research and Capstone Design Conference (GRC/CDC) on April 29 at the UH Hilton. The day-long event included technical sessions in which graduate and undergraduate student research and projects were presented.

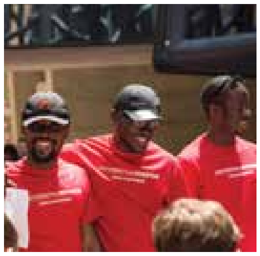










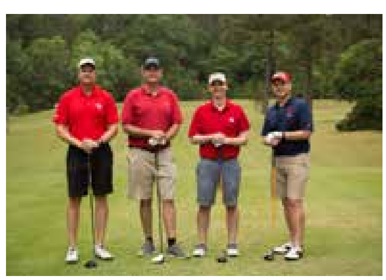

FIFTH GRADERS GAIN "PASSPORT" TO ENGINEERING AT UH

Last April and May, the UH Cullen College of Engineering bustled with activity as local fifth graders from EC Mason Elementary and Memorial Elementary participated in the "Passport to UH" event hosted by the subsea engineering program. The event aims to excite elementary school students about attending college and introduces them to the field of engineering.







2016 GOLF TOURNAMENT

Last April, the Cullen College's annual Engineering Golf tournament brought together more than 100 faculty, staff, alumni, industry professionals and top students to raise funds for UH Engineering student scholarships.

View more photos from the UH Cullen College of Engineering at

www.egr.uh.edu/news/photo-gallery

or on our Flickr page

www.flickr.com/photos/CullenCollege

ENGINES OF OUR INGENUITY:

Excerpted from "Kong Lives" Episode No. 2043

I got right in line to see the 2005 version of the movie "King Kong." How could I not? The first one came out when I was only three and, when I finally got to see it, I was quite blown away. I was disappointed by the 1976 version. But now this:

I left the theater more baffled than ever by the power of something so easy to shrug off as just another special effects tour-de-force. Writer Tom Huntington credits the 1933 "King Kong" with having the greatest special effects ever done. That's in relation to the technology and the expectation of the times. Its genius, Willis O'Brien, had worked in movies from their inception. For "King Kong" he built many models, Kong's full-size, pneumatically-operated head and one full-sized hand. He also used every kind of trick photography.

The original also combined fine black-and-white camera work with complex and sensitive management of the new medium of film audio. But its atavistic concept is what reached its audiences – an ancient idea of love between beauty and beast. First Faye Wray, then Jessica Lange, became indelibly linked to the role of Ann Darrow – the woman who ultimately tamed the great ape.

When Hugh Heffner met an aging Faye Wray, he told her how much he'd liked her movie. Wray shot back, "Which one?" "King Kong" was only one of her 98 movies. Jessica Lange has since made 34 movies, but who can forget her Ann Darrow. Now I've seen the new "King Kong," and I know that, years hence, someone will tell Ann Darrow's latest incarnation, Naomi Watts, "I loved your movie."

Even all today's glorious special effects remain filler around that central story of Darrow and Kong. And yet the special effects are crucial. To give gravity to the ageless story of hopeless love between beauty and beast, special effects people have to infuse it with menace. To love the beast is to stand in the way of terrible dangers.

Then there's the flip side: to love beauty is to become enslaved by it. And, in this movie, that process reminds us of us and the beautiful kitten who owns us. In the role of Ann Darrow, Watt's playfulness wins Kong's heart just as surely as our kitten wins ours.

In a last moment of poignant quiet, before the airplanes come, Kong and Darrow play on the ice and snow of Central Park – suspended in the pure joy of one another's company. Movie critic Roger Ebert, who calls this "King Kong" one of the year's best movies, believes it's about the way beauty always threatens to overwhelm us.

The traditional last line of the movie is, "Oh no, it wasn't the airplanes. It was beauty killed the beast." 97-year-old Fay Wray was to have spoken the line in the new version, but she died before she could, and Kong ends as he always has. Once more slain, he lies upon Fifth Avenue while flash bulbs pop – and Ann Darrow weeps for the beauty of her lost beast.

John Lienhard

The Engines of Our Ingenuity is a nationally recognized radio program authored and voiced by John Lienhard, professor emeritus of mechanical engineering and history at the University of Houston and a member of the National Academy of Engineering. The program first aired in 1988, and since then more than 2,800 episodes have been broadcast. For more information about the program, visit www.uh.edu/engines.

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