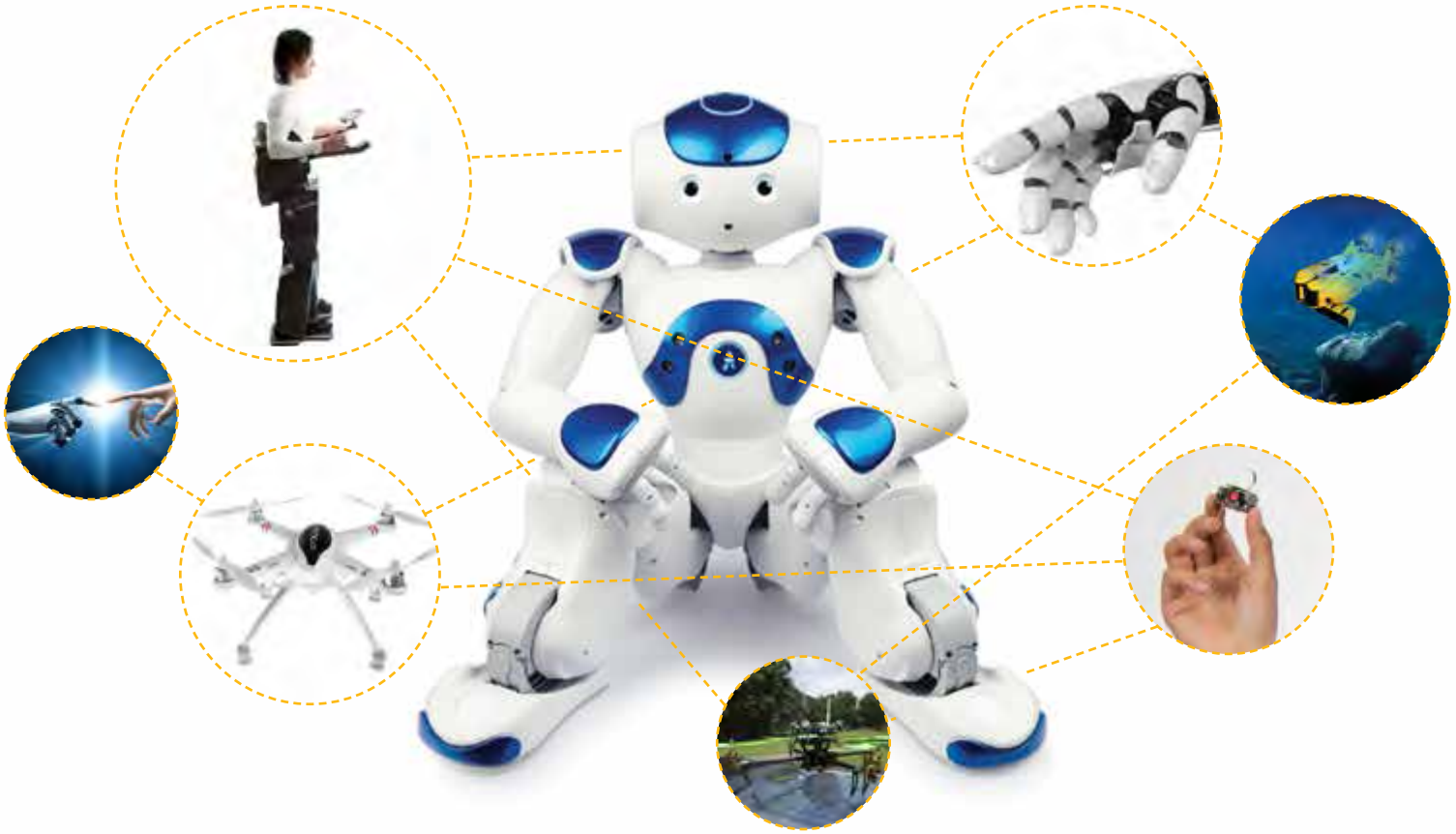
ECE CONNECTIONS

Department of Electrical & Computer Engineering Magazine
UH Cullen College of Engineering
Fall 2017

