Spring 2016

Parameters

Cullen College of Engineering Magazine

UNIVERSITY of HOUSTON | ENGINEERING

SMALL IDEAS / BIG IMPACTS

THE ENTREPRENEUR ISSUE

ENGINEER YOUR FUTURE

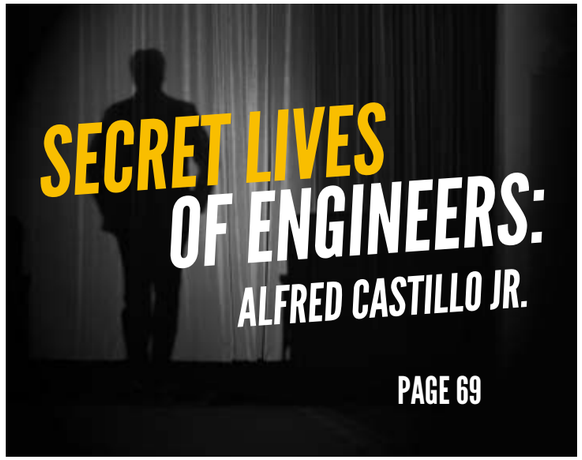
ONLINE LEARNING PROGRAMS

Online learning programs at the UH Cullen College of Engineering aren't your standard online courses. The flexible and innovative digital programs in engineering include live videos of lectures, interactive web-based discussions and opportunities for one-on-one learning experiences.

All of our online engineering programs are specifically designed for working engineers, offering the same rigor of face-to-face classes with the added flexibility of learning whenever and wherever you choose! Most importantly, the degrees earned through the Cullen College's online programs are exactly the same degrees earned by students who choose to attend classes on campus.

LEARN MORE AT
onlinelearning.egr.uh.edu

PAGE 34



Cullen College of Engineering

Dean
Joseph W. Tedesco

Associate Dean for Research & Facilities
Hanadi Rifai

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

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

Parameters

Parameters is published biannually by the University of Houston Cullen College of Engineering, Office of Communications.

Communications Director
Audrey Grayson

Creative Director/Graphic Designer
Rachel Ward

Communications Coordinator
Natalie Thayer

Photographer/Videographer
Carlos Landa

Writer
Elena Watts

Contributing Writers
Jeannie Kever | John Lienhard
Natalie Thayer | Ashley Schwartz

Contact us:
University of Houston
Cullen College of Engineering
Office of Communications
Engineering Building 2
4722 Calhoun Road, Suite E301
Houston, Texas 77204-4009

Phone 713.743.4217
Fax 713.743.8240
E-mail parameters@egr.uh.edu
Website www.egr.uh.edu

Academic Departments

Biomedical Engineering
Chair: Metin Akay
Web: www.bme.uh.edu
832-842-8813

Chemical & Biomolecular Engineering
Chair: Mike Harold
Web: www.chee.uh.edu
713-743-4300

Petroleum Engineering
Chair: Thomas Holley
Web: www.petro.uh.edu
832-842-4848

Civil & Environmental Engineering
Chair: Roberto Ballarini
Web: http://www.cive.uh.edu
713-743-4250

Electrical & Computer Engineering
Chair: Badri Roysam
Web: www.ece.uh.edu
713-743-4400

Industrial Engineering
Chair: Gino Lim
Web: www.ie.uh.edu
713-743-4180

Mechanical Engineering
Chair: Pradeep Sharma
Web: www.me.uh.edu
713-743-4500

Office of Advancement
Mail: University of Houston
Cullen College of Engineering
Engineering Building 2
4722 Calhoun Road, Suite E421
Houston, Texas 77204-4007
Web: advancement.egr.uh.edu

cullen college news
@uhengineering
uhengineering
UHCullenCollege
University of Houston Cullen College of Engineering

UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

DEAN'S LETTER

Some of the greatest scientific achievements known to man came about not by intellect alone, but by accident combined with imagination. Creativity may be undervalued in modern science, though it is in no short supply among students and faculty in the University of Houston's Cullen College of Engineering.

In this issue of *Parameters Magazine*, we focus on the small things – that little spark of curiosity felt when viewing a tiny detail of daily life in a new way – and what happens when these tiny moments, these little ideas, inspire people to do big things.

Our students and professors aren't just motivated to conduct high-quality research; they are motivated to conduct research that has an immediate impact in the lives of people all over the world. Finding solutions to the grand challenges of engineering embodied in our city and our world requires more than knowledge. Engineers must be creative to find solutions to the problems we face as a society, and it is my belief that creativity takes courage.

UH engineers have the creativity to look at an old problem in a new way, and the courage to follow their imaginations in order to identify novel solutions. The same creativity and courage that inspires their research also spurs many UH engineers into entrepreneurial pursuits to bring their life-altering ideas and inventions out of the laboratory and into the consumer marketplace.

I invite you to learn more about these amazing stories in this special issue of *Parameters Magazine*!

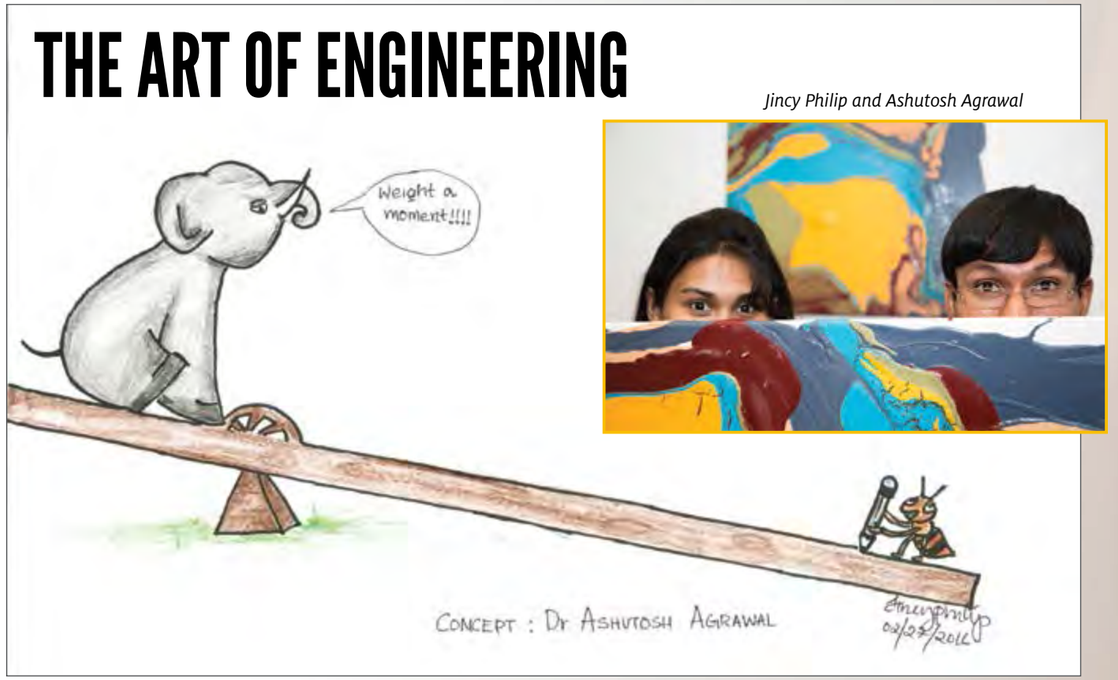
Warm regards,

Joseph W. Tedesco

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

THE ART OF ENGINEERING

Jincy Philip and Ashutosh Agrawal



The cartoon above is part of a new initiative to explain science concepts using cartoons, called "scientoons." This scientoon illustrates the physics principle of moments, which are calculated by multiplying force and distance. In the example above, though the weight, or force, of the elephant is much greater than the ant, the elephant remains in the air because he is much closer to the axis of the seesaw than the ant is.

About the Artist:

MEET ENGINEERING UNDERGRAD JINCY PHILIP

Mechanical engineering junior **Jincy Philip** always knew she was an engineer at heart. In the fourth grade, Philip said she was taking clocks apart to understand their inner workings, but it wasn't until high school that she discovered her passion for illustrating. Philip credits her high school art teacher with helping her discover and cultivate her artistic skills, which grew from drawing to include watercolor and oil painting.

Philip said she was always interested in combining her artistic and scientific pursuits, but hadn't found a way to do so until working with Ashutosh Agrawal, assistant professor of mechanical engineering at the Cullen College.

"I used to think [art and science] were two completely different worlds, but Dr. Agrawal helped me see there is a connection," she said.

Agrawal encouraged Philip to marry her artistic and scientific talents by illustrating engineering concepts with cartoons. So far, Philip has completed three engineering-influenced cartoons, and said she plans on submitting the best for publication in newspapers, journals or magazines.

"I think it's a unique and fun way to engage people, especially young children and non-scientists, with science and engineering," Philip said.

UH ENGINEERING CLIMBS U.S. NEWS RANKINGS, EARNS SPOT ON LIST OF NATION'S BEST SCHOOLS

The UH Cullen College of Engineering is well on its way to becoming a Top 50 engineering college in the nation, earning a coveted spot on the list of the Best Engineering Schools of 2017 by *U.S. News and World Report*.

The Cullen College climbed from #76 to #73 in the most recent *U.S. News and World Report* national rankings for graduate-level engineering programs. Moreover, five graduate programs within the college – civil, mechanical, computer, electrical and chemical engineering – earned the status of Best Engineering Programs of 2017.

Many of the Cullen College's graduate programs were ranked among the top in the nation, including chemical engineering (#33), industrial engineering (#53), civil engineering (#62) and environmental engineering (#64).

"We are a college on the move, and the most recent *U.S. News and World Report* rankings are a wonderful reflection of this," said **Joseph W. Tedesco**, Elizabeth D. Rockwell dean of the UH Cullen College of Engineering.

U.S. News and World Report is a leading source for rankings of colleges, graduate programs, hospitals, mutual funds and cars. Each year, the publication ranks professional school programs in business, education, engineering, law, medicine and nursing. The data for the rankings come from statistical surveys of more than 1,900 programs and from reputation surveys sent to more than 18,400 academics and professionals.

Suresh Khator, associate dean of graduate programs and computing facilities at the Cullen College, said the recent rankings reflect not only the success of the college's professors and students, but also the relevancy of its programs to the city of Houston and the entire nation.

"Graduate programs at the UH Cullen College of Engineering are designed to immerse students in the grand challenges of engineering represented in our city, and our programs encourage students to conduct research that finds solutions to some of the most pressing challenges facing our city and our world," Khator said.

"UH engineers are making major contributions to society both nationally and globally, and it is wonderful to see our programs recognized among the best in the country," he added.

More than 5,000 students are enrolled in engineering courses — 3,759 undergraduates as well as 1,312 master's and doctoral students in biomedical, chemical, civil, computer, electrical, environmental, geosensing systems, industrial, mechanical and petroleum engineering. The college also offers interdisciplinary graduate programs in subsea, aerospace, materials, and computer and systems engineering.

The Cullen College's graduate programs in computer, electrical and mechanical engineering were also ranked among the Top 100 programs in the country.

FOR THE FULL LIST OF RANKINGS
from *U.S. News and World Report*, please visit http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools

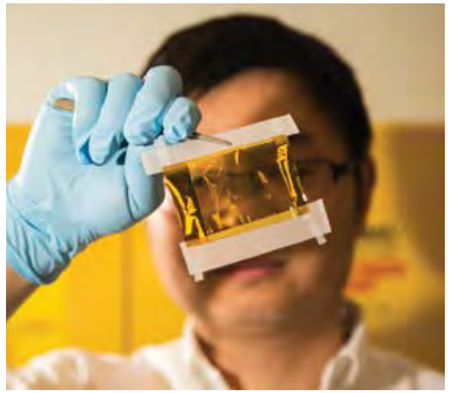
HOW WE STACK UP

THE CULLEN COLLEGE'S GRADUATE PROGRAM RANKINGS

OVERALL	#73
CHEMICAL ENGINEERING	#33
INDUSTRIAL ENGINEERING	#53
CIVIL ENGINEERING	#62
ENVIRONMENTAL ENGINEERING	#64

> "WE ARE A COLLEGE ON THE MOVE, AND THE MOST RECENT U.S. NEWS AND WORLD REPORT RANKINGS ARE A WONDERFUL REFLECTION OF THIS."

NAVAL RESEARCH GRANT WILL SPEED UH WORK ON MATERIALS, ENERGY



A grant from the Office of Naval Research will help researchers from across the University of Houston's Cullen College of Engineering to more efficiently test advanced materials being developed with funding from the Department of Defense.

Venkat Selvamanickam, M.D. Anderson professor of mechanical engineering, said he will use the $810,000 grant from the Office of Naval Research to purchase a physical properties measurement system (PPMS), which will allow researchers to more quickly test the advanced materials being produced in their laboratories.

Selvamanickam, who also is director of the Applied Research Hub at the Texas Center for Superconductivity at UH (TcSUH), said the new equipment will allow his lab to expedite its research on the development of improved superconducting wire.

The money comes from an Office of Naval Research (ONR) program to fund new equipment needed for research sponsored by that office or other Department of Defense research programs.

The new PPMS will benefit a variety of materials research, including solar cells, batteries, graphene, thermoelectrics and flexible electronics. It will allow testing at a wider range of temperatures, from near 0 degrees Kelvin to room temperature, and over a wide range of magnetic fields, up to 140,000 gauss. That's up from 90,000 gauss for the current equipment, which also is limited to use only for superconductor wires.

Yan Yao, assistant professor of electrical and computer engineering at the Cullen College, is among the other faculty who will use the new equipment. His research group focuses on green and sustainable organic materials for energy generation and storage. He also is a principal investigator for TcSUH.

"With the addition of PPMS, we will be able to obtain a fundamental understanding of how the transport properties of two-dimensional layered metal chalcogenides are influenced with the change of interlayer distance and the pillar materials," he said. That should offer valuable feedback for an effort funded by the ONR's Young Investigator Program to design better magnesium-ion intercalation materials.

Joseph W. Tedesco, Elizabeth D. Rockwell dean of the Cullen College of Engineering, said the new testing system has the potential to double the number of samples tested each week, in addition to providing a much wider range of information from each test.

"Many of our UH engineers are investigating novel materials with better properties for applications ranging from energy storage to healthcare," Tedesco said. "As the volume of novel materials discovered and tested by UH engineers continues to grow exponentially, so will UH's reputation as the epicenter of materials engineering research and education."

MORE TEXAS TEENS WANT TO BE ENGINEERS WHEN THEY GROW UP

A whopping 13 percent of Texas teens who took the 2015 SAT test indicated that they intended to study engineering in college. Engineering was listed as the second-most popular career choice for Texas teens – 22 percent of students who reported their future plans indicated they were interested in healthcare professions.

These trends coincide nicely with recent employment projections from the Texas Workforce Commission, which found that the fastest-growing occupations in Texas are in the health, medical and engineering fields.

READ MORE
about this in the *Dallas Morning News* at http://educationblog.dallasnews.com/2015/11/what-do-texas-teens-want-to-be-when-they-grow-up-apparently-doctors-and-engineers

BIOMEDICAL & PETROLEUM ENGINEERING UNDERGRAD PROGRAMS RECEIVE ABET ACCREDITATION

BY AUDREY GRAYSON

The University of Houston Cullen College of Engineering's bachelor's degree programs in biomedical engineering and petroleum engineering have been accredited by the Engineering Accreditation Commission of ABET, the global accreditor of college and university programs in applied science, computing, engineering and engineering technology. All of the UH Cullen College of Engineering's undergraduate programs are now ABET accredited.

ABET accreditation assures that programs meet standards to produce graduates ready to enter critical technical fields that are leading the way in innovation and emerging technologies, and anticipating the welfare and safety needs of the public.

Joseph W. Tedesco, Elizabeth D. Rockwell dean of the Cullen College of Engineering, said that the biomedical engineering program was established to help meet the growing demand for qualified graduates in the field across the city of Houston and the world.

"Biomedical engineering is one of the fastest growing disciplines in engineering, and the city of Houston is home to the largest medical center in the world," Tedesco said. "As Houston's University, we have a responsibility to ensure that the Cullen College is graduating a growing number of highly-skilled, world-class biomedical engineers into the local economy each year."

> "AS HOUSTON'S UNIVERSITY, WE HAVE A RESPONSIBILITY TO ENSURE [WE ARE] GRADUATING HIGHLY-SKILLED, WORLD-CLASS ENGINEERS."

Increasing enrollment would help to generate a talented pool of graduates expected to help staff the biomedical engineering field, which will see faster than average job growth in coming years. Employment of biomedical engineers is projected to grow 27 percent between 2012 and 2022, according to the U.S. Bureau of Labor Statistics. The federal agency attributes the rise in demand for biomedical engineers to the aging population and the need for more sophisticated medical equipment and procedures.

Graduates of the biomedical engineering bachelor's program are prepared for careers in the biomedical technology industry, graduate school or professional programs such as engineering, medicine, business and law.

The bachelor's degree option in petroleum engineering was launched in the fall of 2009 to counteract the critical shortage of talent needed to replace the industry's aging workforce. Since then, the undergraduate petroleum engineering program was highlighted as a model partnership between industry and academia by the Business-Higher Education Forum (BHEF) in 2013.

With significant support from the petroleum sector, the B.S. program in petroleum engineering was established at the University's Energy Research Park (ERP). The program has received support from ConocoPhillips, Devon Energy, Marathon Oil, Southwest Energy, El Paso Corporation, the Society of Professional Engineers Gulf Coast Chapter and major private donors.

Companies and individuals in the field provided the program with funding that has allowed it to build essential facilities such as labs and classrooms and provide students with scholarship funding.

Industry members also serve on the petroleum engineering advisory board, where they help design a curriculum that addresses the realities of the modern petroleum sector. According to the BHEF report, the curriculum addresses the "evolution in the industry toward new technologies that allow engineers to access previously unreachable energy sources." Students gain a solid grounding in the full span of upstream petroleum engineering, including drilling, formation evaluation, production and reservoir engineering.

To learn more

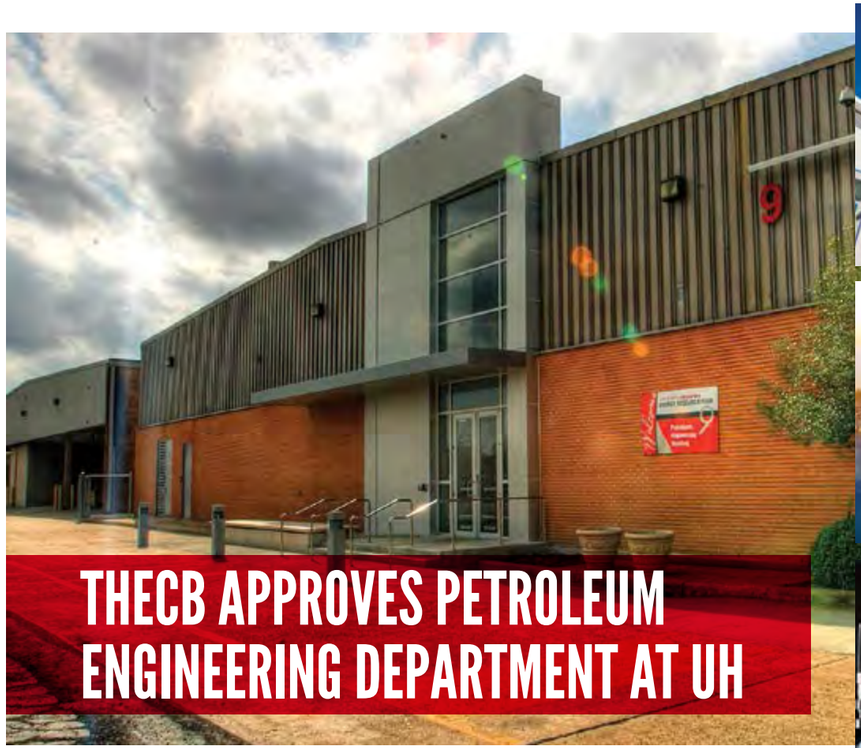
about the B.S. program in petroleum engineering, please visit www.petro.uh.edu

To learn more

about the B.S. program in biomedical engineering, please visit www.bme.uh.edu/undergraduate

More Information

about ABET, its member societies, and the accreditation criteria used to evaluate programs can be found at www.abet.org



THECB APPROVES PETROLEUM ENGINEERING DEPARTMENT AT UH

BY ELENA WATTS

Last November, the Texas Higher Education Coordinating Board approved the establishment of the department of petroleum engineering within the UH Cullen College of Engineering.

"Department status will enhance our national visibility and facilitate the recruiting of additional world-class faculty members," said **Thomas Holley,** interim department chair. "This honor is the culmination of the efforts of the faculty, staff, administration, students and supporters of UH petroleum engineering."

Previously, the undergraduate and graduate programs in petroleum engineering were part of the UH department of chemical and biomolecular engineering.

Degree options remain the same, including bachelor's, master's and doctoral degrees in petroleum engineering. Five tenure-track faculty members, two non-tenured faculty members, 15 adjunct professors and numerous staff members support the instructional programs. The department anticipates hiring two faculty members each year for the next five years.

Last year, 963 undergraduate and 124 graduate students were enrolled in petroleum engineering programs. Of those, 66 undergraduate students and 46 graduate students earned their degrees.

Petroleum engineering is one of the flagship programs in the UH Energy Research Park that contributed to accomplishing the UH Tier One initiative. The 25,000-square-foot Petroleum Engineering Building features state-of-the-art classrooms, teaching laboratories, a computer lab and faculty research laboratories, which were completely refurbished in 2011.

"The petroleum engineering department expects to continue to meet its immediate milestones for further growth of faculty, space and the Ph.D. program in order to contribute to the Tier One status of the University of Houston," Holley said.

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 Texas Workforce Commission estimates.

"The University of Houston is the nation's Energy University, and the establishment of its petroleum engineering department is vital to the economic success of the city of Houston, where the demand for engineering talent is higher than in any major U.S. city," said Joseph W. Tedesco, dean of the UH Cullen College of Engineering. "UH petroleum engineering graduates are the next-generation of global, entrepreneurial energy leaders. I look forward to seeing how our UH petroleum engineers will continue to lead and define the energy landscape of the future."

APPOINTED AS ENGINEERING ARTISTS-IN-RESIDENCE IN NEUROAESTHETICS

BY ELENA WATTS

Three prominent visual artists, Dario Robleto, Jo Ann Fleischhauer and Lily Cox-Richard, were recently appointed Cullen College of Engineering Artists-in-Residence in Neuroaesthetics.

As part of a Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative project funded by the National Science Foundation, the artists are collaborating with **Jose Luis "Pepe" Contreras-Vidal,** Hugh Roy and Lillie Cranz Cullen University professor of electrical and computer engineering, on his scientific approach to the study of aesthetic perceptions of art and music.

The honorary positions provide the artists with access to Contreras-Vidal's laboratory, to university computer accounts and to university libraries, among other resources. The appointments also allow for more interaction between the artists and the engineering students and faculty members.

Robleto was also appointed the 2015-2016 Texas State Visual Artist (3-D), the state's highest recognition for excellence in the arts, by the Texas Commission on the Arts.

TO LEARN MORE
about Contreras-Vidal's ongoing neuroaesthetic research projects, watch our video at https://youtu.be/eoJI19nlFAc

JOURNAL INVITES PROFESSOR TO EDIT PERCEPTION SCIENCE SPECIAL ISSUE

BY ELENA WATTS

Haluk Ogmen, professor of electrical and computer engineering at the UH Cullen College of Engineering, his former doctoral student Hulusi Kafaligonul and his colleague Bruno Breitmeyer, UH professor of psychology, were invited to edit a Perception Science special issue of the journal *Frontiers in Psychology* last year. Titled "Feedforward and Feedback Processes in Vision," the online special issue was also presented as an e-book.

"There are a number of different theories, so we are bringing people and the most updated ideas together in this special issue," Ogmen said. "It's not comprehensive – many more people work on this question – but it's a good sample of what's out there."

Human brains are adept at operating both positive and negative feedback systems, while most electronic systems are capable of efficiently running only negative feedback systems. Engineers have used negative feedback loops in engineering applications for more than 75 years, but they have experienced limited success in stabilizing systems with positive feedback loops. As they join forces across the country to reverse-engineer the brain, a goal of the U.S. BRAIN Initiative, engineers are studying positive feedback systems, which were mostly ignored in the past, as much as they are exploring negative feedback systems.

"From an engineering and mathematical standpoint, positive feedback systems are highly complex and unstable, but the brain remains stable and operates with massive amounts of positive feedback," Ogmen said. "This is the major puzzle we still have not solved."

Ogmen's interest in feedforward and feedback systems, both positive and negative, began two decades ago with his mathematical model of the human visual system circuitry and his theory that proposed feedback as necessary for flexibility in operations.

He found that positive feedback systems could operate without stability by storing ongoing work in memory and resetting the system as often as necessary before system crashes. Since then, he has continued to refine the positive feedback reset loop with an emphasis on sensory memory.

"The advent of optogenetics and neuroimaging has provided additional remarkable investigative tools for refining our theories," Ogmen said. "We hope this issue will inspire the readers and act as a catalyst for future work on the issues of feedforward and feedback processes in vision."

One study in the special section addresses ways the brain's visual system distinguishes foreground from background in the natural environment, while another study focuses on attention as a feedback mechanism that uses prior knowledge, assumptions and hypotheses to selectively choose information from the environment.

> "WE HOPE THIS ISSUE WILL INSPIRE THE READERS AND ACT AS A CATALYST FOR FUTURE WORK."

"We know the brain uses feedback processes, both positive and negative, but we don't know exactly how and when it uses them," Ogmen said. "So unlocking that core brain function can help us to inform engineering principles and to design systems."

ENERGY RESEARCH MAKES COVER OF RESEARCH JOURNAL

BY ASHLEY SCHWARTZ

Yan Yao, assistant professor of electrical and computer engineering at the UH Cullen College of Engineering, and doctoral student Saman Gheytani authored a research paper that was chosen as the cover of the January 2016 edition of the *Journal of Materials Chemistry A*. Their paper highlights the discovery of a method for a light-weight and corrosion-resistant coating for aqueous batteries.

Yao and Gheytani are working in collaboration with Jeff Xu at Southwest Research Institute to usher in a new generation of batteries that can serve as alternatives to traditional lithium-ion batteries. The novel battery developed by the team is water-based, and addresses the safety concerns and high manufacturing costs associated with lithium-ion batteries. The project is supported by the Advanced Research Projects Agency – Energy's (ARPA-E) Robust Affordable Next Generation Energy Storage Systems (RANGE) program, which seeks to accelerate research into next-generation electric vehicle energy storage systems.

"When you use a lithium-ion battery on a small scale, for things like an iPhone or an iPad, battery safety can be easily managed," Gheytani said. "It is in the large-scale energy storage applications, like electric vehicles and stationary energy storage systems, that you must have a very cheap and reliable battery because...they can explode and that is a major safety issue."

Yao and Gheytani have developed a thin layer of coating, just a couple of nanometers thick, to protect the battery shell and avoid corrosion that can shorten the life of the battery. This chromate conversion coating (CCC) is a critical component in the development of the aqueous lithium-ion battery because it guards the aluminum shell and current collectors from the water-based solution.

Gheytani presented the research paper and the CCC aluminum foil discovery to receptive audiences at the University of Houston's 11th annual Graduate Research Conference as well as the Beyond Lithium Ion Batteries VIII Conference at the Oak Ridge National Laboratory in Oak Ridge, Tenn.

"This is a great opportunity for me to work in the energy storage field because I like the research we are working on and I believe this field is important to the public and future of the world. I am very happy to be a part of this community," said Gheytani.

The *Journal of Materials Chemistry A* is a core journal for academic and industrial scientists involved in materials research. The journal publishes an intentionally broad scope of topics covering all aspects of the production of materials or the properties or applications of materials related to energy storage and conversion, sustainability or living.

ENERGY

UH ENGINEER LEADS NEW EFFORT TO IMPROVE CLEAN-UP AFTER OIL SPILLS

BY JEANNIE KEVER

A researcher at the University of Houston Cullen College of Engineering has earned a $1.8 million grant from the Gulf of Mexico Research Initiative to determine how the use of dispersants to break up an oil spill affects the natural cleaning role played by bacteria.

Jacinta Conrad, assistant professor of chemical and biomolecular engineering, said the work will answer fundamental questions important to understanding how bacteria – microscale organisms that naturally occur in marine environments – can help in cleaning up spills during offshore drilling and production.

The Gulf of Mexico Research Initiative was formed in 2010 after BP's Deepwater Horizon drilling rig exploded about 50 miles off the coast of Louisiana, killing 11 men and spilling several million barrels of oil in the five months before the well was sealed. BP pledged $500 million over 10 years for an independent research program to study how the spill and efforts to clean it up have affected the Gulf and coastal states.

The initiative is seeking answers in several areas, including the environmental impact of the oil and dispersants, the public health impacts and the development of new technology to use in future spills.

Conrad's project builds on her previous work in colloid and interfacial science – the study of how complex fluids move, including the movement of bacteria across surfaces. For this project, she will lead a team of three investigators: Roseanne Ford from the University of Virginia; Arezoo Ardekani from Purdue University, and Douglas Bartlett from the University of California-San Diego's Scripps Institution of Oceanography.

Crews attempting to limit damage caused by oil spilled from the Deepwater Horizon used chemical dispersants – chemicals sprayed onto a surface oil slick – to break the oil into smaller droplets. Preliminary studies have questioned whether the dispersant worked the way it was intended.

But there also is a natural remedy for oil spills – hydrocarbons are a source of food for various strains of bacteria in the water, and Conrad and her team will look at whether the dispersants affected the movement of these bacteria toward the spilled oil.

"An oil spill in the ocean is a big, glowing beacon of food to bacteria," she said. "Our work will test whether dispersants changed the rate at which bacteria moved towards the oil and the rate at which they consumed it.

"The really critical question we are asking is how human intervention – the dispersants – interacts with natural cleaning processes – the bacteria," she said. "If dispersants lowered the rate at which bacteria removed the oil, then human efforts to clean up the spill may have been costly and counter-productive."

Her ultimate goal is to determine whether the dispersants helped draw bacteria to the oil and, if so, to measure the impact.

"WE EXPECT THAT BETTER UNDERSTANDING OF HOW DISPERSANTS AFFECT BACTERIAL BIODEGRADATION PROCESSES WILL INFORM FUTURE STRATEGIES TO CLEAN SPILLED OIL," SHE SAID.

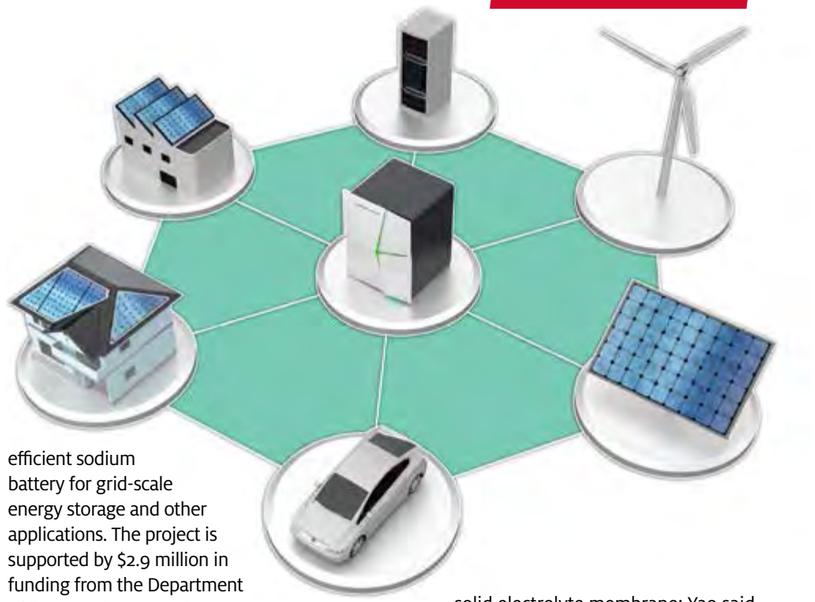
ENERGY

UH ENGINEER JOINS PROJECT TO TRANSFORM ENERGY STORAGE

BY JEANNIE KEVER

An engineer from the UH Cullen College of Engineering will lead development of a key component for a new, all solid-state sodium battery with the potential to revolutionize the nation's electric grid.

Yan Yao, assistant professor of electrical and computer engineering at UH, will work with a team of researchers and battery company Solid Power to produce a low-cost, safe and efficient sodium battery for grid-scale energy storage and other applications. The project is supported by $2.9 million in funding from the Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E).



Yao, who is also a principal investigator for the Texas Center for Superconductivity at UH, said there are three reasons for the work.

While conventional lithium-ion batteries have proven effective at storing energy on a limited scale, the liquid electrolyte in the batteries is flammable; a solid-state sodium battery would be much safer, he said, as well as less expensive and able to store greater amounts of energy.

Yao, whose research group focuses on green and sustainable organic materials for energy generation and storage, will create a new battery cathode, the terminal from which electrical current leaves the battery.

Other researchers include principal investigator Steve W. Martin at Iowa State University; Sehee Lee at the University of Colorado-Boulder; Scott Beckman and Soumik Banerjee at Washington State University; and Josh Buettner-Garrett at Solid Power.

Existing sodium-sulfur batteries for grid energy storage operate at temperatures between 300 and 350 degrees Celsius, using molten sodium and sulfur separated by a solid electrolyte membrane; Yao said those have safety and durability concerns, as well as high production costs. The battery proposed by the researchers would operate near room temperature and, with an all solid-state design, would be more robust, scalable to manufacture and composed entirely of recyclable and renewable materials.

The project is one of 41 cutting-edge energy technologies funded in a $125 million ARPA-E initiative, OPEN 2015. ARPA-E funds innovative technologies that display promise for both technical and commercial impact, but are too early for private-sector investment.

The ARPA-E announcement noted the climate change talks in Paris and global efforts to lower carbon emissions. Large-scale energy storage is considered key to broader adoption of both solar and wind energy, allowing energy generated during sunny and windy periods to be stored for use at a future time.

But Yao said any storage system will have to avoid several hurdles: it must be inexpensive to produce, have high energy density and avoid the flammability and other safety issues inherent in many batteries. Sodium is a soft, highly reactive metal, widely available across the world, he said.

FUNDAMENTAL SCIENCES

PROFESSOR AMONG EXPERTS TO PUBLISH REVIEW OF NONCLASSICAL CRYSTALLIZATION

BY ELENA WATTS

The U.S. Department of Energy sponsored a 2013 workshop in Berkeley, California, that brought together 15 of the nation's top crystallization researchers to discuss the rapidly emerging but still obscure area of nonclassical crystallization.

Jeffrey Rimer, Ernest J. and Barbara M. Henley associate professor of chemical and biomolecular engineering at UH Cullen College of Engineering, was among members of the group who gathered to compose a review article that was published in *Science* last July.

"*Science* is a high-profile interdisciplinary journal that reaches a wide audience and covers a broad range of applications," Rimer said. "Examples of nonclassical crystallization are mounting in the literature, and this review article presents the most comprehensive overview of what is currently known about this topic."

The workshop afforded experts from various fields, including geoscience, materials science, chemistry and chemical engineering, an opportunity to meld their ideas to create a more cohesive framework for exploring nonclassical crystal growth. They established nomenclature and methodologies for reference among researchers working on papers for future publication, and they defined the term crystallization by particle attachment, or CPA, to encompass all pathways of crystal growth not characterized by classical monomer-by-monomer incorporation of atoms, molecules or ions.

"I was asked to join the group because of my work with zeolites, which are one of the first materials identified to grow by these routes," Rimer said. "Our review summarizes what we know about various natural, biological and synthetic crystals that grow by CPA, and it highlights open questions and challenges we face with respect to characterizing their pathways of formation."

PROFESSOR PUBLISHES PAPER ON POLYMER INTERPENETRATION

BY ELENA WATTS

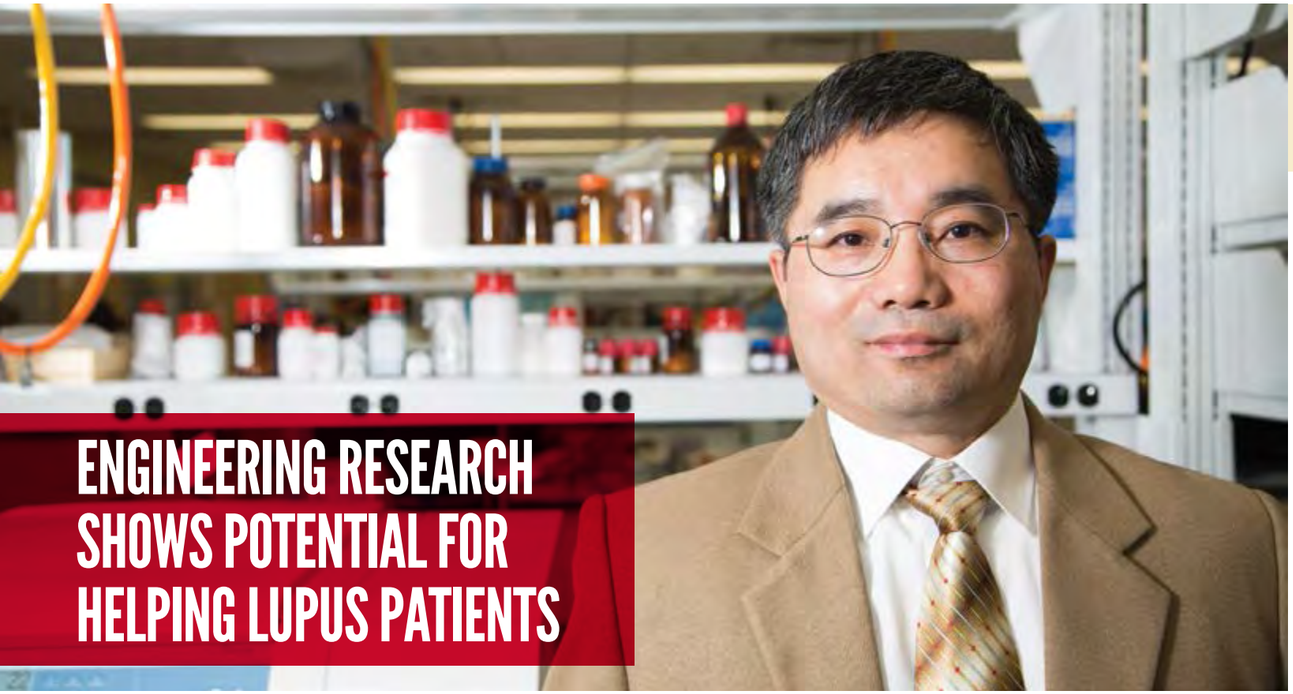
Ramanan Krishnamoorti, professor of chemical and biomolecular engineering at the UH Cullen College of Engineering, co-authored a paper on tuning polymer interpenetration that published in the *Journal of the American Chemical Society* last August.

Researchers tailor properties of polymer nanocomposites for biomedical, pharmaceutical and automotive applications, among numerous other industry uses.

According to a University of Delaware article, they typically employ either wetting or dewetting for either dispersion or aggregation of nanoparticles, respectively, which they believed were synonymous and mutually exclusive processes. Depending on desired properties necessary for particular objectives, both transitions were useful.

Krishnamoorti and his collaborators found a sharp change from dispersion to aggregation of nanoparticles that did not correlate with the gradual change they found from wetting to dewetting, refuting an established scientific theory. Their discovery provides a finer tuning knob to tailor nanoparticles in polymer-nanoparticle composites for specific applications.

Tyler Marin, a graduate student working with engineering professor Arthi Jayaraman at the University of Delaware, was lead author on the paper. Other collaborators included researchers from the University of Colorado, the University of Maryland and the National Institute of Standards and Technology Center for Neutron Research.



ENGINEERING RESEARCH SHOWS POTENTIAL FOR HELPING LUPUS PATIENTS

BY ELENA WATTS

Lupus is a chronic autoimmune disease without a cure and without a highly effective treatment option. Many scientists believe that genetics and environmental factors interact to cause immune cells in the human body to overreact and attack healthy cells and organs in the estimated 1.5 million Americans affected by the disease.

"Over time, 50 to 60 percent of lupus patients end up with renal failure caused by kidney disease, and they also have higher incidents of cardiovascular disease and other health issues," said **Tianfu Wu,** assistant professor of biomedical engineering at the UH Cullen College of Engineering. "It's a dangerous disease, and we want to find a cure or at least more potent treatments than exist now."

Wu earned a $300,000 grant from the Lupus Research Institute, LRI, to continue his pursuit of promising preliminary lupus research. He systematically scanned entire proteins inside cells and determined that one molecule called polo-like kinase 1, or PLK1, might contribute to the onset of the disease.

Wu identified three goals for his LRI grant. First, he intends to uncover a molecular basis for the immune cells that express PLK1 as well as signature pathways used by PLK1 to regulate upstream and downstream molecules. Next, he aims to determine whether or not PLK1 is an effective therapeutic target for treatment of lupus in animal models. Lastly, Wu plans to collaborate with the UT Health Science Center in the Texas Medical Center to translate results found in animal models to human patients.

> "IT'S A DANGEROUS DISEASE, AND WE WANT TO FIND A CURE..."

During the last 50 years, the FDA has approved only one drug, Benlysta, for the specific treatment of lupus. However, in randomized, double-blind, placebo-controlled clinical trials, the patients who received this drug showed only slightly better results than the patients who received the placebo. Other lupus treatments, such as steroids and antimalarial drugs, were not originally designed to treat the disease, but suppress immune responses and inflammation. Unfortunately, they can also cause a host of problematic side effects with prolonged use.

"Hopefully this LRI-funded research will advance our understanding of the pathogenesis of lupus," Wu said. "And the blockade of PLK1 could become a novel and effective strategy in conquering this devastating disease."

STUDY ELUCIDATES MECHANISMS AND EFFECTS OF GREEN TEA ANTIOXIDANT ON ARTHRITIS

BY ELENA WATTS

The *Journal of Inflammation* recently published a paper co-authored by **Chandra Mohan,** Hugh Roy and Lillie Cranz Cullen endowed professor of biomedical engineering, about the effects of green tea on chronic autoimmune arthritis in mice.

Rheumatoid arthritis, RA, is the most common form of autoimmune arthritis, and women account for about 75 percent of the more than 1.3 million Americans affected, according to the American College of Rheumatology website.

The chronic disease that causes pain, stiffness, swelling and limited motion in joints has no known cure, but conventional drug therapies and experimental treatments can slow its progression. Unfortunately, these treatments have limited efficacy and serious side effects, so researchers are exploring herbal products such as green tea that have shown promise for treating the inflammatory autoimmune disease.

Past studies have suggested that an antioxidant found in green tea, EGCG, modulates arms of the immune system, so the purpose of this study was to examine EGCG mechanisms of action and the effects of those actions on collagen-induced arthritis in mice. Mohan and his collaborators at the University of Texas Southwestern Medical Center in Dallas and the Rheumatism Center at Inha University School of Medicine in South Korea conducted their study in two groups of arthritic mice. They administered the green tea antioxidant to the experimental group, and they gave phosphate buffered saline to the control group.

1.3 MILLION
AMERICANS ARE AFFECTED BY RHEUMATOID ARTHRITIS

The researchers observed that EGCG treatment improved clinical symptoms, reduced indicators of disease activity and decreased antibody levels associated with progression of the disease in the experimental group, unlike overall outcomes in the control group. Their study revealed that EGCG treatment suppressed expansion of B and T immune cell populations, which contribute to the development of autoimmune arthritis, by slowing frequency and reducing absolute numbers of cells. They also found that the antioxidant treatment significantly decreased inflammation-related cytokine production and increased production of anti-inflammatory cytokine.

While prior studies have reported correlations between reduction of EGCG activity and escalation of the autoimmune disease, theirs was the first to report a relationship between EGCG treatment and induced expression of a target enzyme, an activity previously shown to increase antioxidant activity that protects against joint destruction in mice with arthritis.

Antioxidant activity that results in increased levels of the target enzyme was a significant discovery because researchers have shown that pharmacological upregulation of the target enzyme causes robust anti-inflammatory response in non-autoimmune arthritis animal models. Their findings provide new insights about EGCG mechanisms and perhaps a novel target for therapeutic treatment of chronic inflammatory diseases for future models.

"Further studies are required to determine the clinical relevance of these findings and to conduct systematic testing of potential therapeutic targets in this regulatory cascade," the authors wrote in their paper. "It remains to be established whether EGCG is useful for the prevention and treatment of rheumatoid arthritis and other inflammatory disorders."

AWARD ALLOWS ENGINEERS TO PURSUE TECHNIQUE FOR ASSESSING SYSTEMIC SCLEROSIS

BY ELENA WATTS

Two professors at the UH Cullen College of Engineering earned a $200,000 Peer Reviewed Medical Research Program (PRMRP) Discovery Award from the U.S. Department of Defense to further explore a quantitative assessment technique for systemic sclerosis (SSc). The autoimmune disorder is characterized by thickening of soft tissues in the body caused by accumulations of collagen.

Chandra Mohan, the Hugh Roy and Lillie Cranz Cullen endowed professor of biomedical engineering, and **Kirill Larin**, professor and director of the graduate biomedical engineering program, have developed a novel non-invasive technique to assess elasticity of body tissues in mice and, eventually, humans. The technology, called phase-stabilized swept source optical coherence elastography (PhS-SSOCE), allows researchers to image tissues with micrometer spatial resolution and sense nanometer-amplitude displacements.

"When not diagnosed and treated early, systemic sclerosis can be dangerous, and even fatal, attacking internal tissues such as breathing passageways, lungs, and the renal and intestinal tracts," Mohan said. "We have shown that our method is capable of early detection of thickened skin in mice, and our idea now is to further explore ways to objectively assess degrees of disease involvement."

Currently, levels of tissue thickness assessed in clinics are relatively subjective with the Rodnan total skin score, the gold standard

that measures multiple sites on the body and tallies a score that typically varies from one physician to the next. Technologies such as magnetic resonance imaging and ultrasound have also been tested with varying levels of success.

"We need to produce a metric to accurately diagnose and stage the disease based on mechanical and optical properties of the skin," Larin said. "The current methods are not capable of objectively assessing progression of the disease or the patient responses to therapies."

With the developed technology, Mohan and Larin have successfully applied a quantitative method in vivo and in vitro for determining elasticity changes caused by SSc in the skin of mice. Their next objective is to assess and monitor skin elasticity of mice with SSc using the new technique over time and to compare those results to assessments of skin elasticity in mice with SSc using the traditional skin score method. They intend to begin with straightforward skin lesions before they tackle more difficult assessments of internal organs using minimally invasive probes.

Their goal is to extend the research to patients with systemic sclerosis, in collaboration with Shervin Assassi, associate professor of rheumatology at the UT Health Science Center in Houston, who is also a lead investigator on this grant. He plans to perform cross-sectional analyses of skin samples from patients with and without SSc using both novel PhS-SSOCE and traditional Rodan total skin score assessment methods. After they prove the feasibility of their research, they could potentially extend the use of this novel technology to other skin and autoimmune diseases.

FISH OIL SUPPLEMENTS OFFER PROMISING RESULTS FOR LUPUS PATIENTS

BY ELENA WATTS

An estimated 1.5 million Americans and at least 5 million people worldwide live with a form of lupus, a chronic autoimmune disorder, and approximately 16,000 new cases are diagnosed in the United States each year, according to the Lupus Foundation of America website. Almost 90 percent of those diagnosed with the disease are women between the ages of 15 and 44.

Systematic lupus accounts for 70 percent of the total cases, and about half of those involve major organs, such as the heart, lungs, kidneys or brain, though the disease can damage any part of the body. Many scientists believe that the disease develops in response to combinations of hormones, genetics and environmental influences.

Patients with Systemic Lupus Erythematosus, SLE, often experience reduced quality of life that lasts from six weeks to many years. A recent evaluation of SLE patients found reductions in antioxidant and energy generation markers as well as increased inflammation markers in their sera, which could manifest physically and mentally as ill-defined symptoms of fatigue, generalized

pain and depressed mood. The evaluation also noted reductions in omega-3 fatty acids, powerful antioxidants, which could contribute to fatigue, oxidative stress, inflammation, disease activity and reduced quality of life experienced by lupus patients.

Last August, **Chandra Mohan,** Hugh Roy and Lillie Cranz Cullen endowed professor of biomedical engineering, published a paper in the *Nutrition Journal* that detailed results of the first clinical trial investigating impacts of fish oil supplements on fatigue and quality of life in SLE patients. His collaborators included the University of Texas Southwestern Medical Center in Dallas and the Functional Medicine Research Center, Metagenics, Inc. in Gig Harbor, Wash.

Other studies have shown reduced oxidative stress, an imbalance between antioxidants and free radicals in the body, in lupus patients who take fish oil supplements containing omega-3 fatty acids. This placebo-controlled, randomized trial aimed to understand the effects of fish oil supplements on clinical measures such as fatigue, quality of life and disease activity in SLE patients.

Thirty-two of 50 SLE patients selected randomly from outpatient clinics completed the six-month study. The participants were divided into two blind groups that received either fish oil supplements or olive oil placebos. The results showed that the Physician Global Assessment, PGA, which categorizes the level of disease as inactive, mild, moderate or severe, improved significantly more in members of the fish oil group than in members of the placebo group.

Members of the fish oil group also showed more improvement than their counterparts on the RAND Short Form-36, a standardized health survey that assesses quality-of-life measures. Furthermore, unlike members of the placebo group, members of the fish oil group experienced improvement in some circulating inflammatory markers. The researchers did not observe substantial differences between the two groups on the Fatigue Severity Scale, FSS, or the SLE Disease Activity Index, SLEDAI.

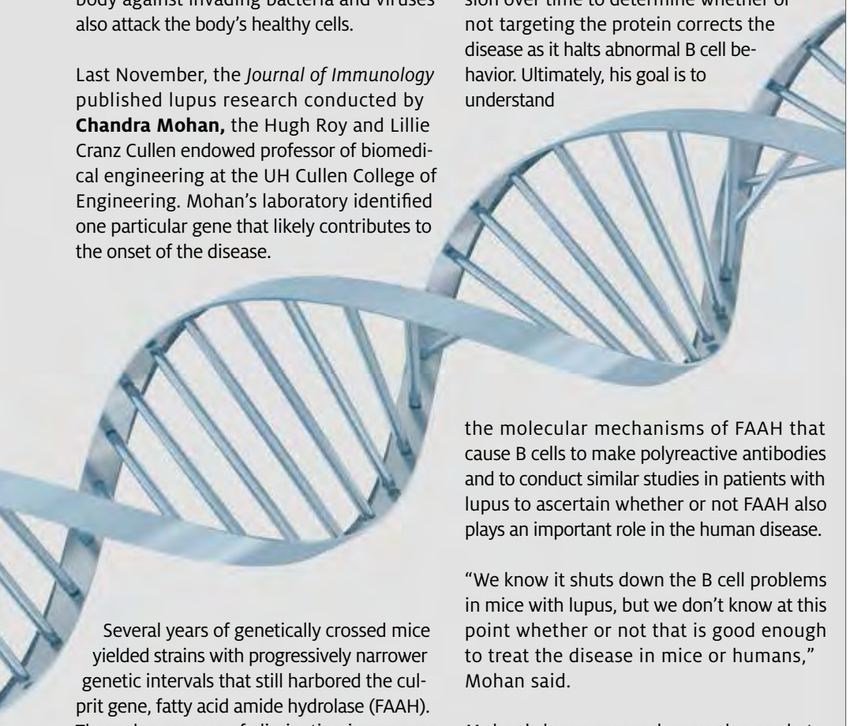
"Although the study evaluated a small group of patients, there were positive indications in the treatment group for quality of life, fatigue, disease activity and inflammation biomarkers," Mohan and his collaborators wrote in their paper. "Further studies are warranted to confirm our promising findings."