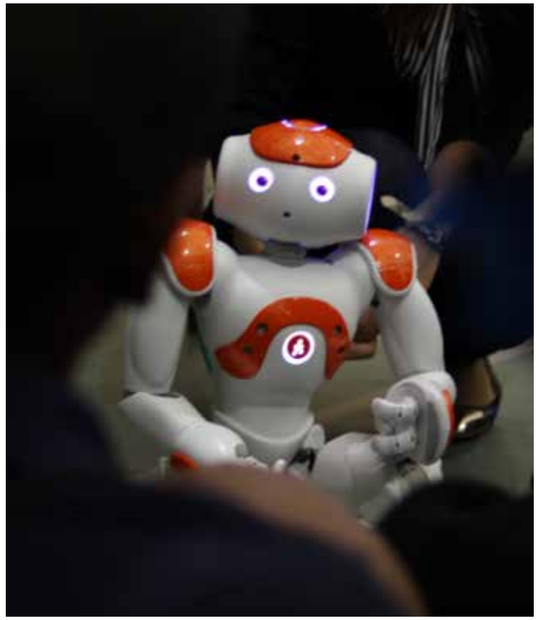


RISE OF THE ROBOTS

UH ECE'S GAME CHANGING ROBOTIC TECHNOLOGIES

RISE OF THE ROBOTS

LEARN ABOUT UH ECE'S GAME CHANGING ROBOTIC TECHNOLOGIES



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ECE CONNECTIONS

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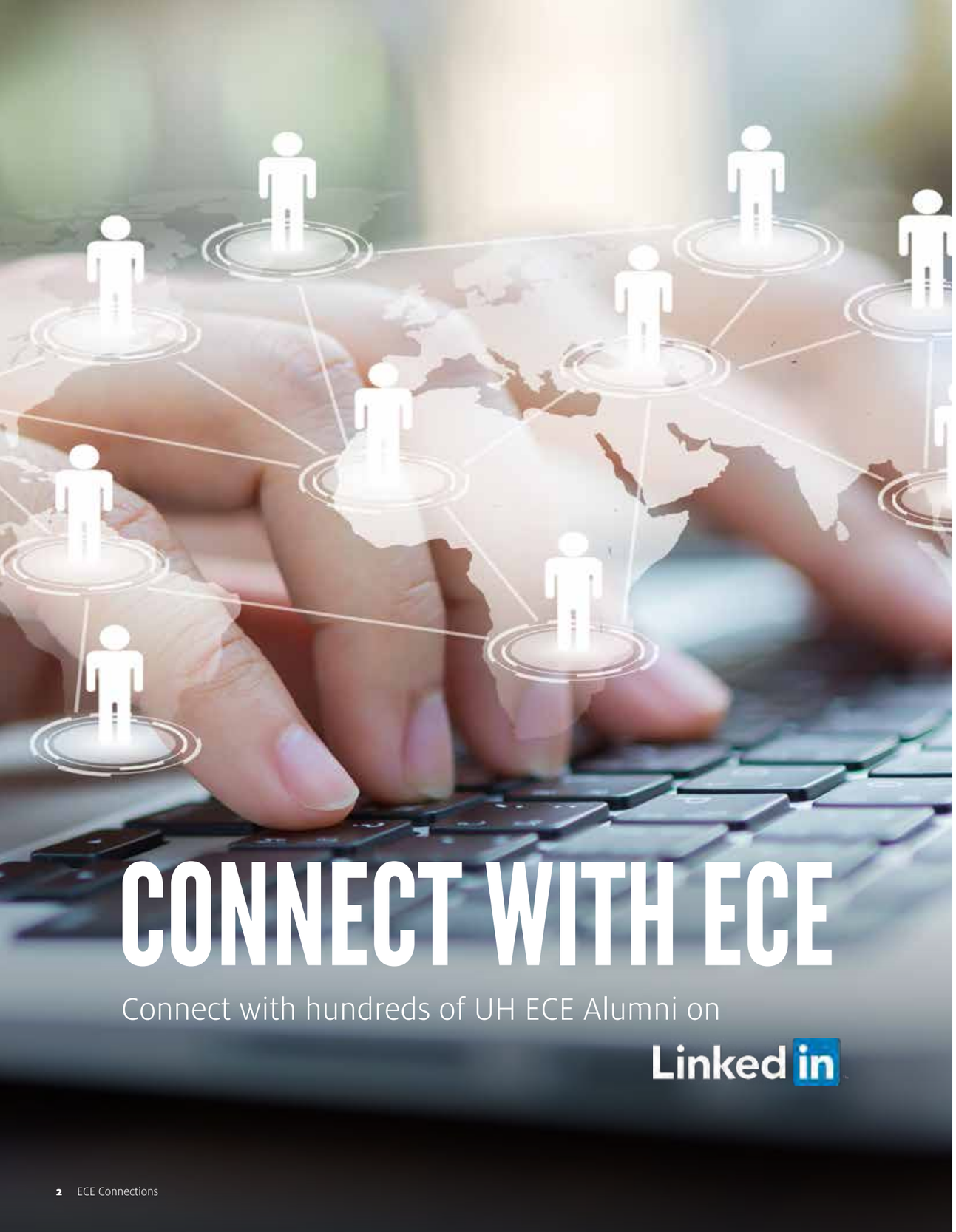