UH ENGINEER DISCOVERS GENE LINKED TO LUPUS

BY ELENA WATTS

Lupus is an autoimmune disease that affects approximately 1.5 million Americans, according to the Lupus Foundation of America. In lupus patients, antibodies that are produced by the immune system's B cells to protect the body against invading bacteria and viruses also attack the body's healthy cells.

Last November, the *Journal of Immunology* published lupus research conducted by **Chandra Mohan,** the Hugh Roy and Lillie Cranz Cullen endowed professor of biomedical engineering at the UH Cullen College of Engineering. Mohan's laboratory identified one particular gene that likely contributes to the onset of the disease.



Several years of genetically crossed mice yielded strains with progressively narrower genetic intervals that still harbored the culprit gene, fatty acid amide hydrolase (FAAH). Through a process of elimination in a mouse model, Mohan and his team confirmed the presence of the gene on mouse chromosome 4 using a microarray analysis technique. Furthermore, they found that FAAH contributes to the B cell polyreactivity in mice with lupus and that levels of the FAAH protein are higher in those abnormal B cells.

To determine whether their findings caused or merely coincided with the disease, they administered a chemical inhibitor that reduced the levels of FAAH in the mice, and they observed that lower levels of the protein corrected abnormalities in the B cells.

Mohan next intends to conduct a study that treats mice with the FAAH inhibitor at the onset of the disease and follows disease progression over time to determine whether or not targeting the protein corrects the disease as it halts abnormal B cell behavior. Ultimately, his goal is to understand the molecular mechanisms of FAAH that cause B cells to make polyreactive antibodies and to conduct similar studies in patients with lupus to ascertain whether or not FAAH also plays an important role in the human disease.

"We know it shuts down the B cell problems in mice with lupus, but we don't know at this point whether or not that is good enough to treat the disease in mice or humans," Mohan said.

Mohan's lupus research may also apply to other autoimmune diseases such as rheumatoid arthritis, multiple sclerosis and irritable bowel syndrome that involve polyreactive antibodies or FAAH. Preliminary studies show that researchers can target FAAH in mouse models for some of these conditions.

Simanta Pathak, a post-doctoral scientist at the UH Cullen College of Engineering, conducted these studies in Mohan's laboratory, and their ongoing work aims to further unravel the complex molecular networks that lead to lupus.

PROFESSOR EARNS GRANT TO EXPLORE PROGRAMMABLE BIOLOGICAL ORGANISMS

BY ELENA WATTS

Biological organisms can be re-engineered for singular purposes, such as production of biofuels, chemicals or pharmaceuticals, while computers are constructed to perform different and diverse tasks with simple downloads of new applications or software updates. An engineering professor at the University of Houston wants to marry the two concepts.

Elebeoba May, associate professor of biomedical engineering at the UH Cullen College of Engineering, earned the National Science Foundation's Early Concept Grant for Exploratory Research, or EAGER, to explore programmable biological organisms. The goal of the two-year, $300,000 grant is to develop a framework through mathematical models and experimental work that moves the field of synthetic biology from re-engineering-based programming to software-based programming.

May proposed that soft-programming of biological organisms has not yet happened. During the pioneer days of programmable computers, engineers hardwire "programmed" massive computer systems by physically moving wires, which is different from the programming that is happening with computers today, May said.

> "THE DREAM IS TO MAKE BIOLOGICAL SYSTEMS THE NEXT GENERATION OF MICROPROCESSORS."

"My objective is to create the same type of evolution for engineered biological systems that happened for computer systems," she said. "We are light years ahead when you look at where we started with computers."

Much of May's ongoing research focuses on multi-scale mathematical modeling for infectious diseases. For this project, she will draw on mathematical and experimental methods already developed in the May Multiscale Immunobiology Design Algorithms and Simulation (MIDAS) Lab at UH as well as established synthetic biology methods to enable software programming of biological systems. May's team for this study includes two of her four doctoral students, Majid Latif and Danielle Stolley, as well as Komal Rasaputra, one of her two post-doctoral research scientists, all of whom work routinely in her lab.

"We want to modulate systems with specific inputs we supply, and prescriptively drive them to specific outcomes that we may not have observed before," May said.

Synthetic biology incorporates existing metabolic and genetic engineering techniques to build databases of biological parts that are characterized and used in the design and engineering of various organisms with novel functionality, May said. During the last decade, the field of synthetic biology has grown rapidly with the creation of new tools by numerous researchers. Engineers have introduced metabolic pathways to organisms that have allowed them to perform new metabolic processes.

May and her team are studying Escherichia coli bacterial biofilms, which are communities of bacterial cells that grow together to form structures in a cooperative manner. The cells detect their environment through quorum sensing and two-component systems, which is the way they determine the relative size and state of their communities. They respond and perform functions based on this information.

"Biofilms are well-suited for the research because their structures allow us to observe interactions between bacterial cells in communities and to experiment with controlling them," May said. "The findings could potentially help us engineer similar biological systems."

Biofilms form on surfaces and inside people, and they are difficult to eliminate because of their structures. They can cause serious chronic infections in humans, and they can serve as contaminant sources in water supplies. An understanding of interactions in microbial communities can provide insight into ways to engineer therapeutic strategies to disrupt and eliminate cooperativity that is detrimental to human health and environmental systems, May said. The ability to interface with biological systems through a software base can also create possibilities for non-experts to engineer systems in novel ways, much like engineering novices develop innovative applications for smartphones.

"Another goal is for people with limited knowledge about the creation of synthetic microbes to do amazingly creative things with them," May said. "The majority of individuals developing software applications for mobile devices have limited, if any, idea of how a microchip functions, but they are still able to develop intricate software applications to leverage the functionality of the integrated circuitry that runs computers. The dream is to make biological systems the next generation of microprocessors."

PROFESSOR INVESTIGATES POLYMERIC MICELLES FOR DRUG DELIVERY

BY AUDREY GRAYSON

Finding improved methods for drug delivery is a hot topic among researchers all over the world. One method in particular, which utilizes polymeric micelles to carry drug molecules to their intended targets inside of the body, has had very promising results in recent years.

Now, an engineering professor at the UH Cullen College of Engineering is uncovering the fundamental science of using block copolymer micelles for drug delivery with a three-year, $165,000 award from the National Science Foundation.

Megan Robertson, assistant professor of chemical and biomolecular engineering, is examining how drug molecules interact with polymers within a micelle and quantifying how these interactions change the structure of the micelle as well as the release of the drug inside of the body.

"If we understand the effect of the drug on the micelle structure, dynamics and release rate, it will help us to design new and improved micelle systems," Robertson said.

Her team will begin by studying Doxorubicin, a chemotherapy drug, but the results from this research could be generalized to other drugs, Robertson said.

Robertson's research collaborator is Louis Madsen, an associate professor in the department of chemistry at Virginia Tech. Madsen is an expert on NMR (nuclear magnetic resonance) spectroscopy, a technique used to determine the structure of organic compounds, atoms and molecules. One of Robertson's areas of expertise is neutron scattering, an experimental technique used to investigate the nanometer to sub-micron scale structure of materials.

In this project, Robertson and Madsen are combining NMR and neutron scattering techniques to further investigate the use of block copolymer micelles for drug delivery.

"I think we can learn more about this system by using a combination of these techniques rather than by one technique alone," she said.

To understand micelles, think about the behavior of a detergent added to a bucket of water: the detergent molecules aggregate together, forming a type of micelle. Molecules like detergents form micelles because they are composed of two parts: one part is hydrophobic (water-hating) and the other is hydrophilic (water-loving). The micelle aggregate keeps the hydrophobic part separate from the water, while the hydrophilic part remains surrounded by water.

delivery, however, is achieving the desired micelle structure, which can contain a spherical core, a cylindrical core, or even adopt a vesicle morphology (vesicles are capsules that contain a water-filled hydrophilic core surrounded by a hydrophobic membrane or shell). Furthermore, in some cases the polymers themselves transfer from one micelle to another, through a process called single chain exchange. Robertson and Madsen will identify the micelle structure and examine the rate of

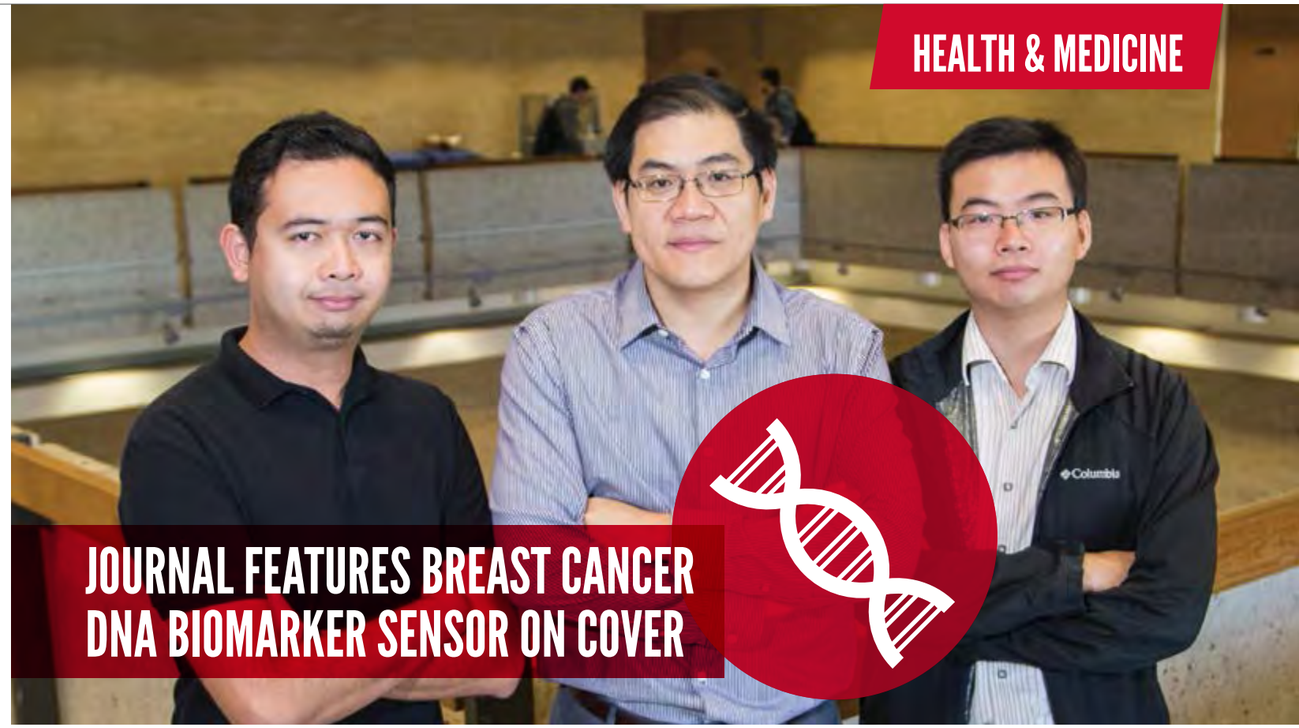
> "I THINK WE CAN LEARN MORE ABOUT THIS SYSTEM BY USING A COMBINATION OF THESE TECHNIQUES RATHER THAN BY ONE ALONE."

When used for drug delivery purposes, drug molecules are stored inside the hydrophobic core of the micelle, and then released in the vicinity of the target, such as a tumor. This can increase the drug's efficiency and, in some cases, decrease the number and severity of side effects caused by the drug.

One example is chemotherapy drugs, which wreak havoc on the patient's entire body in order to deliver toxic agents to a tumor site. If researchers can find drug delivery systems that guarantee that the chemotherapy drug will be released only at the site of the tumor, the drug would be more effective at killing the tumor cells and the cancer patient would experience far fewer side effects as a result of the medication.

One tricky part of using micelles for drug delivery, however, is achieving the desired micelle structure, which can contain a spherical core, a cylindrical core, or even adopt a vesicle morphology (vesicles are capsules that contain a water-filled hydrophilic core surrounded by a hydrophobic membrane or shell). Furthermore, in some cases the polymers themselves transfer from one micelle to another, through a process called single chain exchange. Loading up the core of a micelle with drug molecules may have an impact on the micelle's structure. Moreover, if the interaction between the drug molecules and the polymers causes the micelle's structure to change, this may have an impact on the timed release of the medication inside of the micelle's core. Robertson and Madsen will also investigate the release rate of the drug using fluorescence techniques.

With the completion of this project, researchers will have a model of how drug molecules can change the structure and dynamics of micelles, as well as the timed release of drugs within the micelle's core. This knowledge will enable the design of new and improved drug delivery materials.



HEALTH & MEDICINE

JOURNAL FEATURES BREAST CANCER DNA BIOMARKER SENSOR ON COVER

BY ELENA WATTS

Last October, the cover of the *Journal of Biophotonics* featured molecular sensing research conducted by **Wei-Chuan Shih,** associate professor of electrical and computer engineering at the UH Cullen College of Engineering.

The study describes the development and testing of a novel sensor based on surface-enhanced fluorescence (SEF). The sensor provides a more economical and convenient means for detection of sequence-specific DNA biomarkers, challenging the current gold standard, polymerase chain reaction (PCR), which is labor-intensive, time-consuming and costly. Specifically, Shih's SEF sensor possesses recognition elements that can signal the detection of a breast cancer DNA biomarker with sensitivity in the attomole range.

Unlike PCR, the SEF sensor does not require time-consuming duplication of trace amounts of the DNA biomarker. Instead, light-excited localized surface plasmon resonance (LSPR) on the surface of a special gold nanostructure provides the needed signal amplification. The gold nanostructures, known as nanoporous gold disks (NPGDs), were first prepared by Shih's group in 2012. Their findings on NPGDs were featured on the cover of *Nanoscale* in 2013.

The NPGD features a tunable diameter between 100 and 1,000 nanometers, a thickness from 50 to 100 nanometers, and a three-dimensionally distributed porous network with 10-nanometer pores. The disk drastically enhances the electrical field, and consequently, the ability to amplify optical signals near the surface. The hierarchical nanostructural architecture is unique among all plasmonic nanoparticles.

In 2014, Shih published a paper that described the use of NPGD for breast cancer DNA biomarker detection via surface-enhanced Raman spectroscopy (SERS), another highly sensitive technique for molecular sensing. They demonstrated the detection of single, individual DNA biomarkers when the sensor recognized them.

Shih's sensors enable sensitive and rapid DNA sequence detection down to the single-molecule level without the need for PCR and its associated sample preparation. The sensors can potentially enable faster and more affordable DNA biomarker detection at resource-limited settings and point-of-care facilities.

"Bypassing PCR, which is the process of reproducing large amounts of targeted molecules for analysis, our sensors can operate at an extremely low count of DNA copies – from one to a few hundred," Shih said.

Commercialization of these sensors could benefit clinics around the globe where women are examined for breast cancer, especially in poor countries where costly PCR is not an option and shipping DNA samples cross-country is unrealistic.

"You have to be able to conduct a highly sensitive test right there without sophisticated instrumentation and skilled laboratory personnel," Shih said. "Optical instruments are much less demanding in terms of environment – they're less expensive and more portable."

HEALTH & MEDICINE

ENGINEER EARNS MILLIONS TO EXPLORE EFFECTS OF ALCOHOL AND NICOTINE ON BRAIN DEVELOPMENT

BY ELENA WATTS

Maternal exposures to alcohol and nicotine, which are sometimes abused during pregnancies, are linked to fetal growth retardation and neurotoxicity. However, the individual and combined effects of the toxins on molecular mechanisms of fetal development are poorly understood.

Kirill Larin, professor and director of the biomedical engineering graduate program at the UH Cullen College of Engineering, earned a five-year, $2 million Research Project Grant (R01) from the National Institutes of Health (NIH) to explore molecular pathways involved with brain development during both chronic and occasional exposure to nicotine and alcohol, both separately and combined.

Larin and his collaborator, Rajesh Miranda, professor of neuroscience and experimental therapeutics at Texas A&M Health Science Center in Bryan, are exploring the interplay between the two toxins on embryonic brain development in mice using optical coherence tomography (OCT), a novel high-resolution mouse embryonic brain imaging and analysis approach.

"We have pioneered OCT-based methodology for live in utero imaging and longitudinal phenotypic analysis of mouse fetuses," Larin said. "We propose to further develop both the technology and the methodology for longitudinal brain imaging and analysis."

Larin and Miranda are investigating whether the toxins have antagonistic, synergetic or a combination of those effects on brain development in live mouse embryos. Their study focuses on the second trimester–equivalent period of development when the neuronal stem cells give rise to most of the neurons of the adult brain.

> "[THIS STUDY] MAY HAVE A PARTICULARLY SIGNIFICANT IMPACT FOR THE DEVELOPMENT OF NOVEL AND INNOVATIVE THERAPIES."

During the course of this project, they plan to establish a live mouse embryonic brain imaging approach, to develop a set of protocols and detailed assessments to quantitatively characterize dynamic embryonic brain development with cellular resolution, and to investigate whether ethanol and nicotine synergize to disrupt brain development or exhibit partially antagonistic effects. Furthermore, they intend to explore the feasibility of using nicotinic receptor antagonists and agonists to prevent the individual and combined effects of the toxins.

"Studying these effects is highly significant from both fundamental biology and teratogenic points of view since it may have a particularly significant impact for the development of novel and innovative therapies for reversing teratology," Larin said.

INFRASTRUCTURES

UH ENGINEER FOCUSES ON IMPROVING QUALITY OF BRIDGES

BY JEANNIE KEVER

As the United States struggles to pay for expanding and maintaining the nation's transportation infrastructure, a University of Houston research team is proposing changes to the design for bridge construction that could dramatically lower maintenance costs while improving the quality of the bridges.

Yi-Lung Mo, professor of civil and environmental engineering, is principal investigator for more than $1.2 million in grants from the Texas Department of Transportation (TxDOT) to consider new solutions to two structural problems.

A report released this year by the American Road and Transportation Builders Association reported that nearly 10 percent of U.S. bridges were considered structurally deficient last year.

Mo's most recent TxDOT funding comes in two grants: $623,595 to redesign the way steel reinforcing bars – or rebar – are positioned inside concrete bridge caps, and an additional $616,995 to determine how best to connect the bridge column with the embedded drilled shaft.

Mo, whose research is focused on improving the safety and reliability of infrastructure and building materials, said his proposal would improve the way a style of bridge cap – used to support the girders underlying a bridge – is reinforced. Traditional bridge caps are rectangular, making it easy to evenly space the rebar in a grid.

But about 30 percent of the 50,000 bridges maintained by TxDOT are on curving landforms, which require that the bridge bent cap instead be a parallelogram, or skew, Mo said. Because the corners don't form right angles, the rebar can't be evenly spaced there, resulting in it being too widely spaced on one side and too closely bunched on the other.

That uneven spacing makes the cap more likely to crack, driving up maintenance costs. Mo proposed a novel way to uniformly distribute the rebar throughout the entire skewed bent cap. He said that's never been tried but that computer modeling suggests reduced costs for design, construction and maintenance will be about 30 times greater than the cost of the research.

After additional computer modeling, Mo will build a full-scale bent cap specimen – about 24-feet-by-5 feet – and test it in the University's Thomas Hsu Structural Research Laboratory. Testing will involve using a load of 1 million pounds to determine the load deformation relationship, he said.

Under the second grant, Mo has proposed a way to better stabilize the bridge column connection to the drilled shaft – an element of the foundation, with a round hole drilled into the ground, reinforced with steel and then filled with concrete. Both components are reinforced with steel. But because the shapes don't align exactly and rebar is most effective along the outer edges of the shaft and column, Mo said that one piece of rebar can't be used for both components.

Linking the two with dowel bars embedded in the concrete would achieve that, but because of the design, the bars can't establish contact with the rebar in both components. Mo, relying on computer simulation, has proposed a way to stabilize the components even without contact. As with the bent cap work, the new design will ultimately be tested in the Thomas Hsu Structural Research Laboratory.

His two latest grants bring Mo's total funding from TxDOT to $4.7 million.

PROFESSOR EXPLORES STACKING FAULTS TO STRENGTHEN COBALT

BY ELENA WATTS

Yashashree Kulkarni, associate professor of mechanical engineering at the UH Cullen College of Engineering, earned a three-year, $225,400 grant from the National Science Foundation to study mechanisms of deformation in cobalt with high-density stacking faults.

Cobalt in the form of thin films is ubiquitous in magnetic data storage devices as well as microelectromechanical and nanoelectromechanical devices.

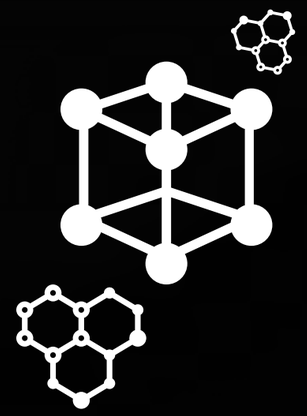
However, Kulkarni and her Texas A&M University collaborator Xinghang Zhang are exploring engineering processes that produce stronger versions of different crystalline forms of cobalt with improved ductility. The combination of strength and ductility in one material is highly desirable for structural engineering applications, yet somewhat uncommon in the materials science world. For example, making steel stronger by adding carbon makes it increasingly brittle, and materials that are naturally ductile like gold and silver are not strong.

When deformed, most crystalline materials that are ductile by nature form stacking faults, or planar defects, until they fail. Environmental stressors can cause natural formation of moderate numbers of stacking faults in cobalt and other crystalline materials, but Zhang has developed a method in his laboratory for prefabrication of cobalt with high-density stacking faults.

He has demonstrated that dense or closely-spaced preexisting stacking faults in cobalt interact with defects created subsequently to provide not only increased strength but also improved deformability. Kulkarni is performing computational simulations to understand the atomistic underpinnings of the phenomenon.

"Zhang is designing cobalt microstructures at the nanoscale, and we're performing simulations on million-atom samples on supercomputers," Kulkarni said. "Stacking faults are conventionally thought of as defects generated when material deforms. To my knowledge, no one has looked at turning these stacking faults into mechanisms for strengthening."

While past research conducted individually and collaboratively by Kulkarni and Zhang specifically focused on methods to improve



strength and ductility in copper for structural applications, this collaboration also emphasizes understanding the universal atomistic mechanisms responsible for such properties in order to apply them to any crystalline material.

Furthermore, the joint venture provides the student research groups at the different institutions with opportunities to exchange complementary knowledge through visits, lectures and seminars as well as frequent video conferences.

"As an engineer, discovering mechanisms that can make materials stronger and more ductile is exciting because it opens up avenues for designing novel materials for structural needs," Kulkarni said. "So we want to see how these planar defects lead to high strength and deformability at the scale of atoms."

UH FERROFLUID RESEARCH MAKES THE COVER OF PRESTIGIOUS JOURNAL

BY ELENA WATTS

Research on ferrofluids conducted by **Hadi Ghasemi,** assistant professor of mechanical engineering at the UH Cullen College of Engineering, and his NanoTherm Research Group published last November on the cover of *Applied Physics Letters*.

"I'm delighted that our work was selected for the cover," Ghasemi said. "I credit my doctoral students, Peyman Irajizad and Nazanin Farokhnia, for bringing competence, dedication and enthusiasm to our research project."

Ferrofluids, which contain magnetic nanoparticles, are used in magnetic drug targeting, magnetic hyperthermia cancer treatment and magnetic resonance imaging contrast agents, among numerous other applications. Basically, a magnetic field can remotely manipulate ferrofluids noninvasively in human bodies and experimentally in laboratories. Small volumes of ferrofluids are necessary for most applications, but existing techniques for dispensing such amounts have limitations.

"Microfluidics and acoustic actuation are current approaches to generate small volumes, but they are complicated, and they cannot be implemented for all applications," Ghasemi said. "So we need to generate a much simpler way to dispense ferrofluids."

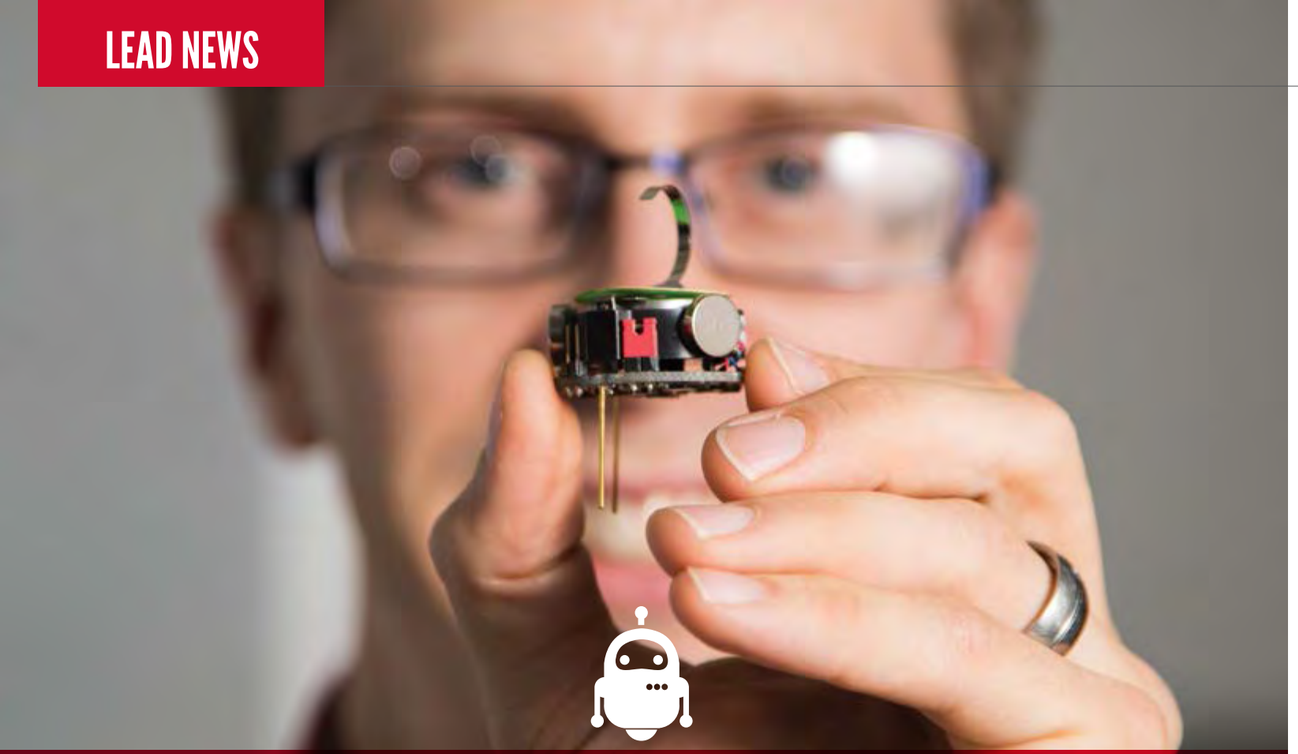
> "I'M DELIGHTED THAT OUR WORK WAS SELECTED FOR THE COVER."

Ghasemi and his students developed a novel method for dispensing small volumes of ferrofluids by constraining flux with a porous membrane and an inhomogeneous magnetic field. They can dispense a wide range of ferrofluids in quantities ranging from nanoliters to picoliters in single or multiple droplets at different frequencies either continuously or intermittently. They can pause dispensation of the droplets by simply deactivating the magnetic field.

"By tuning the magnetic field and changing the type of membrane, we can change the volume of the ferrofluid dispensed," Ghasemi said. "We can dispense one droplet, two droplets or one hundred droplets in one second."

The group also developed a mathematical model that accurately predicts the volume of the dispensed droplets, which provides potential to rational implementation of ferrofluids in a wide range of applications.

"Our goal is to elucidate fundamentals of thermal-fluid systems at nanoscales and pave the way for breakthroughs in smaller scale devices," Ghasemi said.



ENGINEER EARNS NSF CAREER AWARD TO STEER SWARMS OF MICRO-ROBOTS

BY ELENA WATTS

Aaron T. Becker, assistant professor of electrical and computer engineering, earned a five-year, $550,000 CAREER award from the National Science Foundation (NSF) for his robotic research proposal titled, "Massive Uniform Manipulation: Algorithmic and Control Theoretic Foundations for Large Populations of Simple Robots Controlled by Uniform Inputs." The NSF Faculty Early Career Development Program awards 600 grants each year to help promising young faculty members lay the foundations for successful academic careers.

In the 2014 Disney movie "Big Hero 6," the protagonist, Hiro, offers a profound view into the future by manufacturing a swarm of 105 micro-robots. Hiro controls them to self-assemble, to build structures and to transport goods and materials. While the micro-robots of the film are fantasy, the ideas are rooted in reality. Producing large numbers of micro- and nano-robots is possible today. Micro-robots can be manufactured in large numbers by micro-electro-mechanical systems processes. Also, biological agents such as bacteria and paramecium can be grown to achieve large swarms.

Becker's vision is for large swarms of robots remotely guided through the human body to cure disease, heal tissue and prevent infection. The biggest barrier to Becker's vision is a lack of control techniques that can reliably exploit large populations despite incredible under-actuation.

"Robotic manipulation at micro- and nano-scales can fundamentally transform how we treat diseases and assemble objects," Becker said. "My goal is to precisely deliver materials and assemble structures from the bottom up."

This precision manipulation must be coupled with a large population of manipulators to enable rapid progress. The potential impact is broad: large populations of micro-manipulators could provide targeted drug-delivery, perform minimally invasive surgery and engineer tissue.

Manipulation with these robots requires motion control. However, the small size of micro- and nano-robots severely limits computation, sensing and communication. Distributed control is infeasible – building autonomous robots is currently impractical at the micro-scale and seems impossible at the nano-scale. Instead, robots at this scale are currently powered by global force fields, such as a magnetic gradient or light broadcast at a specific frequency. Centralized approaches are feasible, but individually controlling a million robots requires an equally large amount of communication bandwidth, ultimately limiting the population size. Becker is designing new techniques for centralized control under the constraint that every robot receives exactly the same input commands. The unifying theme is using obstacles to efficiently control the shape, arrangement and position of the swarm.

> "ROBOTIC MANIPULATION AT MICRO- AND NANO-SCALES CAN FUNDAMENTALLY TRANSFORM HOW WE TREAT DISEASES AND ASSEMBLE OBJECTS."

In a drug-delivery application, blood vessels and other lumens serve as natural passageways to every part of the human body, so theoretically, external control algorithms could steer concentrations of drug particles to precise targets for more effective treatment of diseases.

Such a technique could revolutionize chemotherapy. Current treatment regimes flood cancer patients' veins with toxins carefully calibrated to kill fast-growing cells. This targets tumors, but unfortunately also destroys cells that form hair and fingernails. With the controllers Becker is designing, physicians could use the body's passageways to deliver concentrations of drugs with higher toxicity to specific areas with fewer patient side effects.

Furthermore, current robotic micro-assembly techniques use sophisticated micro-scale tweezers to individually place one component at a time. Becker's lab is designing maze-like structures that, when actuated, simultaneously assemble multiple copies of a desired structure.

"In parallel, the process would look like a factory on a microchip," Becker said.

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 is looking for intelligent ways to exploit the environment to make large robot swarms perform particular tasks.

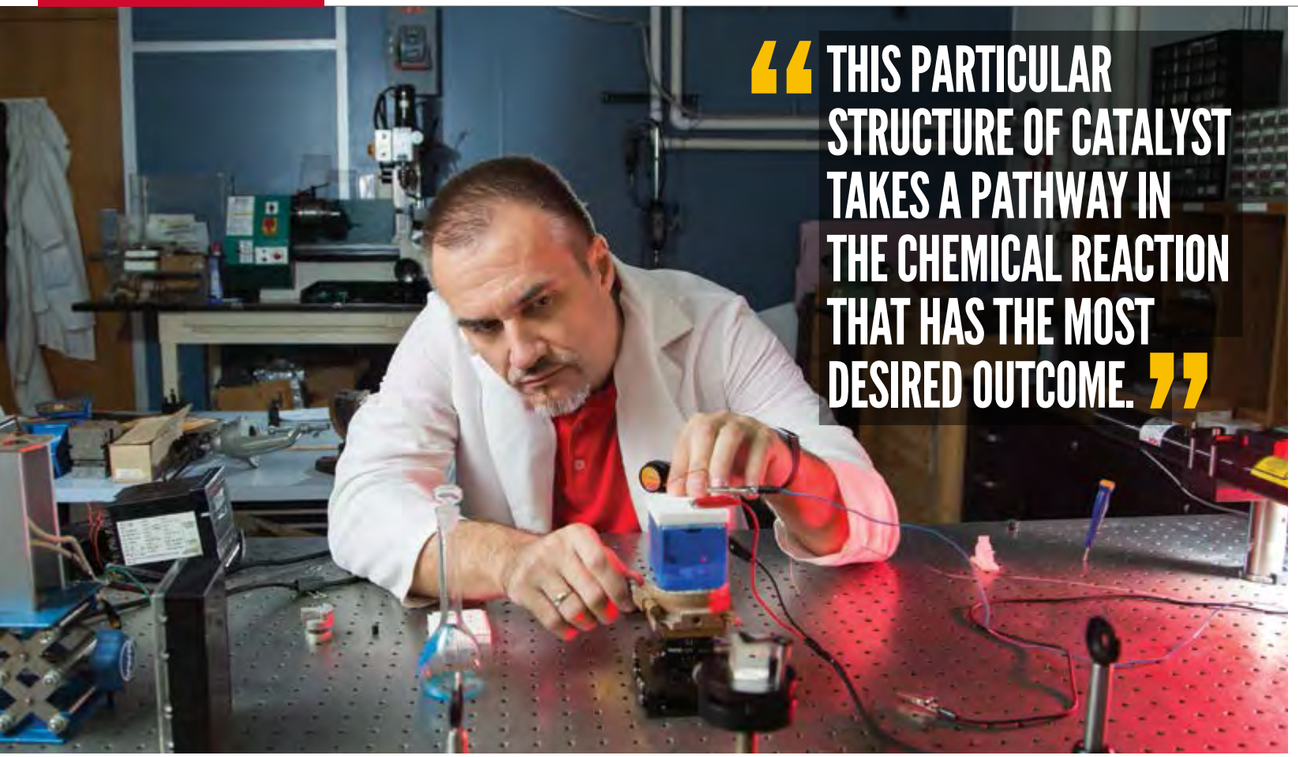
NSF CAREER awards require an emphasis on broader outreach that extends the research into society. Becker's lab hosts externships with local HISD high school teachers, internships for a select group of high school students and outreaches to local robotics clubs. He seeks to empower high school students and teachers, especially those from under-represented groups, to perform STEM outreach to younger students using rapid prototyping, intelligent online gamification and hands-on learning.

Becker developed a website, SwarmControl.net, that allows visitors to play games that compare and contrast several control theories for directing swarms of simulated robots. More than 10,000 people have participated in the two-year study thus far.

"SwarmControl.net gives us an ideal sandbox to test our theories. We have game challenges such as using a swarm of robots to push a ball through a maze," Becker said. "For each game, we can test whether increasing the number of robots from 50 to 1,000 makes the challenge easier or harder, or test if it is better to have a swarm attracted or repelled by a user's mouse click. Anyone interested in robots who has a computer can help us understand how best to control swarms."

In his laboratory, Becker uses a swarm of 100 small robots to test control laws and algorithms. These robots are each about the size of a quarter. One experiment steers the robots to act as compliant manipulators that push around a slightly larger toy piano. These same control techniques will be implemented using global forces to make tiny particles perform useful tasks.

"The key insight is rather than steer individual particles, we treat the swarm as an entity," Becker said. "We then push the swarm into walls to squeeze the swarm, collect the swarm into a dense mass or shape the swarm into a useful tool."



UH ENGINEERS DISCOVER SUPERIOR METALLIC MONOLAYER CATALYST

BY AUDREY GRAYSON

Researchers at the UH Cullen College of Engineering have synthesized and characterized a novel metallic monolayer catalyst with far superior catalytic properties than those currently used in industry.

Stanko Brankovic, professor of electrical and computer engineering, and **Lars Grabow**, professor of chemical and biomolecular engineering, published their findings in a special issue of the journal *Surface Science*. Out of more than 25 papers chosen for publication in the special issue, Brankovic and Grabow's paper, titled "Novel 2D RuPt core-edge nanocluster catalyst for CO electro-oxidation," was chosen as the journal's featured cover story.

Brankovic and his Ph.D. student, Qiuyi Yuan, successfully synthesized nanostructures with catalytic properties far superior to currently available industrial catalysts.

The core of Brankovic's idea was to create a two-dimensional monolayer made up of clusters of one metal, such as ruthenium, with a perimeter made up of another metal, such as platinum.

After confirming the remarkable catalytic properties of the material, Brankovic recruited Grabow, whose primary research interest is in running complex computer simulations to predict how and why some catalysts perform better than others in certain chemical reactions.

"Lars had a hunch that the reason this material performs so well as a catalyst is due to the finite size effect," Brankovic said.

The finite size effect relates to the bonds that form between atoms in a cluster. In a body of atoms, the atoms in the center of the cluster form strong bonds with the surrounding atoms. Atoms located on the periphery of the cluster form weaker bonds because there are no atoms on the other side to keep them in equilibrium.

Grabow, along with his graduate student Hieu Doan, began running computer simulations to try to identify structures that could obtain extremely favorable catalytic properties due to the finite size effect. Using theoretical calculations to test their hypothesis, Grabow and Doan confirmed that the finite size effect contributed to the materials' catalytic qualities.

"They found that the finite size effect in this particular system is huge and leads to reconstruction of the whole cluster, where the morphology of the monolayer has ripples," Brankovic said.

The unique ripples in this system have positions for higher energy absorption and lower energy absorption, Brankovic added. "This leads to a net spectacularly high catalytic effect, so the finite size effect in particular systems such as this one can promote catalytic properties that until now have not been understood."

After characterizing precisely what was happening inside of the metallic catalyst, Brankovic, Grabow, Yuan and Doan tested the material in carbon monoxide oxidation. The team used spectroscopy to measure the absorption energetics in the reaction.

"It turned out that everything Lars and Hieu had calculated was reconfirmed in these tests," Brankovic said.

In addition to discovering a new method of synthesizing monolayer metallic catalysts, Brankovic and Grabow noted that this research represents a turning point for monolayer catalysis in general.

"Many catalysts can do the job, but chemical reactions can go many different pathways," Brankovic said. "This particular structure of catalyst takes a pathway in the chemical reaction that has the most desired outcome, with better activity and selectivity."

Although the researchers noted that more fundamental research is needed in this area, they hope that in the future these catalysts can be used for methanol or ethanol fuel cells as well as synthetic oxidation, such as the conversion of natural gas to methanol.

Both Brankovic and Grabow are winners of prestigious National Science Foundation CAREER awards, which helped partially to fund this research. Funding for this work also came in the form of a University of Houston GEAR award for both researchers, which offers seed funding to young researchers looking to get projects inside their laboratory off the ground.

"There's a lot left to do in this area, and we hope to continue working on this. Our ultimate hope is to attract more funding to continue this work," Brankovic said.

TO ACCESS THE FULL ARTICLE, PLEASE VISIT:
www.sciencedirect.com/science/article/pii/S0039602815000813

PROFESSOR'S SOFT MATERIALS RESEARCH MAKES COVER OF PRESTIGIOUS JOURNAL

BY ELENA WATTS

The November 2015 inside cover of the journal *Soft Matter* features research conducted by **Pradeep Sharma**, professor and chair of the mechanical engineering department at the UH Cullen College of Engineering, his doctoral student Xiaobao Li and his collaborator Liping Liu of Rutgers University.

Under the umbrella of a three-year National Science Foundation grant, they discovered that altering the quantum field of soft nanostructures could cause significant mechanical deformation.

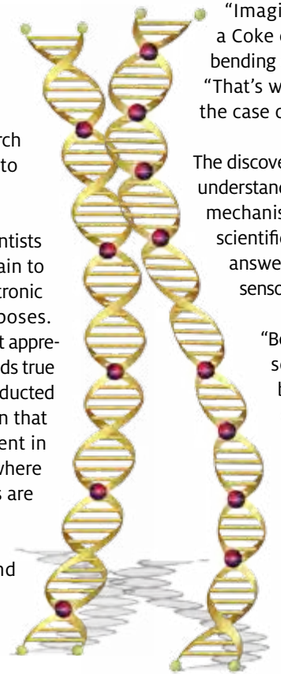
"It's gratifying that our research is what the editor decided to highlight," Sharma said.

For many years, material scientists have applied mechanical strain to semiconductors to tailor electronic properties for specific purposes. However, most of them did not appreciate that the opposite also holds true – until recently. Research conducted by Sharma's group has shown that this phenomenon is prominent in certain soft nanostructures where very large mechanical strains are achievable.

"So this is relatively new and interesting work, but most importantly we took into account aspects of the phenomenon that no one had ever thought of," Sharma said. "We're now trying to understand the ramifications of this fundamental scientific discovery."

Slight changes to the quantum fields of soft semiconductors, such as polymers, DNA and RNA, can cause drastic mechanical deformations. For example, simply shining light from a distance on a soft nanostructure could activate desired mechanical motion.

“WE TOOK INTO ACCOUNT ASPECTS OF THE PHENOMENON THAT NO ONE HAD EVER THOUGHT OF.”



"Imagine that I shine a light on a Coke can, and it starts twisting, bending or stretching," Sharma said. "That's what we're talking about in the case of DNA, for example."

The discovery can lead to an enhanced understanding of the charge transport mechanism in DNA, a fundamental scientific question that remains unanswered, as well as to advanced sensor and actuator technologies.

"Being able to remotely trigger something far away would be an asset in the creation of future devices," Sharma said. "Our work caught the eye of the reviewers and editors, so I'm hoping it will be both useful and well-regarded."

NSF CAREER AWARD ENABLES PROFESSOR TO DEVELOP 3D ELECTRONICS MANUFACTURING PROCESS

BY ELENA WATTS

Cunjiang Yu, assistant professor of mechanical engineering at the UH Cullen College of Engineering, earned a $500,000, five-year CAREER award from the National Science Foundation (NSF) to continue development of his novel manufacturing process for three-dimensional (3D) curvilinear electronics.

While microfabrication with planar and rigid silicon wafers has been used in conventional two-dimensional (2D) electronics for more than a few decades, manufacturing processes for electronics in 3D curvilinear constructs have not yet been developed. With this NSF CAREER award, Yu will explore a platform for conformal stamp printing and manufacturing technology to provide a practical process for construction of 3D electronics.

Using a deformable inflated elastomer balloon with a sticky surface, Yu grabs the ink from a conventional planar surface and presses the balloon to a curved or uneven 3D surface until it conforms, thereby printing the ink. The ink endures a safe level of mechanical strain during the process and the speed of retracting the balloon determines whether the ink is grabbed or printed.

Yu's five-year project will explore the manufacturing process, study the interfaces between the stamp and the inks, and investigate the deformation mechanics and the pattern distortion of the inks during grabbing and printing.

The award will also support educational and outreach activities, and Yu intends to pursue a variety of avenues. He plans to develop a "3D Curvilinear Electronics Day" workshop for junior high and high school teachers and their students, especially those from underrepresented groups; to promote both undergraduate and graduate research; to develop new courses for engineering students; to incorporate research outcomes into the upcoming manufacturing graduate program at UH; and to disseminate knowledge to the general public.

"A piece of paper cannot conform when wrapped around a sphere, and during manufacturing, the devices need to be geometrically compatible," Yu said. "The elastomer balloon is capable of conformation to most surfaces – flat, curved and uneven – so the pre-fabricated electronics as inks on the balloon need to survive stretching or certain amounts of strain during the lifting and printing steps."

The findings from Yu's research project will remove a major roadblock to 3D curvilinear electronics manufacturing. Potential applications for Yu's novel process include telecommunication, biomedical, solar and camera technologies, among others.

ENGINEERS EARN $1.5 MILLION TO PURSUE NOVEL NANOPATTERNING TECHNOLOGY

BY ELENA WATTS

Pictured (from left): Jiming Bao, Paul Ruchhoeft, Vincent Donnelly, Demetre Economou

Last October, four UH Cullen College of Engineering professors earned a four-year grant amounting to almost $1.5 million from the National Science Foundation (NSF) to pursue their nanopatterning discovery that could lead to next-generation transistors for integrated circuitry, among other advanced nanodevices.

With new capabilities developed through this grant, the researchers can explore potential materials to replace ubiquitous silicon transistor switches, the building blocks of computers that are reaching their technological limitations. Specifically, they are studying the effects of nanopatterning on the scientific supermaterial, graphene, to invent faster transistors for computers of the future that consume less energy as they operate more quickly.

Several years ago, **Vincent Donnelly**, principal investigator on this project, and **Demetre Economou**, both Cullen College chemical and biomolecular engineering professors, along with **Paul Ruchhoeft**, Cullen College electrical and computer engineering associate professor, invented nanopantography, a novel nanopatterning technique. An array of lenses disperses a broad ion beam into billions of beamlets that each bend to the same spot, approximately 100 times smaller than the diameter of one lens, on a 2D substrate. The substrate is then tilted so each beamlet can simultaneously etch the desired pattern on its surface.

"In the initial stages of this research, we were able to make features as small as 10 nanometers, which approaches state-of-the-art," Donnelly said. "More recently, we have reduced features to 3 nanometers, and we believe we can go even smaller, which is something no one has done."

The lens array was originally fabricated permanently on the substrate, which presented challenges from a long-term manufacturing perspective. Ruchhoeft joined the new project to develop a reusable stencil mask lens array that the engineers can move to cover large substrate surface areas.

The stencil mask is fabricated with posts that secure a 1-micrometer gap between its lens array and the substrate. The positive voltage applied to the lens array for etching also electrostatically clamps the mask to the substrate. Removal of the voltage after processing releases the stencil mask for repeated use on other substrates, the print-and-repeat process.

"We improved the throughput and resolution of this nanopatterning method with a two-step process," Donnelly said. "Nanopatterns are first formed in a very thin masking layer by nanopantography and then transferred to the underlying material by highly selective plasma etching."

Donnelly, Economou and Ruchhoeft are collaborating with **Jiming Bao**, another Cullen College electrical and computer engineering associate professor. Bao joined the project to provide expertise in development of applications for graphene. He intends to explore potential for creating transistor channels from the nanopatterns etched on the highly conductive one-atom-thick carbon sheets. Four doctoral students and several graduate students will also work on the project.

"The proposed work will provide students with rich scientific and educational payoffs," Donnelly said. "We will also incorporate nanopatterning of 2D materials into our NSF-seeded, multidisciplinary Nano-Engineering Minor Option, NEMO, a subset of the undergraduate curricula."

Economou and Donnelly are developing molecular dynamic simulations to follow atomic evolution of the system, primarily the effects of ion bombardment energy on substrate surfaces, to determine the smallest features that exhibit the desired behaviors.

"With this grant, we will develop a unique tool that prints over large areas through the print-and-repeat process, we will demonstrate nanopatterning of graphene sheets and other 2D materials, and we will measure and characterize these materials," Ruchhoeft said. "It's not just a continuation of existing integrated circuit manufacturing approaches since we will have an opportunity to develop new and better performing materials that can displace those currently used."

THE ENTRE PRENEUR ISSUE

SMALL IDEAS

BIG IMPACTS

BY ELENA WATTS

ILLUSTRATIONS BY LINH HOANG

A coffee ring stained into a white paper napkin. A polymer spilled accidentally onto a hot plate. A children's toy – the kind they give away at dentist's offices – that you must tilt to push ball bearings through a maze.

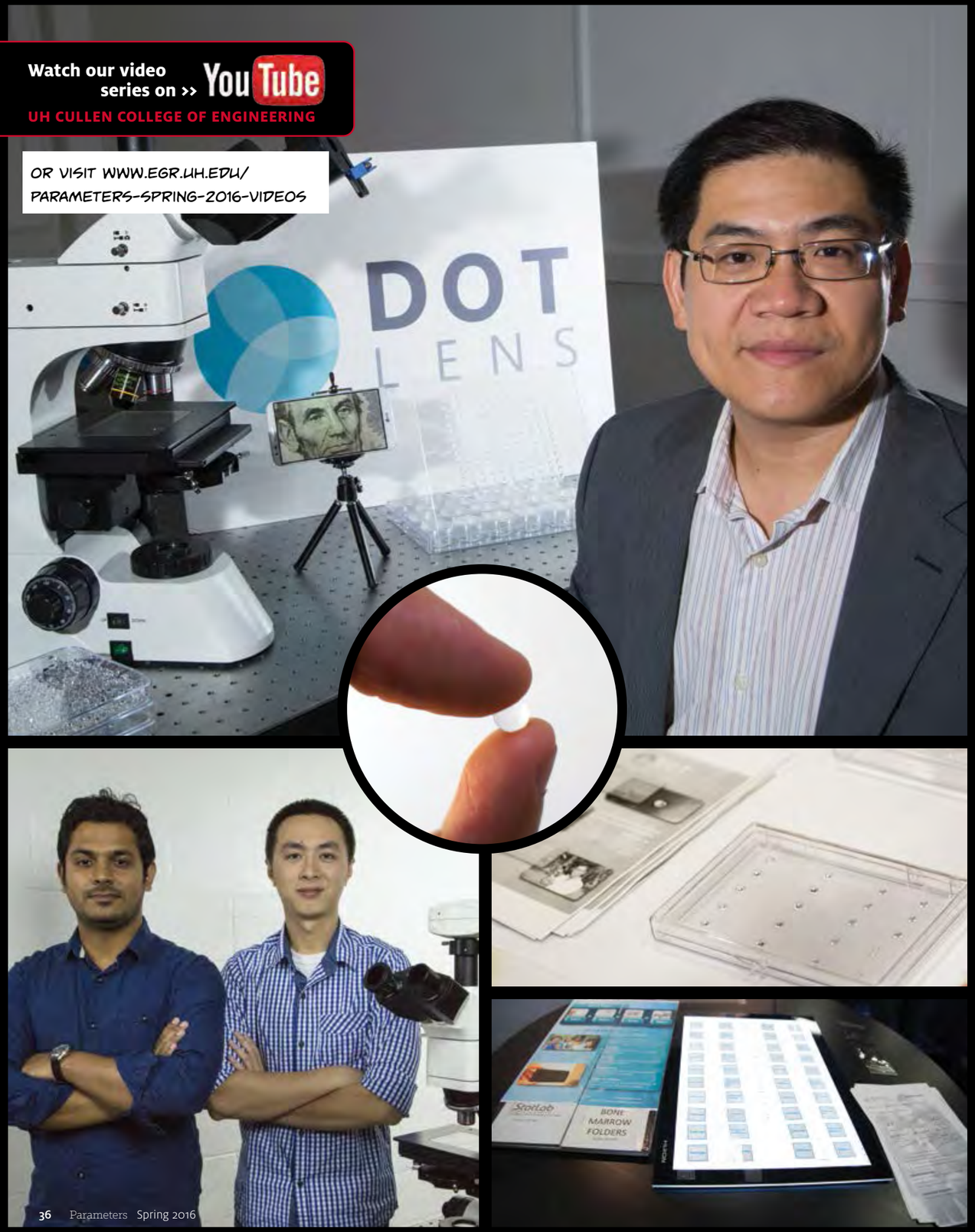
Though these details seem small enough to ignore without consequence, each of them inspired life-altering discoveries and inventions by engineers at the UH Cullen College of Engineering.