CONNECT WITH ECE

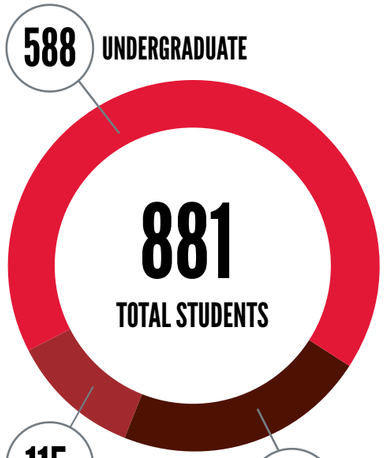
Connect with hundreds of UH ECE Alumni on LinkedIn

ECE BY THE NUMBERS

GRADUATE PROGRAMS IN ELECTRICAL AND COMPUTER ENGINEERING NAMED "BEST ENGINEERING PROGRAMS OF 2017" BY *U.S. NEWS & WORLD REPORT*

38
TOTAL FACULTY

$7M+
TOTAL RESEARCH EXPENDITURES



1342
AVERAGE SAT SCORE OF ENTERING FRESHMEN

AVERAGE STARTING SALARIES

ELECTRICAL ENGINEERING

B.S. $66,920
▼
M.S. $75,317
▼
Ph.D. $93,857

COMPUTER ENGINEERING

B.S. $68,191
▼
M.S. $78,101
▼
Ph.D. $104,600

Source: National Association of Colleges and Employers 2017 Salary Survey

UH ENGINEERING BY THE NUMBERS

BEST GRAD SCHOOLS U.S.News & WORLD REPORT ENGINEERING 2017

#73

Best Engineering Program in the Nation

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

139 total faculty

1,287 graduate students

\+

3,267 undergraduate students

4,554 total students

Top-ranking graduate programs in:

- Aerospace (#56)
- Biomedical (#73)
- Chemical (#38)
- Civil (#60)
- Electrical (#65)
- Environmental (#59)
- Industrial (#50)
- Materials (#71)
- Mechanical (#69)
- Petroleum (#12)

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

Degrees Awarded in 2017

601 - B.S.

405 - M.S.

72 - Ph.D.

1300 average SAT score of entering freshman

$26M+ annual research expenditures

14 National Academy of Engineering faculty members

$104,640 average annual salary for engineers in Houston, Texas *(Source: U.S. Bureau of Labor Statistics, May 2016)*

25% of engineers in the Houston metro area earn **25% higher annual salaries** than the national average *(Source: U.S. Bureau of Labor Statistics, May 2016)*

87,500 jobs in engineering and architecture in the Houston metro area in 2016 *(Source: U.S. Bureau of Labor Statistics, May 2016)*

ENGINEERING EMPLOYMENT OUTLOOK: BY THE NUMBERS

Higher Demand for Engineers Than All Other Occupations

Median Income for Engineers is

x2

That of Other Occupations

ENGINEERING JOB PROJECTIONS THROUGH 2023:

Top 10 Occupations

GROWTH FORECAST FOR ENGINEERING OCCUPATIONS

Civil engineers	+45,745
Mechanical engineers	+25,485
Architectural and engineering managers	+19,650
Industrial engineers	+17,660
Electrical engineers	+16,561
Electronics engineers*	+12,139
Petroleum engineers	+11,469
Computer hardware engineers	+10,799
Biomedical engineers	+10,542
Environmental engineers	+10,129

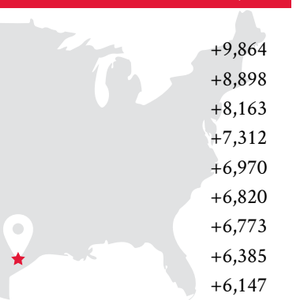
11% Growth

249,908 new jobs will be available for engineers

Top 10 Locations

THESE U.S. METROPOLITAN AREAS WILL HAVE THE GREATEST DEMAND FOR ENGINEERS:

Houston, TX	**+14,925**
Washington, D.C.	+9,864
Los Angeles, CA	+8,898
Dallas, TX	+8,163
San Francisco, CA	+7,312
New York, NY	+6,970
San Jose, CA	+6,820
Boston, MA	+6,773
Denver, CO	+6,385
Phoenix, AZ	+6,147



Source: kellyservices.us/engineeringcareers

*Excluding computer engineers

DID YOU KNOW?

- **UH GRADUATES BEAT THE NATIONAL AVERAGE FOR STARTING AND MID-CAREER SALARIES** (Source: PayScale.com)
- **UH IS #7 IN U.S. FOR GRADUATING STUDENTS WITH THE LEAST AMOUNT OF DEBT** (Source: U.S. News & World Report)
- **UH IS A "BEST VALUE COLLEGE"** (Source: Princeton Review)
- **UH IS AWARDED $113 MILLION IN GRANTS AND SCHOLARSHIPS EACH YEAR**
- **UH IS AMONG THE "TOP 100 MOST AFFORDABLE LARGE PUBLIC COLLEGES"** (Source: AffordableCollegesOnline.org)

IN THE MEDIA SPOTLIGHT

U.S.News & WORLD REPORT

U.S. News & World Report asked **Rose Faghih** to weigh in on the similarities between engineering pioneers Elon Musk and Nikola Tesla, after whom Musk named his electric car. Tesla went broke pushing his obsession with wireless communication and power transmission on a world that wasn't yet ready in 1900, and many pose the question whether the same could happen to Musk as he relentlessly pursues technology.

READ FAGHIH'S THOUGHTS ON THE NATIONAL TESLA VS. MUSK DEBATE AT
money.usnews.com/investing/articles/2017-04-27/elon-musk-is-determined-to-change-the-world

KHOU11

KHOU aired a story about **Wei-Chuan Shih's** invention that turns smartphones into microscopes that can detect whether your pond water is healthy – and perhaps even diagnose diseases.

WATCH THE VIDEO AT
www.khou.com/tech/new-lens-turns-smartphones-into-microscopes-/352116602

HOUSTON CHRONICLE

The Houston Chronicle profiled three UH engineers changing the world and engineering the future, including **Jose Luis "Pepe" Contreras-Vidal,** who is helping paraplegics walk again with mind-reading robotic exoskeletons.

MEET THE GAME-CHANGING UH ENGINEERS AT
www.egr.uh.edu/news/201610/houston-chronicle-profiles-uh-engineers-who-are-changing-world

The Houston Chronicle asked wireless communications expert **Zhu Han** whether Super Bowl LI fans inside of NRG Stadium – formerly known as a wireless "deadzone" – would be able to Tweet, Facebook and Snapchat their experiences at the big game.

READ HAN'S PREDICTIONS AT
www.egr.uh.edu/news/201702/houston-chronicle-taps-uh-engineering-expertise-wireless-technology-upgrades-super-bowl

TMC | NEWS

TMC News featured **Aaron Becker's** work using tiny robots to complete huge tasks –making surgeries much less invasive in the process. Becker's vision is to deploy millimeter-sized robots in the body's venous system to deliver drugs or break up harmful masses and growths, and he's working with TMC physicians to make his dream a reality.

READ MORE ABOUT BECKER'S VISION FOR THE FUTURE OF TARGETED TREATMENT AT
www.tmc.edu/news/2017/05/solutions-small-robots-big-jobs/

For the latest news about the groundbreaking research at the Cullen College of Engineering, please visit

www.egr.uh.edu/news

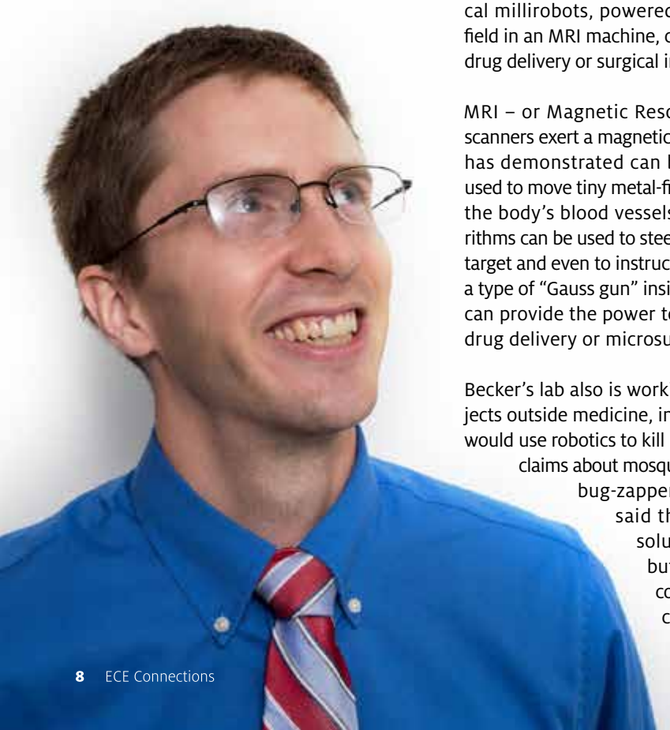
UH Professor Meets With Congress About

NATIONAL ROBOTICS INITIATIVE

BY JEANNIE KEAVER

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

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



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

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

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

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

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

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

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

> ***"My goal was to share some of the great things we're doing, how the University of Houston is a hotbed of innovation."***
>
> - AARON BECKER

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

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

UH Engineering and Honors Colleges Launch

STUART LONG UNDERGRADUATE RESEARCH FUND

BY AUDREY GRAYSON

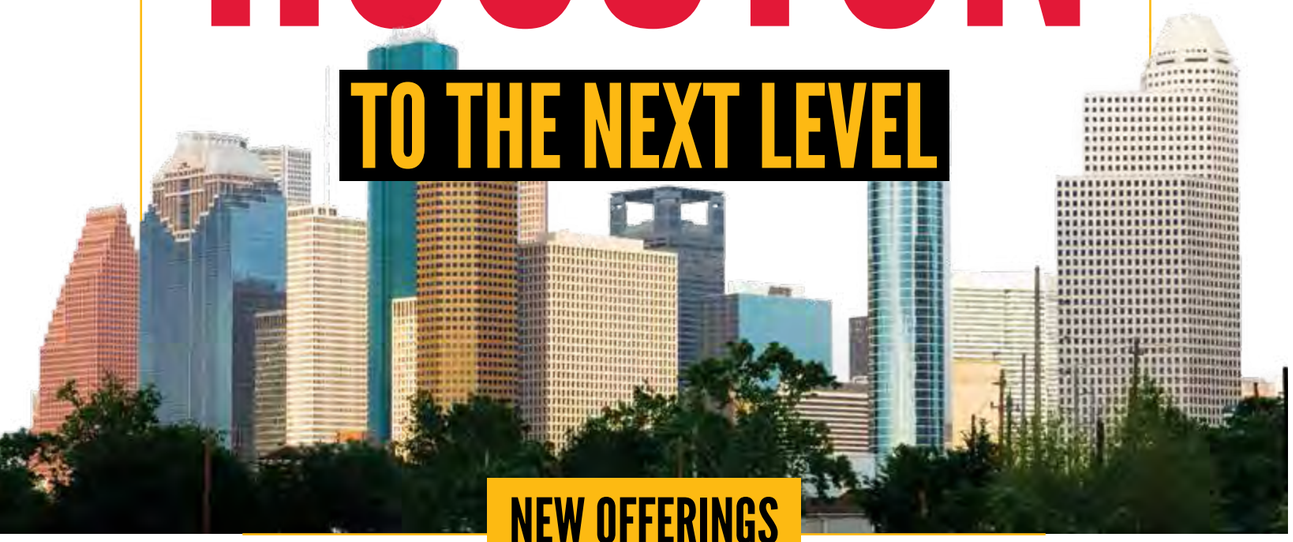
UH engineering students will have more opportunities than ever to pursue research in one of the world-class laboratories on campus thanks to the Professor Stuart Long Undergraduate Research Fund, which will provide support to students across the UH campus conducting innovative, high-level research.