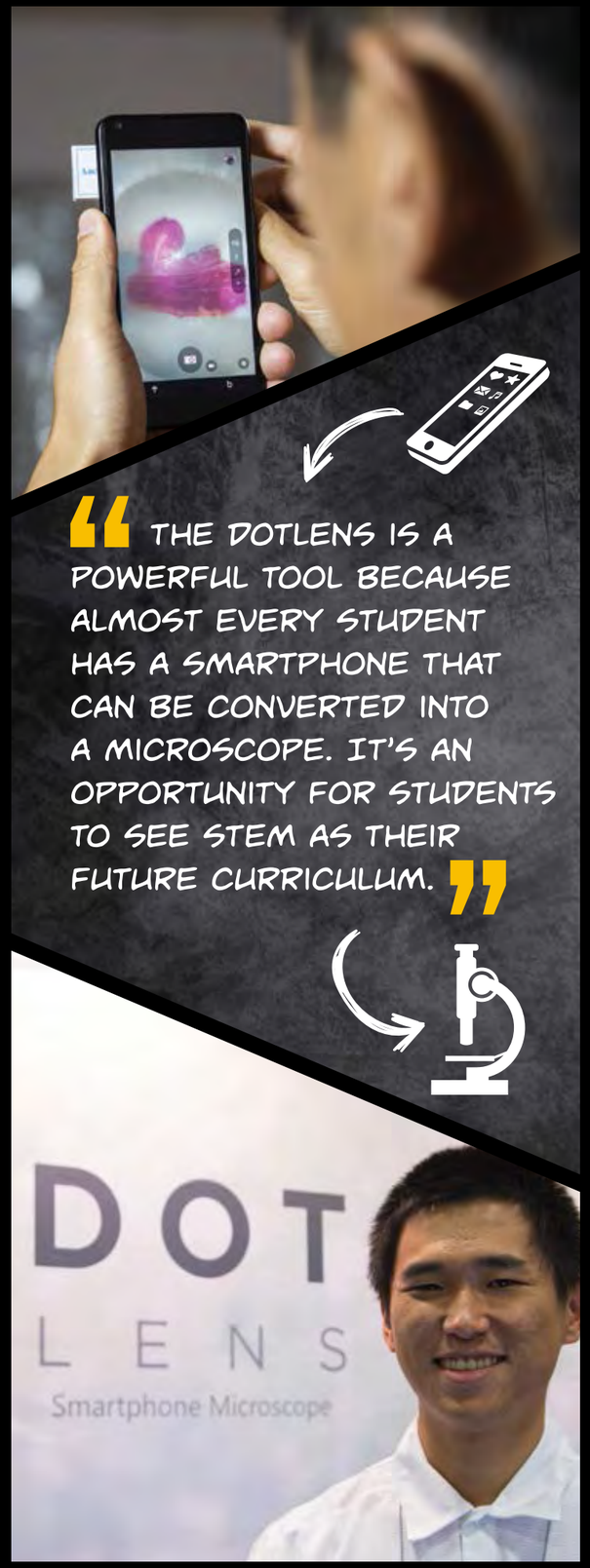
Some of the game-changing advancements we explore in this issue were inspired by paying attention to life's smallest details. Others came about by simple ideas, little accidents or happenstance conversations. And some are just tiny – physically tiny – such as robots small enough to travel through the human body or nano-sized water filtration systems.

"To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science," Albert Einstein wrote in *The Evolution of Physics*, published in 1938.

Professors and students at the UH Cullen College of Engineering apply more than knowledge to the scientific process – these engineers bring creativity to problem solving and imagination to scientific discovery. UH engineers look at life's smallest details and see the solutions to some of the world's biggest problems.

Read on to explore the small ideas that are making big impacts in the world today, and how many UH engineers are taking their ideas out of the laboratory and into the consumer marketplace.





SMARTPHONE MICROSCOPE AMPLIFIES STEM EDUCATION

DotLens Smartphone Microscopy is a UH Cullen College of Engineering project that could revolutionize science, technology, engineering and mathematics (STEM) education in K-12 classrooms around the world, among other innovative initiatives.

Wei-Chuan Shih, associate professor of electrical and computer engineering, developed an optical lens that converts smartphone cameras into microscopes that can magnify specimens by more than 100 times.

"For schools without the financial resources to outfit student labs with expensive microscopes, this economical lens has potential to greatly enhance science education," Shih said. "Ultimately, the applications for this technology are limited only by one's imagination."

The lens was discovered when a droplet of polydimethylsiloxane (PDMS), a polymer with the consistency of honey, was accidentally spilled on a hot surface in Shih's lab. Shih and his students soon found that the temperature determines the curvature of the lens, and consequently, the level of magnification. The flexible, removable optical lens adheres to the smartphone camera without an additional apparatus.

Last year, Shih won the National Science Foundation's Innovation Corps (I-Corps) award to pursue commercialization of his product. The purpose of the I-Corps program is to take scientific ideas out of the laboratory and into the marketplace. Shih is the principal investigator, and **Yulung Sung**, his doctoral student, is the entrepreneurial lead. They recruited Ken Jones, director of the Wolff Center for Entrepreneurship at the UH Bauer College of Business, as their industry mentor.

Shih and his team attended entrepreneurial workshops and interviewed more than 100 potential customers to strengthen their business case as part of the NSF program. They discovered that science teachers enthusiastically endorse the smartphone lenses for their classrooms and that distributors of classroom science kits and textbook publishing companies are the best nationwide distribution channels for their product.

Of the 21 participating I-CORPS teams, the UH team was one of only seven businesses ready to launch by the end of the program. Their goal moving forward is to secure additional funding, to engage strategic partners and distributors, and to secure a manufacturing facility for mass production of the optical lens at a reasonable cost.

"The DotLens is a powerful tool because almost every student has a smartphone that can be converted into a microscope," Sung said. "It's an opportunity for students to see STEM as their future curriculum."

> "THE DOTLENS IS A POWERFUL TOOL BECAUSE ALMOST EVERY STUDENT HAS A SMARTPHONE THAT CAN BE CONVERTED INTO A MICROSCOPE. IT'S AN OPPORTUNITY FOR STUDENTS TO SEE STEM AS THEIR FUTURE CURRICULUM."

NASA, David Stanley, Guillén Pérez

SOFTWARE HELPS SOUTH ASIANS PREPARE FOR FLOODS

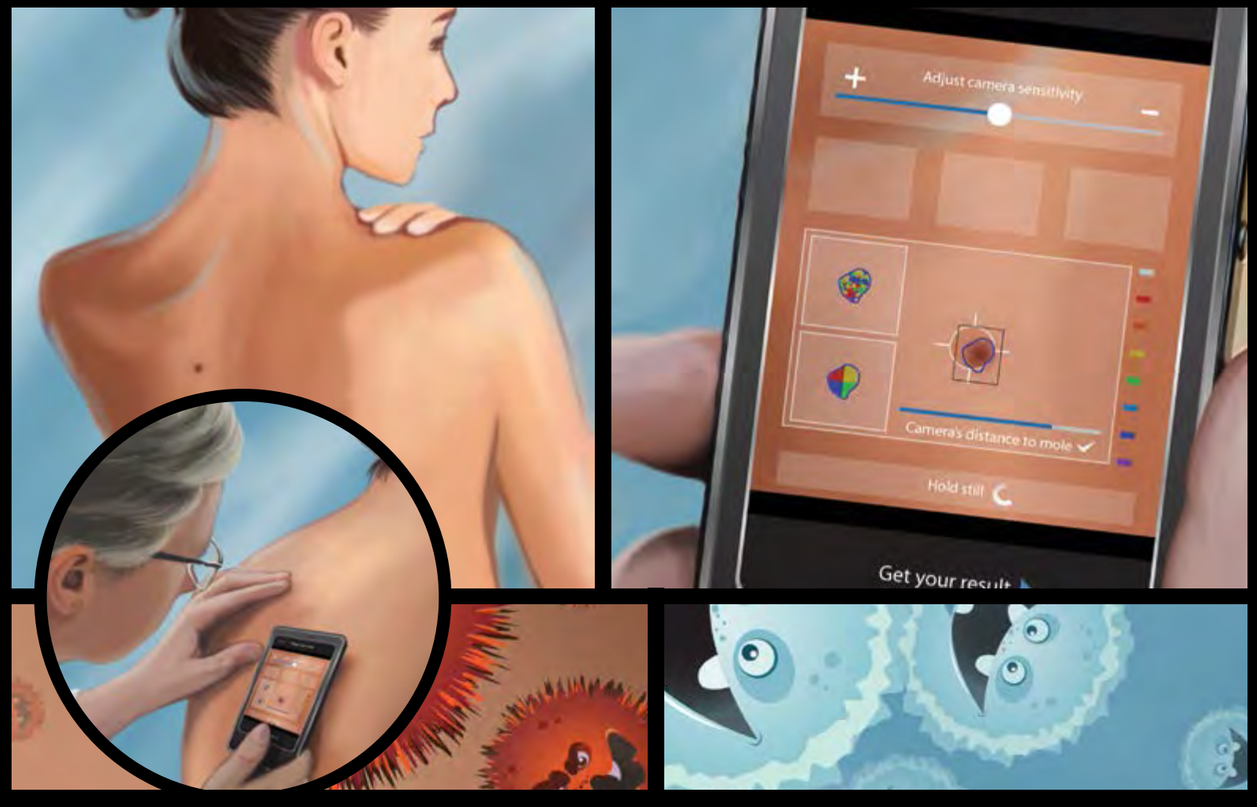
South Asian governmental officials are using novel software produced by **Hyongki Lee**, assistant professor of civil and environmental engineering, to predict river levels and to prepare for flooding during monsoon season.

In recent years, the annual heavy rains combined with increased glacial melt have made flooding more severe as well as more difficult to predict in regions of South Asia. Compounded by poor communication between South Asian officials about flood conditions in their respective countries, those downstream have had insufficient advanced warning. As a result, high waters have stranded millions of people in their homes, and waterborne diseases, electrocution, building collapses and drowning have killed many others, according to news reports.

A few years ago, Lee composed computer algorithms to translate NASA's Jason-2 satellite altimetry data on river water levels throughout the Ganges-Brahmaputra-Meghna Basin into robust flood prediction data sets. Recently, the Bangladesh Flood Forecasting Warning Center officially adopted the software to accurately predict floods up to eight days before they occurred, providing those living in the region with an additional five days for preparation.

With a NASA grant from the Applied Sciences Program, Lee and his collaborators from the University of Washington and Ohio State University traveled to Pakistan last year to train officials from various water management agencies to use the novel software. Lee and his team are also traveling to Vietnam, Bhutan and Nepal to train officials to operate the software and to get feedback to further customize the toolkits for the specific needs of each country.

"NASA encourages engineers to find novel ways to use satellite data for positive impacts on the Earth, and I specialize in that area of research," Lee said. "The software we develop will strengthen the ability of governments and other stakeholders to use NASA's satellite data to respond to natural disasters."



SMARTPHONE APP SCREENS PATIENTS FOR SKIN CANCER

A smartphone application called DermoScreen and a dermoscope attachment could allow millions of people without access to expensive medical specialists to evaluate suspicious-looking moles or skin lesions for signs of cancer, a condition that develops when skin cells become abnormal and multiply.

George Zouridakis, professor in both the College of Technology and the Cullen College of Engineering at UH, began developing the software in 2005 and converted his technology to a smartphone application when iPhones became ubiquitous.

"My initial goal is to provide automated skin cancer screening to physicians for prescreening of melanoma during routine patient checkups, and my eventual plan is to help consumers determine whether or not moles on their bodies need medical attention," Zouridakis said. "Our technology can also have a significant impact in the lives of people living in rural areas and developing countries who are underserved by medical specialists."

The UH Wolff Center for Entrepreneurship produced a business plan for the technology that won the $60,000 Grand Prize at the 2013 California Dreamin' National Business Plan Competition. Zouridakis also received $50,000 from the UH Division of Research to help take his product from conceptualization to commercialization.

The dermoscope attachment, which currently costs about $60, is a special patented magnifying lens that illuminates suspicious skin abnormalities for analysis with the patented DermoScreen software. Preliminary tests proved 85 percent accurate, a rate that nears accuracy achieved by dermatologists and exceeds preciseness provided by primary care physicians, he said.

"The project is an intersection of engineering, physics, biology, computer science and medicine," Zouridakis said.

Kelly Nelson, clinical associate professor of dermatology at M.D. Anderson Cancer Center, is in the preliminary phases of establishing protocols for testing the sensitivity and specificity of the new diagnostic technology. This April, she and Zouridakis plan to begin clinical validation of the technique for accurate diagnoses of cancerous skin lesions.

"At either end of the skin cancer spectrum – from normal skin lesions to advanced skin cancer – diagnoses are pretty straightforward," Nelson said. "Sorting out the middle ground is the challenge for an emerging diagnostic technology, and I'm excited to work with Dr. Zouridakis to validate the DermoScreen technology."

Other research projects using DermoScreen and related hardware are also in progress. The National Institutes of Health awarded Zouridakis with more than $400,000 to explore using the technology to screen for Buruli ulcer, a flesh-eating bacterial disease prevalent in Africa.

Watch our video series on >> YouTube

UH CULLEN COLLEGE OF ENGINEERING

OR VISIT WWW.EGR.UH.EDU/PARAMETERS-SPRING-2016-VIDEOS

SMARTPHONES DOUBLE AS RAPID DIAGNOSTIC TESTS

A professor and two researchers at the UH Cullen College of Engineering are developing a technology platform that transforms smartphones into medical devices that can rapidly detect bacteria, viruses and proteins in tiny blood and other human-derived fluid samples in less than 15 minutes. Initially, they are focusing on validation of the smartphone reader platform for detection of infectious diseases including chlamydia and dengue fever.

Bala Raja, a recent UH chemical engineering doctoral alumnus, and **Andrew Paterson**, a UH chemical engineering doctoral student, founded a startup company called Luminostics Inc. to commercialize the platform. Paterson first developed the technology in the laboratory of **Richard Willson**, UH Huffington-Woestemeyer professor of chemical and biomolecular engineering, who continues to serve as a technical adviser to Luminostics.

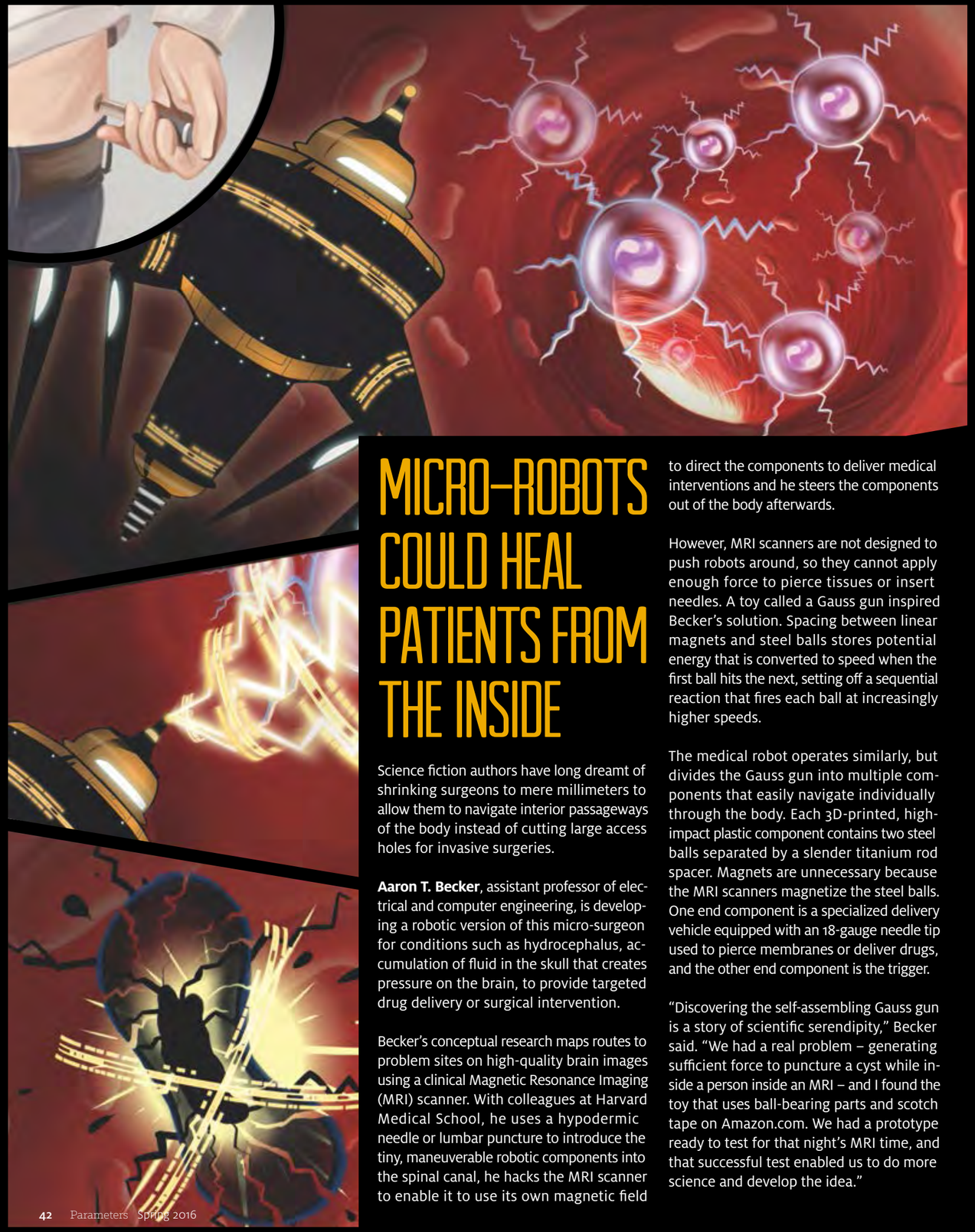
"Our vision is to ultimately sell over-the-counter rapid tests for common diseases and medical conditions at affordable prices in drug stores," Raja said.

To use the device, a few drops of blood or other fluid samples are added to a disposable test cartridge containing glow-in-the-dark nanoparticles called nanophosphors. The cartridge is inserted into a smartphone attachment that is similar to a protective case. A smartphone application automatically controls the phone's camera and flash to capture images of the luminescence emitted by the nanophosphors. The app then analyzes the images and displays a positive, negative or quantitative result for the user.

The light-based readout provides more sensitive, quantitative and reliable results than other over-the-counter, rapid diagnostic tests – for example, pregnancy tests – that sometimes require reading faint-colored lines with the naked eye. Furthermore, existing tests cannot detect low levels of diagnostic targets for many diseases as Luminostics' test can.

The nanophosphor research began with funding from the Western Regional Center of Excellence for Biodefense and Emerging Infectious Diseases Research (WRCE). A $50,000 National Science Foundation Innovation Corps (I-Corps) award in 2014 with Raja as entrepreneurial lead helped the team evaluate business aspects of the technology and partially fund the development of the smartphone reader platform.

The Centers for Disease Control and Prevention Dengue Branch in Puerto Rico recently funded a pilot project for the UH team to develop a diagnostic test using the nanophosphors and smartphone platform for dengue fever, a mosquito-borne infectious disease. Additionally, Johns Hopkins University's Center for Point-of-Care Testing for STDs recently awarded Luminostics with a $50,000 contract to develop a smartphone-based point-of-care test for chlamydia.



MICRO-ROBOTS COULD HEAL PATIENTS FROM THE INSIDE

Science fiction authors have long dreamt of shrinking surgeons to mere millimeters to allow them to navigate interior passageways of the body instead of cutting large access holes for invasive surgeries.

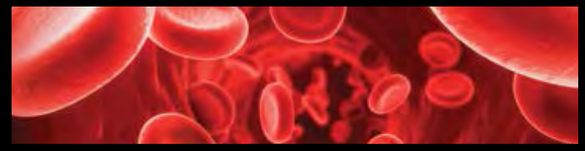
Aaron T. Becker, assistant professor of electrical and computer engineering, is developing a robotic version of this micro-surgeon for conditions such as hydrocephalus, accumulation of fluid in the skull that creates pressure on the brain, to provide targeted drug delivery or surgical intervention.

Becker's conceptual research maps routes to problem sites on high-quality brain images using a clinical Magnetic Resonance Imaging (MRI) scanner. With colleagues at Harvard Medical School, he uses a hypodermic needle or lumbar puncture to introduce the tiny, maneuverable robotic components into the spinal canal, he hacks the MRI scanner to enable it to use its own magnetic field to direct the components to deliver medical interventions and he steers the components out of the body afterwards.

However, MRI scanners are not designed to push robots around, so they cannot apply enough force to pierce tissues or insert needles. A toy called a Gauss gun inspired Becker's solution. Spacing between linear magnets and steel balls stores potential energy that is converted to speed when the first ball hits the next, setting off a sequential reaction that fires each ball at increasingly higher speeds.

The medical robot operates similarly, but divides the Gauss gun into multiple components that easily navigate individually through the body. Each 3D-printed, high-impact plastic component contains two steel balls separated by a slender titanium rod spacer. Magnets are unnecessary because the MRI scanners magnetize the steel balls. One end component is a specialized delivery vehicle equipped with an 18-gauge needle tip used to pierce membranes or deliver drugs, and the other end component is the trigger.

"Discovering the self-assembling Gauss gun is a story of scientific serendipity," Becker said. "We had a real problem – generating sufficient force to puncture a cyst while inside a person inside an MRI – and I found the toy that uses ball-bearing parts and scotch tape on Amazon.com. We had a prototype ready to test for that night's MRI time, and that successful test enabled us to do more science and develop the idea."



SICKLE CELL DISEASE DIAGNOSTIC TEST TO SAVE LIVES IN SUB-SAHARAN AFRICA

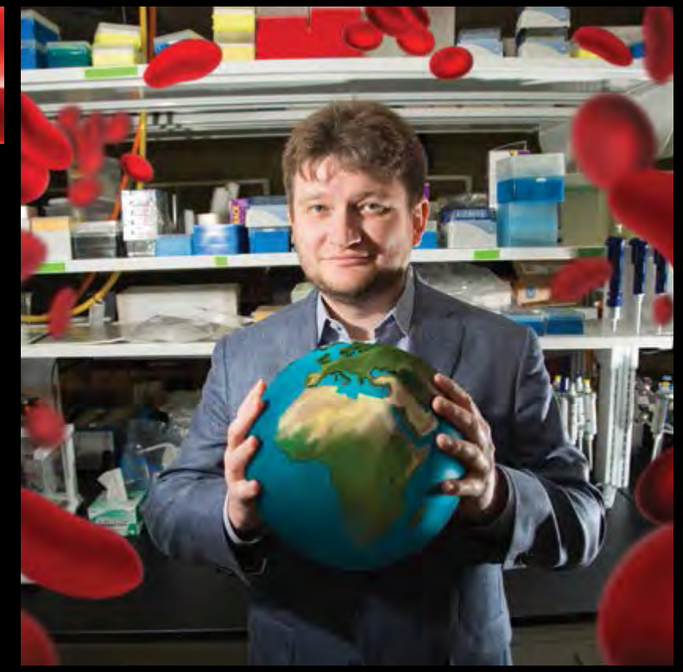
In the near future, an inexpensive paper-based diagnostic test for sickle cell disease, SCD, could help extend millions of lives, particularly those of young children in sub-Saharan Africa. More than 300,000 infants are born every year with SCD, an inherited blood disease that affects the way oxygen is carried in the human body. When SCD is not diagnosed early in life, most of these children die before reaching the age of 5.

Sergey Shevkoplyas, UH Cullen College professor of biomedical engineering, at the urging of his wife, **Natalia Zhivan**, UH clinical assistant professor of economics, found the time and resources to develop the diagnostic test for SCD. The disease has historically attracted significantly less funding than similar incurable diseases like cystic fibrosis that affect more affluent populations.

Inspiration for the test sprang from coffee stains on paper napkins. Tiny suspended particles that give coffee its blackish-brown color are transported through paper differently depending on their shape and size, and this phenomenon accounts for the coffee-ring effect – dark edges around light interiors. Shevkoplyas applied a similar principle to his SCD paper-based test to reliably detect indications of the trait, the disease or neither with the naked eye.

This simple test could replace the existing diagnostic methods that are too expensive for widespread use in developing countries. In 2014, the National Institutes of Health (NIH) awarded Halcyon Biomedical Incorporated, a company co-founded by Shevkoplyas, with a two-year, $450,000 Small Business Innovation Research grant to commercialize this diagnostic test. The current cost to produce each SCD paper-based test from off-the-shelf components is less than 15 cents.

"My personal goal is to make screening of children for SCD in Africa a self-sustaining venture, for which successful commercialization of the paper-based test is absolutely vital," Shevkoplyas said. "I believe that biomedical engineering can change the world for the best through innovative medical technology."