The UH Cullen College of Engineering and the UH Honors College created the fund in honor of Stuart Long, associate dean of undergraduate research at UH and professor of electrical and computer engineering at the Cullen College. The Professor Stuart Long Undergraduate Research Fund will support undergraduate research programs at UH such as the Summer Undergraduate Research Fellowship (SURF) and Houston's Early Research Experience (HERE) for many more years to come.

For many years Long has been a proponent of undergraduate research and is credited with increasing varied research opportunities for undergraduate students. "Engaging undergraduate students with research projects or professional opportunities not only helps them connect-the-dots between classroom lessons and their real-world applications – it also helps them earn better grades and increases the chances that they will successfully complete their engineering degree," Long said.

FOR MORE INFORMATION AND TO MAKE A GIFT TO THE PROFESSOR STUART LONG UNDERGRADUATE RESEARCH FUND, please contact Ryan Kenney at rpkenney@uh.edu.

TAKING HOUSTON TO THE NEXT LEVEL



NEW OFFERINGS

UH Engineering launches certificate programs in power and energy systems

Two new graduate certificates launched at the UH Cullen College of Engineering will produce talented engineers to take on leadership roles in the electrical energy industry. A certificate in Power Electronics and Renewable Energy Technologies focuses on power electronics and renewable energy technologies. The Power Systems and Smart Grid certificate provides advanced courses in power systems, smart grid and power system protection.

LEARN MORE AT
www.ee.uh.edu/graduate/certificate-programs

University of Houston launches industry-relevant online engineering programs

The UH Cullen College launched flexible, online master's programs in civil, mechanical, subsea and industrial power systems engineering, tailored for working professionals. "It is critical that the Houston region and the U.S. has the engineering talent required to address the grand challenges in energy, infrastructure and the environment facing our society," said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering.

LEARN MORE AT
onlinelearning.egr.uh.edu

NEW OFFERINGS

University of Houston Offers Energy-Focused Courses in Katy

The UH Cullen College of Engineering is expanding its roster of innovative and industry-relevant course offerings in the Katy area. In the fall of 2016 UH began offering five graduate-level engineering courses in high demand along West Houston's Energy Corridor, including petroleum, subsea, electrical and environmental engineering.

LEARN MORE AT
www.egr.uh.edu/engineering-katy

WORD ON THE STREET

Forbes.com lauds University of Houston as leader in energy research and education

Forbes.com calls UH an epicenter of energy education and research, saying it is "increasingly a rival to places like MIT in advancing not just cleaner, safer and more efficient ways of extracting oil and gas from the earth, but also cleaner energy and zero-carbon energy."

READ THE FULL STORY AT
www.egr.uh.edu/news/201611/forbescom-lauds-university-houston-leader-engineering-research-and-education

UH ranks among best universities in the world for engineering and technology by CEOWorld Magazine

The University of Houston is one of the best universities in the world from which to earn an engineering degree, according to 2017 rankings released by *CEOWorld Magazine*. The magazine ranked the UH Cullen College of Engineering No. 73 in the list of top schools to receive an engineering or technology degree. *CEOWorld Magazine* ranked institutions based on academic reputation, admission requirements, job placement rate, recruiter feedback, specialization, global reputation and influence.