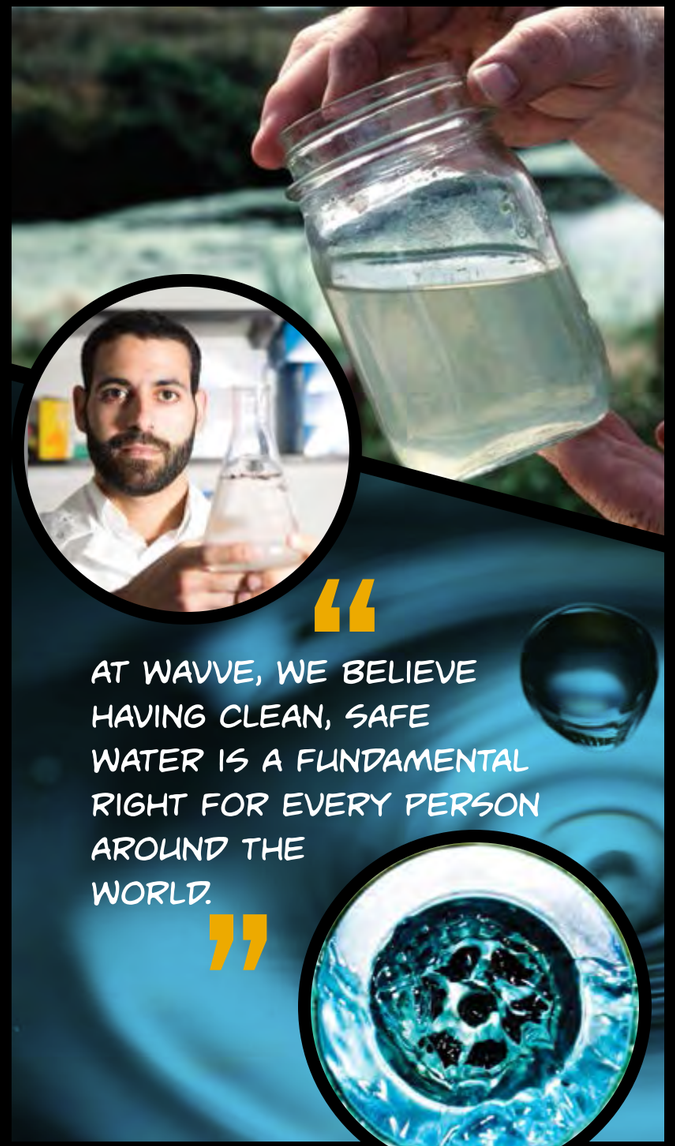
"I BELIEVE THAT BIOMEDICAL ENGINEERING CAN CHANGE THE WORLD FOR THE BEST THROUGH INNOVATIVE MEDICAL TECHNOLOGY."

Watch our video series on >> YouTube

UH CULLEN COLLEGE OF ENGINEERING

OR VISIT WWW.EGR.UH.EDU/PARAMETERS-SPRING-2016-VIDEOS

FROM LEFT: ERIC BEYDOUN, IVETTE RUBIO, DEBORA RODRIGUES, ENRICO NADRES, MARIA RODRIGUEZ-MOYA



"AT WAVVE, WE BELIEVE HAVING CLEAN, SAFE WATER IS A FUNDAMENTAL RIGHT FOR EVERY PERSON AROUND THE WORLD."

NANO-SIZED TECHNOLOGY IMPROVES GLOBAL ACCESS TO CLEAN WATER

A team of UH entrepreneurs formed a startup company, WAVVE, to provide populations throughout the world with clean water, especially those currently without access. **Debora Rodrigues**, assistant professor of civil and environmental engineering at the UH Cullen College of Engineering, developed a novel water filtration system that has served as the foundation for the business.

"I'm originally from a third world country, Brazil, so I always had in mind child mortality caused by problems with water quality," Rodrigues said. "So, when they approached me, I thought about the children's lives we could save with this technology."

Rodrigues' technology drastically improves the ability of existing residential, municipal and recreational water filtration systems to remove contaminants. WAVVE cofounders, **Eric Beydoun** and **Ivette Rubio**, both UH Bauer School of Business alumni, are targeting water filtration companies with their Bio-Bead technology.

"We realized that water was a global problem, and Dr. Rodrigues showed us her passion behind the idea," Beydoun said. "So we researched water problems in different countries and realized they could all benefit from this one product."

Most water filtration companies focus on removing chlorine and chemicals that affect water's odor and taste, but WAVVE's technology also removes heavy metals, microorganisms and organics that can react with chlorine to form carcinogenic compounds.

Rodrigues serves as an adviser to the team, which also includes **Enrico Nadres**, a UH chemistry alumnus serving as lead scientist, and **Maria Rodriguez-Moya**, a Rice University alumna who serves as lead chemical engineer. For their efforts, the UH team was named to the 2015 list of 50 Young Entrepreneurs Aiming to Change the World by *Inc. Magazine*. Furthermore, WAVVE won business plan competitions in Houston, Nassau, Bahamas and Paris, France. The UH RED Labs startup accelerator accepted the business in 2014, and the H_2O Challenge, an aquatech startup accelerator based in Madrid, Spain, admitted the business last year.

"At WAVVE, we believe having clean, safe water is a fundamental right for every person around world," Beydoun said. "We found that 3.4 million people die from water-related diseases every year, and it's completely preventable."

SMARTPHONES SAVE LIVES WITH EARLY EARTHQUAKE WARNING SYSTEM

Global Positioning System, GPS, sensors in smartphones could provide reliable earthquake early warning, EEW, in regions of the world where resources are unavailable for building and maintaining dense networks of scientific instruments necessary for comprehensive advanced warning systems.

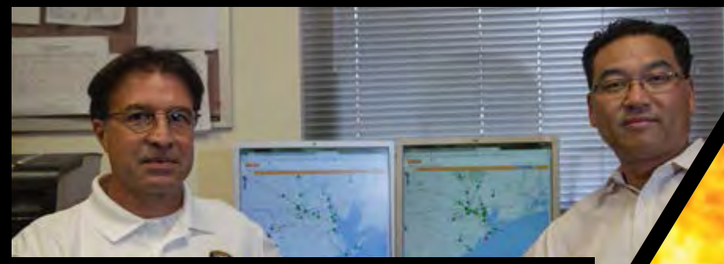
Craig Glennie, assistant professor of civil and environmental engineering at the UH Cullen College of Engineering, collaborated on the development of a system that uses GPS receivers in smartphones for crowdsourcing that, when implemented, could provide users with valuable seconds of advanced warning for magnitude 7 or greater earthquakes.

Although the smartphone systems are less accurate than conventional early warning systems, the GPS sensors and accelerometers in smartphones can detect ground movement caused by fault motion during large earthquakes, providing early warning for areas farther away from the earthquake epicenter. They have potential to minimize damage caused by earthquakes in regions where smartphones are increasingly common and resources are limited.

"Seconds may not seem like a long time to prepare for a quake, but in many cases, it's enough time to make the difference between life and death," Glennie said. "Drivers can pull off the road, people inside buildings can stand beneath doorways and surgeons operating on patients can retract their scalpels."

With support from USAID, the research team is currently installing a test network of approximately 200 smartphone sensors in Chile, one of the more tectonically active regions in the world. This initial test bed will enable full evaluation of the methods and techniques for detecting earthquakes with smartphones and for providing real-time early warning.

The collaborative research project involved other scientists from the University of Houston, the U.S. Geological Survey, California Institute of Technology, NASA's Jet Propulsion Laboratory and Carnegie Mellon University-Silicon Valley, and included support from the Gordon and Betty Moore Foundation.



WIND MAPS HELP SAVE LIVES OF HOUSTON'S FIRST RESPONDERS

A professor at the UH Cullen College of Engineering is helping Houston firefighters stay out of harm's way with maps that track wind speeds and directions in real time. **Gino Lim**, chairman of the industrial engineering department, composed algorithms that convert wind data into graphic displays on computerized maps to assist first responders with strategies and tactics for flame and hazardous material containment.

Wind speeds greater than 10 miles per hour profoundly affect the rates and directions that fires spread. Furthermore, interior conditions change drastically when a window, a door or a roof suddenly fails, allowing high winds to rush inside and fan the flames. During hazardous material emergencies, understanding wind conditions helps responders approach the scenes from safe directions and determine evacuation plans when necessary. Lim's technology provides Houston firefighters with access to this critical information in seconds rather than minutes typically required.

The wind maps are displayed on computer monitors in a Houston fire station and in the Office of Emergency Communications (OEC). Each conveys wind conditions intuitively in real time with nine large, strategically located arrows that point in directions the winds are blowing across the city. The arrows are color-coded to allow responders to effortlessly discern approximate wind speeds – red for speeds at least 15 miles per hour, yellow for speeds between 10 and 14 miles per hour and green for speeds lower than those. The exact wind speeds are displayed inside the bases of the arrows.

Currently, 18 of approximately 350 wind sensors located across Houston are capable of collecting and sending information to the central computing station. While Houston firefighters are already benefitting from Lim's wind maps, the next important step for the UH team is to secure funding for the addition of advanced sensors across the region.

FROM LEFT: GINO LIM AND FERNANDO HERRERA, DEPUTY CHIEF OF THE HOUSTON FIRE DEPARTMENT

UH ENGINEER WINS AMERICAN VACUUM SOCIETY'S PAUL H. HOLLOWAY YOUNG INVESTIGATOR AWARD

BY AUDREY GRAYSON

Cunjiang Yu, assistant professor of mechanical engineering, is the 2015 winner of the American Vacuum Society's (AVS) Thin Film Division Paul H. Holloway Young Investigator Award. In addition to a cash prize, Yu was presented his award at the 62nd AVS International Symposium & Exhibition last October.

The award honors young scientists who have contributed outstanding theoretical and experimental work in an area related to thin films. Yu received the award for his significant contributions in the areas of flexible, stretchable and wearable electronics.

"I'm very honored and grateful to receive this award," Yu said. "I feel like it is a vote of confidence for my research. This award will spur me to work harder to make more contributions to the scientific community."

Thin films are commonly used in electronic semiconductors and optical coatings, such as the metal coating placed on glass to create a reflective mirror. Now, researchers across the world are racing to perfect a new application for thin films: stretchable, bendable and wearable electronics.

Yu was among the group of researchers to first begin developing flexible, stretchable and wearable electronics – an endeavor that began in 2007 while he was earning his Ph.D. in mechanical engineering from Arizona State University.

In order to move away from the hard, bulky electronic components of modern computers, such as silicon chips and circuit boards, Yu developed novel, ultrathin silicon devices

printed onto soft, polymer substrates. Yu's thin film electronics are only 1 micron thick – about 50 times thinner than a single strand of human hair. One of the goals of his research group is to develop thin, bendable and stretchable electronics with an electrical performance equal to current hard electronics.

Since 2009, Yu has published more than 20 articles in major scientific journals about his thin-film-based flexible, stretchable and wearable electronics.

"We want these wearable electronics to be everything-in-one. We want them to power other electronics, such as your cell phone or iPad, but we have also integrated them with sensors so that they can monitor the users' overall health and internal processes and display that information in a very user-friendly way," Yu said.

The eventual goal, Yu said, is to take these ideas out of the laboratory and into the consumer market.

"It's an extremely exciting area to be working in," Yu said. "The wearable electronics we're developing can be commercialized and brought to market in the near future."

For Yu, seeing a technology he developed make a real impact on people's lives would be a dream come true.

"For researchers and professors, one of the goals is to see their research have real impact. That's why I chose this area in particular – this can make a real difference and have a real application in everyday life. My students and I are all excited about this," Yu said.

Yu earned his B.S. in mechanical engineering and M.S. in electrical engineering from Southeast University in China. Prior to joining the UH Cullen College of Engineering faculty in October of 2013, Yu was a post-doctoral researcher in the materials science and engineering department at the University of Illinois, Urbana-Champaign.

The Paul H. Holloway award is named after the University of Florida professor who has a distinguished and continuing career of scholarship and service to AVS.

PROFESSOR ELECTED OPTICAL SOCIETY FELLOW

BY ELENA WATTS

Kirill Larin, professor and director of the biomedical engineering graduate program at the UH Cullen College of Engineering, was recently elected a Fellow of The Optical Society, OSA. He is recognized for his exceptional contributions to optical imaging in developmental biology and optical elastography.

Founded in 1916, the society, with 19,000 members, is the world's preeminent professional association in optics and photonics with offerings that include publication subscriptions, meetings and programs about the science of light. In addition to membership benefits and recognition, Fellows can apply for travel grants to visit and lecture in developing countries.

Nominations for the fellowship are made by current OSA Fellows, who can comprise no more than 10 percent of the society's total membership, according to the bylaws. The Fellow Members Committee reviews and recommends candidates to the OSA Board of Directors, and the number of Fellows elected each year is limited to approximately .4 percent of the current total membership.

PROFESSOR HONORED WITH ISMR PIERCE AWARD IN AFFINITY TECHNOLOGY

BY ELENA WATTS

Richard Willson, Huffington-Woestemeyer professor of chemical and biomolecular engineering, is the recipient of the 2015 Pierce Award in Affinity Technology from the International Society of Molecular Recognition. Willson traveled to Puerto Vallarta last September to collect the award and present a lecture at the biennial ISMR Affinity Conference.

The Affinity Conference is a long-standing tradition distinguished by its crosscutting focus on the science and technology of biomolecular affinity interactions, according to the ISMR website. Scientists and engineers from academia and industry meet to exchange knowledge on affinity technology and molecular recognition and their applications for health and disease as well as bioprocessing and biosensing.

Founded in 1985, ISMR fosters communication between researchers concerned with molecular recognition in chemistry, biology, biotechnology and medicine. In recent years, advances in numerous methodologies have provided researchers with tools to identify and characterize interacting molecules and to understand general rules of molecular recognition. This knowledge complements the field of affinity technology, making it possible to use both native and designed interacting molecules for such biotechnological applications as purification, diagnostics and therapeutics, according to the ISMR website.

Willson, who serves as immediate past-president for the society, co-organized the 2015 Affinity Conference.

KAVLI FRONTIERS IN SCIENCE INVITES UH ENGINEER TO NATIONAL AND INTERNATIONAL SYMPOSIA

BY AUDREY GRAYSON

Since its inception in 1989, an invitation to the Kavli Frontiers in Science Symposia has symbolized a young scientist's vast accomplishments in his or her field. Each year, 80 to 100 of the world's most outstanding scientists under the age of 45 are invited to the symposia, which are sponsored by the Kavli Foundation and the U.S. National Academy of Sciences (NAS).

Last year, a chemical and biomolecular engineering professor at the UH Cullen College of Engineering was invited to participate in two Kavli Frontiers of Science Symposia.

Assistant professor **Megan Robertson** was among the 80 top young scientists invited to Indonesia last July to participate in the Indonesian-America Kavli Symposium. Robertson was also among the 25 scientists invited to participate as a speaker at the 27th Annual U.S. Kavli Frontiers of Science Symposium held in Irvine, California last November.

The overarching purpose of the Kavli Frontiers in Science symposia is to bring together researchers from a broad range of scientific backgrounds to engage in one-on-one discussions and forge new, interdisciplinary collaborations.

"These symposia give participants the opportunity to think about new topics and develop collaborations with people who we wouldn't typically have the opportunity to meet," Robertson said.

The Indonesian-American Kavli Symposia began in 2010 following a visit to the country by former NAS president Bruce Alberts. Serving as one of the first U.S. science envoys appointed by President Obama to strengthen scientific and technical collaboration between the U.S. and Muslim-majority nations, Alberts established the Indonesian Kavli Symposia with support from the U.S. State Department and the Kavli Foundation. The symposium series is co-organized by the NAS and the Indonesian Academy of Sciences.

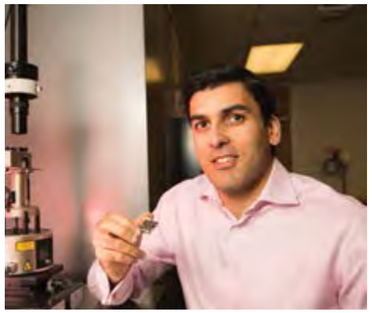
Symposia speakers covered topics including marine microbiology, astrophysics and exoplanets, infectious diseases, and nanomaterials found in nature. Robertson presented a general poster at the symposium relating to one of her laboratory's core research areas: developing polymers from renewable resources, such as biomass and plant sources.

"This topic is very relevant to Indonesia because there is an emphasis on using available resources to grow the local industry," Robertson said. "I am very hopeful that a collaboration between my lab group and researchers in Indonesia will result from this symposium."

Robertson traveled to the Beckman Center of the National Academies of Sciences & Engineering in Irvine last November for the U.S. Kavli Symposium, which covered topics including personalized medicine, cyber security, behavioral economics, space, reverse-engineering the brain, and feedstocks for new materials. As introductory speaker of one of the symposium's sessions, "Utilizing New Feedstocks to Access the Next-Generation of Materials," Robertson presented an overview focusing on the use of waste resources to develop polymers.

PROFESSOR EARNS U.S. AIR FORCE'S YOUNG INVESTIGATOR AWARD

BY ELENA WATTS



Hadi Ghasemi, assistant professor of mechanical engineering at the UH Cullen College of Engineering, earned the Young Investigator Research Program (YIP) award from the Air Force Office of Scientific Research (AFOSR). He is exploring a bio-inspired thermal management system for high-performance electronic and photonic devices with the $360,000, three-year grant.

The U.S. Air Force program supports young scientists and engineers who show exceptional ability and promise for conducting basic research, according to the AFOSR website.

For the last two decades, researchers have consistently developed smaller and higher functioning electronic and photonic devices. However, increased thermal energy generation that results from miniaturization and enhanced function has become a barrier to further advancement.

Currently, one of the most promising approaches to meet future thermal management demands is thin film evaporation. While the current techniques based on this approach manage space-averaged heat flux, they are not capable of addressing instantaneous local hot spots – the main cause of electronics and photonics failure. Ghasemi is exploring a new direction for thermal management that addresses both issues.

His bio-inspired smart thermal spreader (BSTS) mimics the elegant approach to thermal management that exists in nature. In the transpiration system of plants, a collection of nano-pores in the leaves called Stoma perform the thin film evaporation by adapting their dimensions as a function of temperature to tune local dissipated heat flux. Ghasemi is studying this natural phenomenon to develop next generation thermal management technology for durable electronic and photonic device performance at safe temperatures.

"The interesting point is that the nano-pores adopt their shapes in a smart fashion based on demand – they decrease their sizes at high temperatures, while they increase their sizes at low temperatures," Ghasemi said. "So they tune heat flux through their leaves as a function of temperature."

For this project, Ghasemi will use in situ scanning probe microscopy to study the fundamentals of thin film evaporation in plants both experimentally and theoretically to guide development of his BSTS and to assess its performance.

"Through these studies, we envision a new way for sophisticated design of thermal management systems to accelerate advancements in high-performance electronic and photonic systems," Ghasemi said. "In general, this program will study fundamentals of heat dissipation in natural nano-pores and will implement the lessons in the next generation of smart thermal spreaders."

CULLEN COLLEGE EXPERT COMPOSES CHAPTER IN RESPECTED OXFORD HANDBOOK

BY ELENA WATTS

The editor of *The Oxford Handbook of Perceptual Organization* invited **Haluk Ogmen**, professor of electrical and computer engineering at the UH Cullen College of Engineering, and his colleague Michael Herzog, professor of psychophysics at the Ecole Polytechnique Fédérale de Lausanne

(EPFL) Brain Mind Institute in Switzerland, to contribute a chapter on apparent motion and reference frames.

The reference book, which published in 2014, compiles the entire scope of perceptual organization research into 10 sections of one comprehensive volume. Published by Oxford University Press, which dates back to 1478, the book is part of a series of prestigious handbooks that includes scholarly reviews on 14 different subjects composed by foremost experts in their fields.

"*Oxford Handbooks* are among the most respected, authoritative reference books in the world, especially in the area of cognitive science," Ogmen said. "It was an honor to be asked to contribute a chapter."

Ogmen and Herzog's collaborative overview of motion perception research begins about 450 B.C. with ancient philosopher Zeno's concept that physical motion is an illusion created in the mind. The authors follow a timeline of important philosophical and psychological theories, ending the chapter with contemporary neuroscience studies, including their own two-stage theory of reference frame construction.

"Most biological systems, including the human visual system, devote extensive neural processing resources to motion analysis," Ogmen said. "In fact, in the brain, motion is not derived indirectly from other perceptual dimensions, rather, it is a fundamental dimension of our visual system. Understanding how this fundamental dimension leads to the construction of ecologically valid representations of our environment is key in reverse-engineering the brain."

OUTSTANDING STUDENTS

BY NATALIE THAYER

With an enrollment of more than 3,000 hard-working and dedicated undergraduate students, finding ways to shine among a sea of overachieving students is no small task. This year, however, two students managed to stand out among the Cullen College's seniors – chemical engineering student Nhan Peter Tri Vo and petroleum engineering student Sarah Elizabeth Williamson – share the title of outstanding senior at the college. Mechanical engineering student Tam Nguyen was named the college's outstanding junior.

In addition to naming an outstanding junior and two seniors at the college-level, administrators named outstanding juniors and seniors for each of the engineering departments.

The Cullen College's outstanding students were recognized at the Outstanding Student Recognition Luncheon hosted by the Texas Society of Engineering at Prairie View A&M University on Feb. 23, 2016.

OUTSTANDING JUNIOR:

Tam Nguyen

Nguyen, who describes herself as a lifelong learner, said she was drawn to the Cullen College's mechanical engineering department because she enjoys solving complex problems and working with mechanical systems.

"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 she embarks on her second semester as a junior at UH, she has a wealth of research experience behind her, a handful of distinguishing accolades on her resume and a summer internship at Shell on the horizon.

Last summer, she was a recipient of the 2015 Summer Undergraduate Research Fellowship (SURF) at the University of Houston. During the 10-week fellowship, she studied how chaos theory causes inaccuracies in weather prediction over a long period of time. Going beyond the SURF requirements, she also built a Lorenz water wheel to demonstrate characteristics of her research.

However, it was in her faculty advisor's lab that Nguyen found her true passion. Since 2014, she has worked as a research assistant studying nanomaterials for lithium-ion batteries with Haleh Ardebili, Bill D. Cook assistant professor of mechanical engineering.

Lithium-ion batteries have various everyday applications and play an integral role in many people's day-to-day lives, powering everything from cell phones and electric vehicles to energy storage systems and even hoverboards. However, some lithium-ion batteries carry major safety concerns, including a high risk of flammability as evidenced in recent cases of exploding hoverboards.

"Hoverboards explode because lithium batteries are not as safe as they could be, but we want to improve them," she said. "I want to make batteries that are safer, last longer, are more affordable and have better storage capabilities."

Nguyen said she plans to pursue a doctoral degree in mechanical engineering with an emphasis on nanomaterials to further her current research.

When she's not studying for classes or working in the lab, Nguyen can be found with her "second family" at the UH Society of Asian Engineering Students (SASE), an organization for which she serves as president. She also strives to become a bona fide "foodie" in the dining-out mecca that is Houston.

When asked what the secret to her success is, Nguyen said: "Dedication! I always try to put in my best and avoid doing just the minimum to get by."

OUTSTANDING SENIOR:

Nhan Peter Tri Vo

Vo said he was first inspired to pursue a degree in chemical engineering by his father, who has a doctorate in chemistry. Throughout his five years at the Cullen College, Vo found himself drawn to chemical reactions, catalysts and chemistry's role in contributing to human development.

"Ultimately, everything in the world is governed by chemical reactions," he said. "Because catalysts facilitate and speed up reactions, their interactions are where some really amazing things happen."

Last summer, Vo interned with the Japanese pharmaceutical company Kaneka North America at their location in Pasadena, Texas. He said that the hands-on industry experience he gained during the internship prepared him to tackle his senior year, providing him with skills he could apply directly to his senior Capstone Design Project.

For the project, Vo and his Capstone teammates began designing the concept for a fully-functional chemical plant last fall under the guidance of his faculty advisor Micky Fleischer, adjunct professor of chemical and biomolecular engineering at the Cullen College. This semester the team will explore the economic aspects of developing a plant, such as calculating operational costs, reducing utility costs and developing a practical budget.

"For this project, all the information we've learned from our first years in school is combined and applied to the design," he said. "It's really great to come back to everything and see how it works together."

Outside of the classroom, Vo is an avid sports fan. He supported the UH Cougars through their entire 2015 football season, even cheering from the stands at the Peach Bowl in Atlanta, Ga. He said he identified with the spirit of determination displayed during the games, and tried to apply the same attitude to his academics.

"[The players] tried very hard, every time. Even when we would be behind in a game by several points, they would continue fighting until the end," Vo said. "I think the most important advice [for engineering students] is to try hard and don't give up. Even though engineering degrees require more time that other degrees, it's important to concentrate and keep going."

OUTSTANDING SENIOR:

Sarah Elizabeth Williamson

Williamson's career began in the education field, where she worked in an elementary school teaching math, science and reading skills. However, she was inspired to return to school to pursue a degree in petroleum engineering by her father.

"Growing up, I saw how much he enjoyed his career," she said of her father, who worked as the vice president of operations for an energy company in California and Texas.

As she begins the final semester of her undergraduate studies, Williamson's resume boasts a variety of honors, awards and scholarships. She gained field experience through a summer internship with Pacific Coast Energy Company in California and is actively involved in several professional organizations through the University of Houston, including the American Association of Drilling Engineers, the Society of Petroleum Engineers and the Society of Women Engineers.

This semester also marks a major milestone for the Cullen College's petroleum engineering program. When Williamson began her education at the college, the petroleum engineering program was housed within the chemical and biomolecular engineering department. At the end of 2015, the Texas Higher Education Coordinating Board approved the establishment of the department of petroleum engineering within the college. Williamson said it was exciting to be a part of the program's evolution to a full-fledged department at the University of Houston. She added that the diversity of her peers and classmates in engineering helped to prepare her for a career after college.

"It taught me to be more flexible and to trust other people. I think that's one of the most beneficial things because we are going to have to learn to rely on other people when we go into the real world," Williamson said.

Although the road to earning her engineering degree at UH has required a great deal of time, dedication and elbow grease, Williamson said that earning the outstanding student award from the Cullen College was a reward for her years of hard work.

"Pursuing my engineering degree has been, by far, one of the most challenging things I've ever done. To know that all the hard work and persevering through it paid off, it's a really big honor and very humbling," she said.

See below for the full list of outstanding students from the Cullen College of Engineering.

Department	Outstanding Senior	Outstanding Junior
Biomedical Engineering	Juan Reyna	Alexis Deleon
Chemical Engineering	Nhan Peter Tri Vo	Priya Patel
Civil Engineering	Rodolfo Mendoza Garana	William Arsola
Computer Engineering	Cherub Harder	Ryan Galate
Electrical Engineering	Julia London	Derian Widjaja
Industrial Engineering	Antonio Cabrales Juan	Rebeca Oliver-Gomez
Mechanical Engineering	Hamdi Sherif	Tam Nguyen
Petroleum Engineering	Sarah Williamson	Bryan K. Printz

GRADUATE STUDENT WINS TRAVEL AWARD FOR BIOMASS RESEARCH

BY NATALIE THAYER

Each year, the American Institute of Chemical Engineers (AIChE) presents travel awards to outstanding students from across the nation to present their research at the annual AIChE meeting. **Sashank Kasiraju,** a chemical and biomolecular engineering graduate student at the UH Cullen College of Engineering, was one of just 20 students to receive this honor from AIChE's Catalysis and Reaction Engineering (CRE) Division last year.

AIChE is the world's leading organization for chemical engineering professionals, boasting more than 45,000 members from over 100 countries. The organization is dedicated to promoting excellence in the chemical engineering profession through advancing education, career development and professional standards within the field.

Kasiraju's research focuses on hydrotreating bio-oil obtained from biomass to lower its oxygen content and convert it to renewable and sustainable biofuels. Hydrotreating refers to a process using high-pressure hydrogen gas to remove unwanted contaminants, such as oxygen, sulfur and nitrogen from fuel products.

The petroleum industry currently uses a method of hydrotreating that removes sulfur from fossil feedstock to produce clean diesel and gasoline. This hydrodesulfurization technology is well established and practiced daily in every refinery worldwide.

Under the guidance of his faculty advisor Lars Grabow, Kasiraju is attempting to translate this existing knowledge to explore efficient catalysts for the related hydrodeoxygenation process of bio-oil. By building on existing industry technologies to improve the hydrotreating process, Grabow and Kasiraju hope to accelerate the discovery of hydrodeoxygenation catalysts and, ultimately, to contribute to the development of renewable biofuels.

Kasiraju, who is in his fourth year at the University of Houston, has been fascinated by science for as long as he can remember. "As a kid, I was always building gadgets and breaking things apart to put them back together afterwards," he said.

For this award, Kasiraju traveled to Salt Lake City last November to attend his first AIChE meeting. At the meeting, he gave an oral presentation on the results of his research. Kasiraju was officially recognized for his award at the formal CRE Division Dinner.

STUDENT-DESIGNED SATELLITES LAUNCH INTO ORBIT

BY ASHLEY SCHWARTZ

A year's worth of hard work paid off for a team of electrical and computer engineering students in the UH Cullen College of Engineering when their small satellite technology was launched into space last January.

Small satellites, also known as CubeSats, are 10-centimeter cubical satellites that occupy low Earth orbit, collecting invaluable data for a wide range of scientific applications. On Jan. 29, 2016 at 10:25 a.m., astronaut Scott Kelly deployed CubeSats that contained software designed by the UH engineering students from the Japanese Experiment Module (JEM), a Japanese science module on the International Space Station (ISS).

The UH student team invented their novel technology as part of their senior design project, spearheaded by electrical and computer engineering (ECE) professor **Steve Provence**, a NASA engineer and alumnus of the Cullen College's ECE department. For this project, the UH team worked closely with researchers at the University of Texas at Austin, Texas A&M University and Georgia Tech University.

"We really depended on them to get this work done and find a solution," said Provence. "From experiencing this process, the students have a better understanding of what it means to be a real world engineer, and to have an assignment they don't already know has a solution."

The students involved in this project took on the challenge after a 2009 CubeSat mission led by teams at Texas A&M University and the University of Texas was unsuccessful without definitive answers. While the satellites were being deployed from the payload bay of space shuttle Endeavour, CubeSats Bevo-1 and AggieSat2 were to separate. They never did, and with little evidence of what caused the failure, the students were left without explanation.

Working closely with both NASA and AggieSat students, the ECE team designed and built a visual data capture system (VDCS) to photograph the ejection of the CubeSat, called AggieSat4, into low Earth orbit from a full-size satellite.

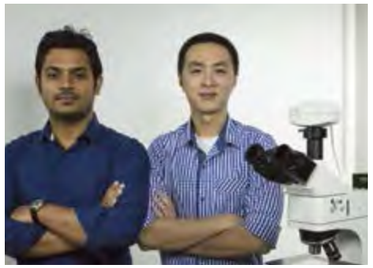
With a fish-eye lens that captures almost 180 degrees, the VDCS captured images in the seconds before deployment and recorded any conditions affecting the bay door. As Bevo-2, the University of Texas' CubeSat for this project, detached from AggieSat4, the camera photographed 10 rapid-fire sequences in about 10 seconds. The VDCS will also perform several other photographic missions during its trip through space.

"This project provided confidence in myself as an engineer," said **Emery Annis**, an electrical and computer engineering undergraduate student on the UH team. "I learned that I can take on any task, regardless of my skill level, identify the project restraints and requirements, and collaborate with a group of engineers to ultimately deliver a successful product on time and under budget."

View a video of the launch at https://youtu.be/xAqxvzcPB8s

DOCTORAL STUDENTS, PROFESSOR HONORED AT NEUROENGINEERING SYMPOSIUM

BY ELENA WATTS



Md Masud Parvez Arnob and **Hoang Nguyen,** both doctoral students at the UH Cullen College of Engineering, won 2nd place for their poster abstract at the 5th Annual Neuroengineering Symposium sponsored by the Gulf Coast Consortia last October.

Arnob, an electrical and computer engineering student, and Nguyen, a materials science and engineering student, work together under the supervision of **Wei-Chuan Shih**, associate professor of electrical and computer and biomedical engineering at Cullen College.

Shih, also an associate professor of chemistry and materials science, was invited to present a broad talk on light-based techniques in neuroscience and neuroengineering relating to the topic of his students' poster.

Shih presented an array of optoanalytical technologies that he and his team developed for molecular sensing, imaging and stimulation. One project uses a tiny lens to convert a smartphone camera into a powerful microscope. Another focuses on development of a neural probe for delivering light to deep brain regions for simultaneous stimulation and recording of neuronal signals.

"I immediately received feedback regarding potential applications for DotLens Smartphone Microscopy from my colleagues," Shih said. "The symposium provides an excellent platform for crosscutting idea exchange."

Arnob and Nguyen competed against 28 other submissions to win one of three awards with their poster, "Micro-machined optical fiber with multiple stimulation sites for optogenetics applications."

"It was exciting to participate in the symposium and to meet experts in the field of optogenetics, but getting chosen for an award among all the good work was exhilarating," Arnob said. "We have designed a novel tool for light delivery inside brain tissue and modeled the light-brain interaction, which will facilitate the efficient positioning of recording systems along with the estimation of recorded brain region."

A grant from the National Institutes of Health (NIH), a CAREER award from the National Science Foundation and another Career award from NASA support Shih's optics research. The NIH grant specifically funds the neural probe project, which is a collaboration with Jack Wolfe, also a professor of electrical and computer engineering at Cullen College.

"Our novel design addresses the current barrier of having single-fiber waveguide with multiple stimulation sites covering 360-degree excitation capability," Nguyen said. "It's always inspiring to be recognized, especially in a competition of excellent peers."

ENGINEERING STUDENT EARNS SILVER NANO RESEARCH POSTER AWARD

BY ELENA WATTS

Yanliang (Leonard) Liang, electrical and computer engineering research associate at the Cullen College, won the Silver Nano Research Poster Award at the 10th Sino-U.S. Symposium on Nanoscale Science and Technology last June.

Liang's poster titled, "Rational Nanostructure Design for Efficient Mg Rechargeable Batteries," was among more than 200 posters submitted and was one of only eight that earned awards. The symposium, sponsored by Tsinghua University Press, attracted more than 1,000 attendees.

"No one expects to win anything because the environment is pretty competitive with scientists from all over China and the United States," Liang said. "The work started long before this forum, so it's good to be recognized for our contribution to the field and to know that people are interested in our work."

Under the supervision of Yan Yao, assistant professor of electrical and computer engineering, Liang helped to develop an alternative to traditional lithium-ion batteries, and papers about their breakthrough published in the journals *Nano Letters* and *ACS Applied Materials and Interfaces*.

Instead of lithium ions, Liang and Yao opted for safer and more economical magnesium ions to produce their battery. Magnesium is an abundant material and discharges twice as much energy as its lithium counterpart. However, magnesium ions move slowly in host materials because of their interaction with the batteries' negatively charged lattices.

Liang and Yao created an interlayer expansion method to boost magnesium's diffusivity by two orders of magnitude, and researchers could potentially leverage this approach across a range of host materials that store various ions. Their discovery provides opportunities for the development of advanced materials for next-generation electric vehicles, among other sustainable development innovations.

The symposium provides a forum for researchers to share their work in the field of nanotechnology to optimize solutions for energy shortages, environmental contamination and life science challenges, according to the event's website.

"Yanliang joined my research group in the fall of 2012 as a postdoc researcher, and he has undoubtedly shown a high level of excellence and distinction in materials and battery research," Yao said. "I am confident that he has great potential in making more significant achievements and becoming a young leader in the future. This award recognizes his past achievements and motivates him to achieve a higher level of success in his career."

ENGINEERING STUDENTS SELECTED AS GRASP DAY FINALISTS

BY NATALIE THAYER

The University of Houston's Graduate Research and Scholarship Projects (GRaSP) Day offers students the opportunity to network and introduce their research to a wide audience through oral and poster presentations. GRaSP Day celebrates the research, scholarship and creative endeavors of UH graduate and professional students across all disciplines.

Last year, two doctoral students from the Cullen College of Engineering were selected as GRaSP Day finalists. Mechanical engineering student **Peyman Irazijad** and electrical and computer engineering student **Apeksha Awale** were invited to give oral presentations about their respective research projects to the GRaSP audience last October.

Working as a member of the NanoTherm Research Group under the guidance of faculty advisor Hadi Ghasemi, Irazijad's research explores the fields of thermodynamics, heat transfer and nanotechnology. At GRaSP Day, he presented his work on dispensing nano-pico droplets of ferrofluids, which was featured on the cover of the November 2015 issue of *Applied Physics Letters*.

Though the potential benefits of this research are multifaceted, Irazijad said he believes his work has the potential to benefit the medical community in particular.

By combining drugs with ferrofluids, which contain magnetic nanoparticles, medical professionals may be able to more accurately control the delivery of drugs to a specific site in the body. This would provide the potential to decrease the amount of drugs needed and, simultaneously, increase the effectiveness of drug treatments for patients, he said.

Irazijad added that the device he works with is small, inexpensive and lightweight. These factors further contribute to its benefits, making it potentially viable for spacecraft and medical applications.

Awale, a fifth-year doctoral student working under the guidance of faculty advisor Jack Wolfe, presented her research on manufacturing neural probes that can be used to map brain circuits. By mapping neural circuitry, these probes have the potential to play a key role in the development of novel treatments for illnesses such as stroke and Parkinson's disease.

While current treatments for neurological diseases and disorders often come with cumbersome or long-lasting side effects, the neural probes developed by Awale have the potential to provide improved treatments for such patients.

Though other researchers have developed similar devices, Awale said the probes developed at UH are unique because of their reliability, flexibility and low manufacturing costs.

"I feel that this research can make a huge difference in the community," she said, adding that getting the word out about the research is the next important step.

"[GRaSP] is a great platform to share this research with the University and the greater community," she said.

DOCTORAL STUDENT WINS YOUNG INVESTIGATOR AWARD AT AFFINITY 2015

BY ELENA WATTS

Andrew Paterson, a chemical engineering doctoral student at the UH Cullen College of Engineering, won the Young Investigator Award at Affinity 2015, a conference of the International Society for Molecular Recognition. He presented his rapid medical diagnostic research at the conference in Puerto Vallarta, Mexico last September.

"I wasn't expecting anything, but the researchers found our work interesting and potentially useful," Paterson said. "Experts in different areas of biotechnology approached me after my presentation, and their excitement helps validate what we're doing and has really inspired us to push the technology to the next level."

Paterson has worked to improve the sensitivity of point-of-care and over-the-counter rapid medical diagnostic tests since 2012 when he joined the lab of Richard Willson, UH Huffington-Woestemeyer professor of chemical and biomolecular engineering. The team also includes Balakrishnan Raja, who obtained his doctorate in chemical engineering under Willson in 2014.

"Our goal is to get this diagnostic technology out of the lab and into doctors' offices," Paterson said. "Ultimately, we plan to develop a consumer device sold in drugstores, so people can buy off-the-shelf diagnostic tests for a variety of diseases."

Paterson spent the first couple of years establishing novel ways to use nanophosphors, light-emitting nanoparticles, to detect biomarkers such as molecules, viruses, proteins and bacteria. The last couple of years, he and the UH team developed a smartphone-based diagnostic platform that uses a lateral flow assay (LFA) reader and highly detectable nanophosphors for sensitive disease detection.

The LFA reader attaches to the top back half of the smartphone, similar to a protective case, and has a compartment that holds a rectangular disposable test cartridge. The cartridge contains the nanophosphors and a result window, which lines up with the phone's camera when the cartridge is inserted in the reader.

To perform the test, a liquid sample such as a drop of blood is added to the cartridge, and the nanophosphors bind to the targeted biomarkers in the result window. The camera flash activates the luminescent nanoparticles, the flash switches off and the camera immediately captures an image of the light emitted by the nanoparticles. The smartphone application then analyzes the image, determines a positive or a negative test result and displays the information on the smartphone screen. The diagnostic tool can also be used to quantify concentrations of the targeted biomarkers.

"The nanophosphors are similar to the material used to make glow-in-the-dark stars that children stick on their bedroom ceilings," Paterson said. "The stars charge while the light is on, and they glow with a very bright intensity just after the lights are turned off."

The light-based readout provides more sensitive, quantitative and reliable results than other rapid diagnostic tests that require subjective reading of faint-colored nanoparticles with the naked eye. Furthermore, existing tests are not quantitative enough and struggle to detect low levels of diagnostic targets for numerous diseases.

"The nanophosphors in our diagnostic tests currently provide 10-fold better sensitivity than the most commonly used particles in rapid diagnostic tests, which opens up new opportunities in point-of-care testing," Paterson said. "We can achieve more on the fundamental materials side, and we can optimize the assay side to provide even better sensitivity for use in medical applications, where high sensitivity is critical."

Paterson used hCG, a pregnancy hormone, to develop the novel diagnostic technology, but he and Willson are focused mainly on detecting infectious diseases with their smartphone-based diagnostic platform. They are collaborating with Jakoah Brgoch, UH assistant professor of chemistry, to synthesize new nanophosphors with even better performance in the smartphone-based test.

Meanwhile, Paterson and Raja have formed a startup company, Luminostics, to commercialize the diagnostic technology and LFA reader.

"Earning awards from respected conferences helps establish our team's credibility – that we know what we're doing," Paterson said. "It can help with pitches to investors and could ultimately help us in getting this technology through the FDA-clearance process."

The nanophosphor research began with funding from the Western Regional Center of Excellence for Biodefense and Emerging Infectious Diseases Research (WRCE). A $50,000 National Science Foundation Innovation Corps (I-Corps) award in 2014 with Raja as entrepreneurial lead helped the team evaluate business aspects of the technology and the startup's first product, as well as partially fund the development of the smartphone reader platform. The Centers for Disease Control and Prevention Dengue Branch in Puerto Rico recently funded a pilot project for the UH team to develop a diagnostic test using the nanophosphors and smartphone platform for dengue fever, a mosquito-borne infectious disease. Additionally, Luminostics was recently awarded a $50,000 grant from Johns Hopkins University to develop a point-of-care test for chlamydia using the smartphone reader platform.

DOCTORAL STUDENT WINS NATIONAL RESEARCH LABS FELLOWSHIP

BY NATALIE THAYER

Biomedical engineering student **Majid Latif**, a Ph.D. candidate in the May Multiscale Immunobiology Design Algorithms and Simulation (MIDAS) Lab at UH, recently won the U.S. Department of Energy's (DOE) Office of Science Graduate Student Research award. This unique research opportunity aims to advance Latif's overall doctoral thesis while providing him with access to the expertise, resources and capabilities available at the DOE laboratories. Latif is spending the 2016 spring semester at the Sandia National Laboratories site in Livermore, Calif., developing algorithms to predict gene regulation.

At the Sandia National Labs, Latif is working with Bert Debusschere, a highly regarded computational scientist and former colleague of Latif's faculty advisor Elebeoba May, biomedical engineering professor and director of the MIDAS Lab.

"I couldn't be happier about Majid working with Debusschere because he's a great colleague and Majid will benefit from the experience," said May.

Latif brings an academically diverse background to his studies. He earned his bachelor's degree in mathematics with a minor in philosophy from the University of Houston in 2012. He then went on to earn a master's degree in applied cognition and neuroscience at the University of Texas in Dallas before returning to his alma mater for his doctoral studies in biomedical engineering.

Latif unearthed his passion for machine learning and algorithm development while working on his master's degree – a passion that continues to drive his research. He said he was drawn to the Cullen College's biomedical engineering program because biological systems, which are inherently chaotic, provided a unique challenge for him.

Latif began working in May's lab in early 2014, though they first met when he took her Quantitative Systems Biology class, a complex course that introduces students to computational and mathematical techniques for modeling biological systems. As a result of Latif's dedication to understanding the topics presented in the class and his overall interest in applying mathematics to biological systems, May invited him to join her research team.

With the guidance of May, who believes that biology is the next engineering frontier, Latif is exploring novel questions at the intersection of computational and experimental biology through his research.

Latif won the DOE fellowship for his proposed work on developing an algorithm that describes the behavior of gene networks that regulate behavior in an Escherichia coli community. His research is part of a larger National Science Foundation Early Concept Grant for Exploratory Research project in May's lab.

DOCTORAL STUDENTS HONORED WITH CULLEN COLLEGE'S BEST DISSERTATION AWARDS

BY NATALIE THAYER

Two doctoral students in the UH Cullen College of Engineering received the college's Best Dissertation Awards for fall 2015.

Mechanical engineering student **Nikhil Walani** and civil and environmental engineering student **Maruti Mudunuru** were selected as the 2015 winners based on the originality and importance of the research presented in their dissertation defenses, as well as their potential to make significant contributions to the future of their respective disciplines.

Under the guidance of his faculty advisor, assistant professor of mechanical engineering Ashutosh Agrawal, Walani explored how nutrients and other molecules are transported across the membranes of biological cells, and the role that proteins play in this process. His dissertation was titled "Mechanics of Cellular Transport."

Walani, who earned his undergraduate degree in civil engineering, said he was drawn to mechanical engineering at the University of Houston because he wanted to study the fundamentals that govern the behavior of materials.

"I went from working with structures designed on a macro scale, where the measurements are in tens of meters, to exploring structures at the subcellular level, where most of the measurements are in nanometers," he said. "By this change of scale, I've gained a new perspective on the physics of structures. It's been fascinating."

Cells are surrounded by a membrane, which serves to protect the DNA and other organelles within the cell. In addition to forming a barrier, cell membranes allow for transport of essential proteins, ions and other nutrients across them. For the transport of nutrients and molecules, or cargo, that cannot penetrate this membrane, a specific set of proteins from the interior of the cell is called to action. These proteins drive the deformation of the membrane, causing it to wrap around the cargo, fuse at the neck and detach from the parent membrane, thereby creating a sealed vesicle to transport the cargo to various organelles inside of the cell.

Walani and Agrawal's research focused primarily on understanding the cellular transportation processes involving the protein clathrin, which plays a primary role in the formation of coated vesicles in eukaryotic cells.

This research has the potential to contribute to the future of engineering through biomedical applications, Walani said, because it provides scientists and engineers with more information about the specific roles of each protein involved in the cellular transportation process.

"By understanding how proteins behave in different mechanical environments, drug designers can develop more effective drugs because they can tailor the drugs accordingly," he said.

Mudunuru worked with his faculty advisor, assistant professor of civil and environmental engineering Kalyana Nakshatrala, to develop various numerical methodologies to address common subsurface challenges, such as hydraulic fracturing. His dissertation was titled "On Enforcing Maximum Principles and Element-wise Species Balance for Advective-Diffusive-Reactive Systems."

Subsurface energy sources present a significant and long-term opportunity for power production, making the ability to accurately model and predict the performance of these systems more essential than ever before.

By addressing commonly faced subsurface challenges and deficiencies, Mudunuru said his research has the potential to impact long-term infrastructure sustainability, climate research, groundwater modeling, energy security and waste management.

Drawn to engineering by the desire to apply scientific concepts to practical, real-world problems, Mudunuru received degrees in mechanical and civil and environmental engineering before attending the University of Houston for his doctoral studies.

"Taking diverse engineering courses and engaging with people outside my own department were instrumental in my academic and professional development," he said. "Doing so reinforced basic scientific concepts, generated new ideas and enhanced my communications skills, which are vital during and beyond life as a student."

As recipients of the Best Dissertation Awards, Walani and Mudunuru were recognized at the fall 2015 convocation ceremony. Both students received a plaque and honorarium of $1,000.

MECHANICAL ENGINEERING PH.D. STUDENT WINS PRESTIGIOUS TEACHING FELLOWSHIP

BY NATALIE THAYER

Mechanical engineering Ph.D. student **Christopher Ortega** was awarded the American Society of Mechanical Engineers (ASME) Graduate Teaching Fellowship for the 2015-2016 academic year. The fellowship, awarded by the ASME Board on Education to outstanding mechanical engineering Ph.D. students interested in an academic engineering career, supports his current studies and provides a full teaching assistantship in the department.

Ortega, a native Houstonian, is not only the first University of Houston student but also the first Latino to be awarded the fellowship in the 23 years of its existence. After attaining his bachelor's degree in mechanical engineering from UH in 2012, he was admitted into the Cullen College's mechanical engineering doctoral program. Ortega has been an active member of ASME since 2009, participating in both the local UH ASME student organization and the South Texas Section. He is also the founder of the UH ASME student section's Intro to Cougar Engineers Program, an educational outreach event that introduces over 400 local high school students each year to engineering principles through a design competition.

Ortega comes from a family of UH alumni and is proud to carry on the legacy of representing the University of Houston.

ENGINEERING STUDENTS LEAD STEM OUTREACH EVENT IN BRAZIL

BY NATALIE THAYER

Last summer, three Cullen College of Engineering students and one alumnus boarded a plane bound for Brazil for the third annual Society of Women Engineers (SWE) "One Day in Engineering" outreach event. Held in the city of Teresopolis and nearby rural areas, the event aims to inspire excitement about STEM (science, technology, engineering and math) fields and encourage local high school students to pursue higher education.

Last year, the event's founder, mechanical engineering graduate student **Gabriela Bernardes**, was joined by fellow SWE members **Mah-rukh Muhammad** and **Debjani Chakravarty** and mechanical engineering alumnus **Ben Richardson**. Bernardes, who came to the University of Houston from Brazil, originally founded the event in conjunction with her grandmother's social project, Nadir Furtado. In preparation for the trip, members of SWE's Houston student chapter collaborated with Nadir Furtado to plan travel and event logistics. While SWE members developed workshops for the event, Nadir Furtado coordinated local volunteers, booked venues and connected with Brazilian high schools to get the word out about "One Day in Engineering."

The two-day event introduced over 100 students from more than 11 high schools to an array of engineering principles through hands-on workshops, activities and games. Students were divided into small groups and rotated between workshops on civil, chemical, mechanical and electrical engineering.

In the civil engineering workshops, led by civil engineering student Muhammad, students designed and built structures out of lightweight materials such as straws and tape. Muhammad then applied weights to the seemingly flimsy structures to test their strength. Students were amazed by how strong the structures could be when triangles were incorporated into the design, she said.

Muhammad added that the most exciting part for her was seeing the students explore their creativity through the design process. "It isn't easy at first to get into the engineering mind frame, figuring out how to be creative and coming up with something on your own… but once they got into it, once it clicked, they just kept going and building really fast," she said.

Chakravarty, who is also a civil engineering student, led two chemical engineering workshops. In the first workshop, students learned about polymers by creating glow-in-the-dark putty out of household materials. In the second workshop, students were introduced to thermodynamic principles by making homemade ice cream with rock salt.

Bernardes taught students how to build water bottle rockets powered by a bicycle pump in the mechanical engineering workshops and, in the electrical engineering workshops led by Richardson, students played challenging games of "circuit bingo" for prizes.

Muhammed said she was impressed by the students' overall engagement. "I felt that the kids were very open to learning and new ideas. It was a good experience. They were very interested," she said.

The interest even extended beyond the workshops with several students asking about college life, said Chakravarty. Between workshops, she was able to answer questions about scholarships, SWE and her experience at the University of Houston. "Helping men and women understand their potential and actually take initiative, like we're taking initiative to do something for their community…for me, that was probably the greatest part," she said.

Bernardes said seeing the impact the event has had on the Teresopolis community is the biggest reward. Some of Bernardes' family members who live in Teresopolis said that children in their community have pursued engineering in college after attending the event. Bernardes added that several former participants also attended this year's event to volunteer as translators and facilitators.

For both Muhammed and Chakravarty, who had never visited Brazil before this event, the biggest takeaway from their experience was bonding with the students and the community. "Even though we didn't speak the language, [working with international students] gives you an overwhelming view that we're all the same," said Chakravarty.

Muhammed added that the experience reinforced the interdisciplinary nature of engineering. "[At first] it seems like everyone's so different, but once we're all working together toward a common goal, we form a team to get things done," she said.

> "WORKING WITH INTERNATIONAL STUDENTS GIVES YOU AN OVERWHELMING VIEW THAT WE'RE ALL THE SAME."

UH STUDENTS BUILDING FORMULA ONE-STYLE RACECAR

BY NATALIE THAYER

Though the Society for Automotive Engineers (SAE) once boasted an active University of Houston student chapter, the organization has been dormant on the UH campus for several years. Now, a group of dedicated Cullen College of Engineering students is bringing the student organization back into the fast lane – literally.

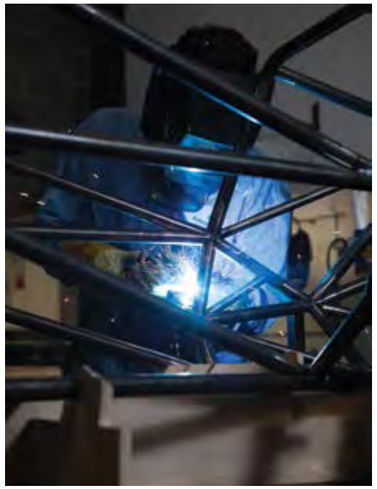
The UH Engineering students responsible for reviving SAE are designing and building a Formula One-style racecar from the ground up to compete in the Formula SAE Series (FSAE) races. The FSAE Series are part of the society's annual Collegiate Design Series, which encourages students from around the world to "go beyond textbook theory" by designing, building and racing a real vehicle, according to the organization's website.

DESIGN PROJECT

The new UH SAE group, led by mechanical engineering students **Jacob Gallery**, **Shibly Abughazaleh** and **Grant Mottershaw**, is in the midst of a busy year. Last semester, the students began manufacturing the team's Formula One-style racecar at UH's Texas Center for Clean Engines, Emissions and Fuels (TxCEF) to enter the 2016 competition in Lincoln, Nebraska.

The FSAE competition has several vehicle divisions, including internal combustion engines, electric and hybrid vehicles, and includes two stages of testing. The first stage is comprised of rigorous design and safety tests, including tilt and braking tests. Only vehicles that pass the static tests move on to compete in the races.

The racing portion, also called the dynamic event, includes straight line acceleration, autocross and endurance challenges. For Gallery, the new UH SAE president, this is where the greatest excitement lies.



"If we can make it to the dynamic event, I'll be crying tears of joy," he said. "Sitting in the cockpit, flipping the glass down on the helmet and waiting for that green flag — that will be everything."

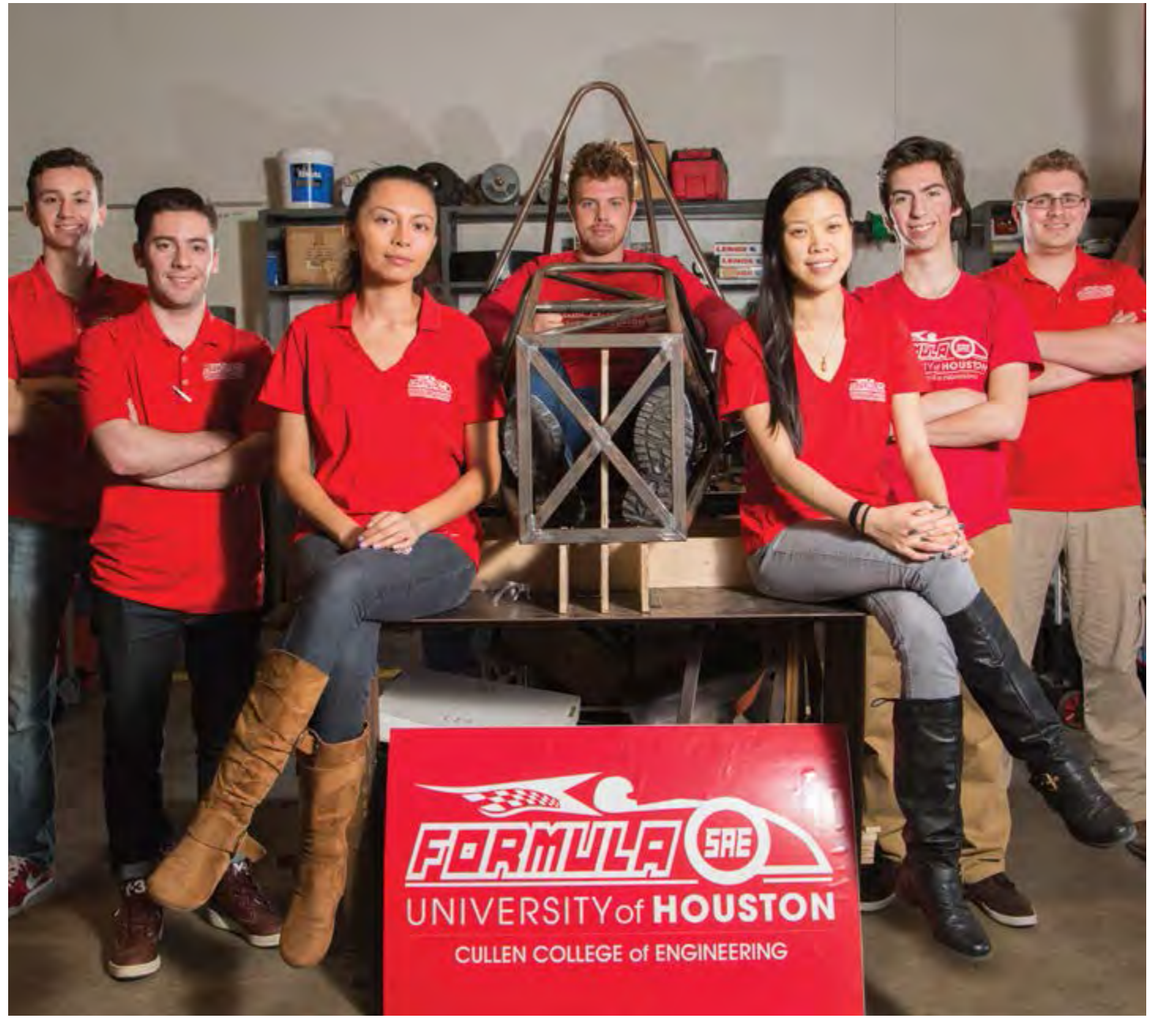
In the meantime, the UH FSAE team has built their internal combustion engine vehicle for the competition and is building the car's body and framework this spring.

NEW BEGINNINGS

Abughazaleh, UH SAE co-chair and treasurer, first began looking into SAE when he transferred to the Cullen College's mechanical engineering department two years ago. Despite the lack of a formal SAE organization, he sought out fellow students who shared his passion for automotive engineering and, with that, set the wheels in motion for the UH SAE revival.

Abughazaleh connected with fellow Cullen College student Gallery early on. Gallery said he was immediately interested in the project after talking to Abughazaleh and was excited to join the organization at the ground level. In addition to leading the UH SAE as president, Gallery supports the team as the chief engineer on the FSAE design project.

Recognizing that the burgeoning UH SAE organization would benefit from focused fundraising efforts, Mottershaw approached Gallery about joining the organization's leadership team. As the UH SAE's co-chair and business development lead, Mottershaw is responsible for operations, financial management and new member recruitment.



The excitement surrounding the racecar design project is palpable. The process of turning concepts into realities, Mottershaw said, is a motivating force on its own. Yet, the mission of UH's SAE chapter extends beyond this year's car design. The organization aims to foster interdisciplinary collaboration, innovation and camaraderie across the UH campus and the Houston community, said Gallery.

> "SITTING IN THE COCKPIT, FLIPPING THE GLASS DOWN ON THE HELMET AND WAITING FOR THAT GREEN FLAG – THAT WILL BE EVERYTHING."

Currently, the FSAE team is composed of students from various backgrounds and disciplines including mechanical, electrical and civil engineering, as well as architecture, industrial design and computer science. Gallery also said that by encouraging diversity amongst its members, the group is trying to promote an interdisciplinary effort by "[bringing] together a community where it's not only engineers, but it's everybody you would expect to see or work with in the future."

Gallery added that he believes University of Houston students are uniquely equipped to take on the challenge of building a winning racecar. "You have a number of people at this school that have what many other universities' students don't — and that's life experience," he said.

ENGINEERS WITHOUT BORDERS TEAM BUILDS SCHOOLHOUSE IN NICARAGUAN VILLAGE

BY NATALIE THAYER

Last summer, five students from the University of Houston's Engineers Without Borders (EWB) student chapter traveled to the rural Nicaraguan village of Telpochapa to construct a schoolhouse from the ground up.

The trip took place last August and was the final implementation stage of a long-term EWB project that began six years ago. UH Engineering students **Ishan Chakrabarty**, **Conner Judson**, **Rafi Mohammed**, **James Schouten** and **Ayesha Sohail** were joined by Jody Muniz, a professional engineer who served as their industry mentor, and Juan Guzman, a mechanical engineering office assistant at UH who served as their translator.

Engineers Without Borders is an international non-profit humanitarian organization that partners with developing communities worldwide in order to improve their quality of life. The University of Houston's student chapter was established in 2006 with the goal of designing and implementing sustainable solutions for communities in need, both locally and globally. The UH EWB chapter is open to students of all majors and encourages interdisciplinary collaboration and problem solving.

> "BEING ABLE TO SHOW THE COMMUNITY THAT WE GENUINELY CARE WAS THE MOST REWARDING PART OF THE EXPERIENCE."

Located in a remote region of the country, the village of Telpochapa sits in a valley and is only accessible by unpaved roads. Just to arrive at the work site, the UH team had to navigate difficult terrain in a 4x4 truck. The remote location and tough terrain made coordinating material deliveries a surprising challenge.

Several trips by a semi-truck were required to bring all of the materials from the nearest participating hardware stores to the worksite. During those trips, the semi-truck blew out several tires and lost its headlights.

As all of the materials arrived, Chakrabarty, Judson, Mohammed, Schouten and Sohail had their work cut out from them. Only the concrete foundation for the schoolhouse had been laid by a previous UH EWB travel group; the rest of the structure remained to be built. The students, eager to get their hands dirty, set to work mixing and pouring concrete, moving cinderblocks and shoveling an entire trailer's worth of rocks at the construction site. They were also joined by local construction workers and skilled laborers who provided guidance throughout the project.

"Honestly, the attitude of the group was that we wanted to help in a hands-on way," said Schouten, who served as the project manager on the trip.

Telpochapa's residents had requested help from EWB because the foundation of the previous schoolhouse had eroded, making the school unstable and unsafe. The new one-room schoolhouse was designed by EWB to withstand a 6.5 or 7.0 earthquake, as well as 150 mile per hour winds. The students also implemented additional reinforcements onsite to ensure long-term structural stability, strength and safety.

"Being able to help the village get a school where their children are safe and being able to show the community that we genuinely care was the most rewarding part of the experience," said Judson, who served as co-project lead on the trip.

Seeing how the local children responded to the group's effort was another big reward, the group members agreed.

"You'd see their curiosity and awe and happiness," said Schouten. He added that Sohail, the only female member in the group, made a huge impression on the children.

"The kids all gravitated toward Ayesha. The girls didn't take their eyes off her and, near the end, they even wanted to help," said Schouten.

Although the schoolhouse project came to a successful completion by the end of their trip, UH's EWB chapter isn't slowing down their efforts to give back to other communities. The group is now in the early stages of planning the next project, determining the destination of the next trip and carefully researching how best to apply their efforts to future endeavors.

The UH EWB chapter has more than doubled in size this school year, and the student leaders are seeking input from current members to determine the scope and details of their next project. Judson, who is taking on the role of project lead this year, said that "because this is the start of a new cycle, we want to find out what projects are meaningful to our members."

THREE DOCTORAL STUDENTS GIVE ORAL PRESENTATIONS AT GORDON RESEARCH CONFERENCES

BY NATALIE THAYER

Last summer, Cullen College of Engineering doctoral students **Manjesh Kumar, Matt Oleksiak** and **Katy Olafson** were invited to give oral presentations at two of the prestigious Gordon Research Conferences (GRC).

The conferences, founded in the late 1920s by Dr. Neil E. Gordon, aim to promote discussions and the exchange of ideas by focusing on new, innovative research in the fields of biological, chemical and physical sciences.

Under the guidance of faculty advisor and Ernest J. and Barbara M. Henley assistant professor of chemical and biomolecular engineering Jeffrey Rimer, Kumar, Oleksiak and Olafson presented their respective exploratory research on zeolites, which are crystals made up of aluminum, silicon and oxygen often used in the energy industry, and malaria pathophysiology.

Manjesh Kumar was invited to give an oral talk titled "Mechanisms of SSZ-13 Crystallization and Methods to Tailor Material Properties" at the GRC on Nanoporuos Materials & Their Applications in Holderness, N.H. He was selected based on the strength of his poster and the overall quality of his research. Kumar's project provides an interface between fundamental research of catalyst design and potential applications for industrial use.

Matt Oleksiak was also invited to give an oral presentation at the GRC on Nanoporuos Materials & Their Assembly. Much like Kumar, Oleksiak was selected based on the strength and quality of his poster presentation. Oleksiak presented research on zeolite synthesis and its application in the energy industry. His research explored cost-effective methods to create zeolites, map particular structures and tune the properties of the crystals.

Katy Olafson was invited to speak about her research on malaria pathophysiology from the aspect of hematin crystallization at the conference on Crystal Growth & Assembly in Biddeford, Maine. She studied how anti-malarial drugs affect crystallization with the hopes of discovering new drugs to treat the disease. Rather than being invited to speak based on her poster presentation, Olafson submitted her abstract before the conference and was pre-selected through a new pre-screening process implemented only at select GRCs.

Watch our video series on >> YouTube
UH CULLEN COLLEGE OF ENGINEERING

SECRET LIVES OF ENGINEERS:

CIVIL ENGINEERING ALUMNUS ALFRED CASTILLO JR.

BY NATALIE THAYER

When asked to imagine a "typical" engineer, many people may find themselves conjuring images of sleep-deprived, math-obsessed or highly-analytical individuals. In reality, there is no one-size-fits-all stereotype for engineering professionals – engineers come in all shapes and sizes and from all walks of life.

In the video series "Secret Lives of Engineers," the University of Houston's Cullen College of Engineering challenges conventional engineering stereotypes by exploring engineers' lives beyond the workplace. The series highlights the wealth of diverse talents, ambitions and passions that engineers bring to the table.

In the first installment of the series, we introduce you to Houston native and UH civil engineering alumnus **Alfred Castillo Jr.** By day, Castillo is the sourcing manager for Dow Chemical's global purchasing department – but after business hours, Castillo is a professional (and very successful) actor.

"I've always enjoyed acting," he said, recalling how he memorized the entire script of the movie "Pee-Wee's Big Adventure" in middle school. "I was just repeating that movie to my family and friends and people were getting a kick out of it."

Today, he embraces pursuits in both the engineering and performing arts fields, finding something uniquely fulfilling in each. "You define you," he said, adding that individuals can cast off stereotypes and the status quo. "You can be whoever you're called to be," he said.

WATCH OUR VIDEO
with Castillo in our "Secret Lives of Engineers" series at www.egr.uh.edu/secret-lives-castillo

MEET BEN AMABA:

IBM Executive, IE Guru and the Newest Member of the IE Industry Advisory Board

Q&A

BY NATALIE THAYER

Ben Amaba isn't from the city of Houston, and he isn't an alumnus of the University of Houston. But as an industrial engineering guru, Amaba said he now finds himself inextricably tied to both Houston and its University.

"There is so much opportunity in Houston for industrial engineers, and the University of Houston is a big part of that," Amaba said. "That's why I'm here, and that's why I'm such a big supporter of the University of Houston and its industrial engineering programs."

Amaba is the newest member of the UH Cullen College of Engineering's Industry Advisory Board for the industrial engineering department. As a worldwide executive for IBM, Amaba spends his days eating, sleeping and breathing industrial engineering processes for optimizing the performance of systems and integrating humans, machines, materials and information.

Tech, Amaba said, is the next great frontier for industrial engineers, and Houston is the best city in the world for industrial engineers to break into the tech industry.

Q: What are industrial engineers responsible for at IBM and how do they contribute to the company?

A: Industrial engineers contribute to the company in a myriad of ways because they can apply their skillsets across the company. The five major cross-disciplinary areas that industrial engineers work in at IBM are systems analysis and design, facilities, logistics, quality, human factors and ergonomics.

Q: You gave the Cullen College's industrial engineering department the gift of a scholarship for students pursuing a Professional Engineering (P.E.) license. What motivated you to provide this scholarship?

A: I think it's very important for engineers to aspire toward that level of professionalism because, as an engineer, you're responsible for public health, safety, security and environmental protection. I gave the scholarship to increase awareness of the Professional Engineering license amongst students and to remove the economic constraints of pursuing it. I believe it's very important for established industry professionals to mentor young engineers and help them get to the professional level.

Q: What career advice can you share with industrial engineering students and recent graduates?

A: First of all, target and brand yourself as a professional by pursuing a P.E. license. Secondly, collaborate in public and private partnerships, like industry consortiums, to figure out where you want to go and where the industry is going. And, thirdly, find mentors that you can turn to for advice on your career path. Much like a corporation benefits from a board of directors, you can benefit from the feedback of trusted advisors.

Q: What do you see as the future of industrial engineering?

A: Since industrial engineers are not constrained by industry, geography or domain, the possibilities are almost endless. Because industrial engineers can apply their skillsets to so many avenues – from a hospital, to a theme park like Disney, to a software factory – I don't think you can put borders on the discipline right now. I think the future is wide open.

DEAN HONORS TWO ORGANIZATIONS WITH INDUCTION INTO THE BRIDGEBUILDER SOCIETY

BY NATALIE THAYER

At the Energy Leadership Board (ELB) dinner last November, two organizations were honored with inductions into the Bridgebuilder Society for the Cullen College of Engineering.

Established in 2000, the Bridgebuilder Society recognizes and honors those who have made transformational and impactful gifts to the Cullen College of Engineering. Induction into the society is the highest honor the Cullen College bestows upon a donor.

Last year, **Joseph W. Tedesco**, dean of the Cullen College, recognized **The Institute for Rehabilitation and Research Foundation**, also known as TIRR Foundation, and the **Offshore Industry Crawfish Boil Committee** for their significant financial contributions and commitment to the future of the college.

The TIRR Foundation is a nonprofit 501(c)(3) organization that seeks to improve the lives of people who have sustained central nervous system damage through injury or disease. The TIRR Foundation created, directs and funds Mission Connect, a collaborative neurotrauma research project. Mission Connect is focused on supporting the discovery of preventions, treatments and cures for central nervous system damage caused by brain injuries, spinal cord injuries and neurodegenerative diseases.

Led by executive director Cynthia Adkins, the TIRR Foundation has provided significant support to Jose Luis "Pepe" Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen University Professor of electrical and computer engineering, and his Non-Invasive Brain Machine Interface Systems Laboratory at the UH Cullen College.

The Offshore Industry Crawfish Boil Committee has organized, managed and lead efforts to host the annual offshore industry, pre-OTC crawfish boil for 27 years. The popular on-campus event draws several thousand individuals to the University each year, including industry partners, alumni and community members. The tireless efforts

Tedesco honors TIRR Foundation

Tedesco honors Crawfish Boil Committee

of the committee members have resulted in more than $1 million in financial support for programs and student scholarships in the Cullen College of Engineering.

AMERICAN JEREH SUPPORTS ENGINEERING STUDENTS WITH NEW SCHOLARSHIP

BY AUDREY GRAYSON

Oilfield-equipment manufacturer **American Jereh International Corporation** showed its support for the University of Houston Cullen College of Engineering by granting scholarships to two engineering students for the 2015 fall and 2016 spring semesters.

The demand for skilled engineers in the city of Houston, the energy capital of the world, is higher than in any other major U.S. city. Company leaders at American Jereh hoped to give back to the Houston community by helping engineering students at UH to successfully complete their degrees.

The academic curriculum at the UH Cullen College of Engineering is widely regarded as one of the most rigorous engineering programs in the nation. On top of the challenging course work, the majority of UH Engineering students work full-time or part-time to finance their education.

Consequently, many Houston companies in the energy industry choose to support the college and its students through academic scholarships, providing students with funding for textbooks, tuition and even on-campus housing.

American Jereh is the latest Houston-based company to provide such support.

Ricca Leatherman, vice president of human resources for the manufacturer, said that the company's chief executives were very impressed with the caliber of graduates from the college.

"We have some very successful UH alumni here that were hired right out of college. UH engineering students come across as highly intelligent, creative and innovative problem-solvers who are ready for the challenges ahead of them," Leatherman said.

While the purpose of the scholarship funding is primarily to ease students' financial burdens, it's also an opportunity for companies to recruit talented individuals to join their teams, Leatherman added.

As a global manufacturer of advanced oilfield equipment, American Jereh serves clients in over 30 countries with custom, integrated technology for land and offshore operations. When the company's North American headquarters was established in Houston, American Jereh's leadership was adamant on giving back to the community in a way that would have true impact.

"In our brainstorming sessions, giving back to UH Engineering was one of the first things that came up," said Leatherman. "We decided on UH Engineering because it's an excellent, up-and-coming program and because we want to help the students in Houston who are the future leaders of our community."

American Jereh provided scholarships in the amount of $3,000 for two undergraduate students pursuing degrees in electrical and mechanical engineering, respectively.

TO LEARN MORE about giving opportunities at the UH Cullen College of Engineering, please visit advancement.egr.uh.edu/giving-opportunities/ways-give

TO LEARN MORE about American Jereh International Corporation, please visit www.americanjereh.com

TECH COMPANY BRINGS INNOVATION LEGACY TO ENGINEERING STUDENTS

BY ASHLEY SCHWARTZ

Since 1933, **Omron Global** has provided products and services critical to improving the lives and supporting the safety and health of people around the world. Omron's innovative products and technologies range from automated traffic signals and the first digital thermometer to the first smartphone facial recognition technology.

Now, the Omron Foundation is supporting the education of UH Cullen College of Engineering students in the electrical and computer engineering department through the establishment of the Omron Senior Design and Robotics Laboratory. The company's donation will fulfill the cost of construction of the laboratory, which will be stocked with Omron equipment and tools that will be used by students working on robotics and Capstone Design, a course for senior engineering majors.

The lab will consist of two main areas: the senior design area and the robotics area. The senior design area will primarily serve as a workshop for students in the senior design program. The Omron Laboratory will give senior design students access to a variety of state-of-the-art equipment, as well as the capability to view demonstrations and educational videos. The robotics area will be largely devoted to students enrolled in "Microprocessor Systems" and "Embedded Systems" courses, providing them with a space for completing lab assignments and hands-on demonstrations associated with the class.

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

"The department of electrical and computer engineering is extremely appreciative of this latest gift from Omron," said **Badri Roysam**, chair of the department of electrical and computer engineering. "This laboratory will provide an invaluable experience to the students and allow them to learn about the very real challenges and ultimate payoff all engineers experience."

Intended to be a showcase laboratory for the electrical and computer engineering department, the Omron Senior Design and Robotics Laboratory will feature a glass wall so those walking through the Cullen College's hallways can watch students and faculty conduct research and work on projects inside of the lab.

Omron will also donate the equipment needed for the laboratory. The company provided a five-day training session for three faculty members and two students at their headquarters in Chicago so that faculty could evaluate which pieces of equipment would be the most useful to current and future electrical and computer engineering students. Future courses in the electrical and computer engineering department will be designed around the state-of-the-art equipment donated to the laboratory by Omron.

"At Omron we focus on innovation and quality, and recognize the importance of supporting the community and contributing to a better society. The University of Houston, with its continued growth, diversification and commitment to excellence, is an institution that shares those same values. We at Omron are pleased to support the Cullen College of Engineering and the Omron Senior Design and Robotics Laboratory," said Robert Bost, President and COO of Omron Oilfield and Marine, Inc.

Omron Oilfield and Marine is a leading manufacturer of AC and DC drive systems and custom control systems for the international oil and gas industry. More specifically, they provide power distribution equipment and automated control systems for offshore and mobile drilling rigs.

TO LEARN MORE
about Omron Global,
please visit www.omron.com

THE ENGINES OF OUR INGENUITY:

TAKEN FROM EPISODE NO. 1431

DOGS

A recent issue of *Discovering Archaeology* magazine has two articles on dogs. We've long supposed that the symbiosis between human and dog developed as dogs followed Neolithic hunters and scavenged scraps. But animal species don't bond the way human and dog have bonded without there being a balance of benefits. So what was in it for the humans? The common assumption was that animals offered companionship in exchange for food, and that humans accepted the gift. Although that much appears be true, the gift of companionship runs a lot deeper than we realized.

Archaeological evidence now shows that wolf-like animals first evolved in the Americas. They migrated to Europe over the Bering Strait land bridge 10 million years ago. Dogs didn't evolve away from wolves until only 130,000 years ago. That makes dogs about as old as the Neanderthals. We modern humans didn't appear until 40,000 years ago, and we've domesticated dogs for only a scant 14,000 years. That's roughly when human burials begin to include the remains of dogs.

Biologist Wolfgang Schleidt describes evidence that humans both profited and learned from wolves and dogs, long before any bonding or domestication took place. Humans following reindeer (and other) herds would hunt the best specimens. That would've led to weakened herds. But canine packs followed the same herds, weeding out the weakest animals. They did humans a service by maintaining the quality of the herds.

More than that, canines taught cooperative hunting to humans. Wolves and dogs are unique among animals for the texture of their cooperation. They don't compete within the pack; they form friendships instead. Apes and monkeys don't do that. An ape bonds to a mate, or to its children, but a dog has friends beyond its kin.

So human and dog joined forces in the hunt, and dogs helped to humanize us (or to doggify us). We find an early stone-age farmer buried with tools for grinding grain and with his favorite dog. A brick from the 3rd millennium B.C. City of Ur is stamped with an inscription. But it has also been marred by four dog footprints left in the once-wet clay. A 16th century crowd scene painted by Pieter Brueghel shows a blind man with a seeing-eye dog.

We've all been led to think that dogs are just one more house pet. It turns out that they're much more. They were part of our process of coming of age. Now we find that bonding with a dog lowers our blood pressure, cholesterol and triglycerides. We suffer less depression. No wonder Elizabeth Barrett wrote these lines when her dog died:

Therefore to this dog will I,
...
Render praise and favor:
With my hand upon his head,
Is my benediction said
Therefore and forever.

DEDICATED TO GRAYSON

ABOUT THE SHOW

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.

UNIVERSITY of HOUSTON | ENGINEERING

UH Cullen College of Engineering
Office of Communications
Engineering Building 2
4722 Calhoun Road, Suite E301
Houston, Texas 77204-4009

ENGINEER YOUR FUTURE

ONLINE LEARNING PROGRAMS

LEARN MORE AT
onlinelearning.egr.uh.edu