READ THE FULL STORY AT
www.egr.uh.edu/news/201702/uh-ranks-among-best-universities-engineering-and-technology-ceoworld-magazine

UH among top U.S. universities for return on investment and upward mobility

Stellar academics, strong career prospects for graduates and affordability are among the reasons the University of Houston has been featured in the *Princeton Review*'s 2017 edition of "Colleges That Pay You Back: The 200 Schools That Give You the Best Bang for Your Tuition Buck." In addition, a recent study by the Equality of Opportunity Project shows UH is among the best universities in the U.S. at turning low-income students into top earners.

READ THE FULL STORY AT
www.egr.uh.edu/news/201702/uh-among-top-us-universities-return-investment-and-upward-mobili

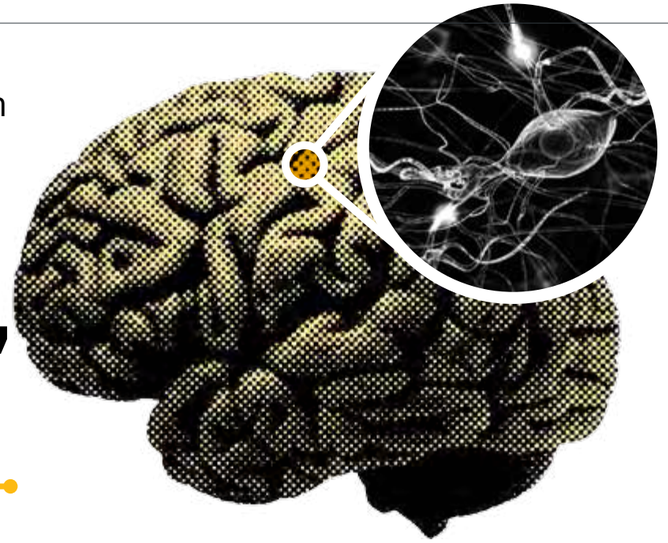
UH rated among best colleges for undergraduate education by Princeton Review

Princeton Review ranks UH among the nation's best institutions for undergraduate education in the 2017 edition of its flagship college guide, "The Best 381 Colleges," based, in part, on surveys from students. "Outstanding academics are the chief reason we chose UH for this book, and we strongly recommend it to applicants," said Robert Franek, *Princeton Review*'s editor-in-chief and author of "The Best 381 Colleges."

READ THE FULL STORY AT
www.egr.uh.edu/news/201609/uh-rated-among-best-colleges-undergraduate-education-princeton-review

Academia, Industry Collaborate on

SOLUTIONS TO NEURAL DISEASE, INJURY



BY JEANNIE KEVER

Neurological disorders like Parkinson's, the aftermath of stroke, limb loss and paralysis significantly diminish the length and quality of life – affecting about one in six people worldwide. But a growing number of biomedical innovations, driven in large part by an aging population dealing with debilitating health issues, are improving both cognitive and motor function.

A new National Science Foundation (NSF) Industry/University Cooperative Research Center (I/UCRC) will focus on developing and testing new neural technologies with the potential to dramatically enhance patient function across a wide range of conditions while both lowering costs and increasing accessibility.

The BRAIN Center (Building Reliable Advances and Innovation in Neurotechnology) will be led by researchers from the University of Houston and Arizona State University and, working with industry partners, will speed technologies to market.

BRAIN will focus on developing and testing neurotechnologies designed to address a wide range of sensory, motor and cognitive functions. Such neural technologies could save an estimated $400 billion in future costs, according to the U.S. Centers for Disease Control and Prevention.

"The BRAIN Center is a way to bring together top faculty at both institutions to address critical challenges in the biomedical field," said **Jose Luis Contreras-Vidal,** professor of electrical and computer engineering at the UH Cullen College. "The best way to do that is working with industry."

Contreras-Vidal and Marco Santello, director of ASU's School of Biological Health Sciences, will lead the project, which involves more than 50 researchers from both institutions, along with 14 members from industry, including several hospital systems. The researchers come from a wide range of disciplines, from engineering to law, data science and physiology. More information is available on the center's website.

"Medical advances have dramatically increased life expectancy in the 21st century," said Santello. "The BRAIN Center will enable us to develop safe, reliable neurotechnologies to address the rise in chronic, degenerative diseases associated with an aging population."

The BRAIN Center was launched with a $1.5 million grant from the National Science Foundation, shared equally by the universities; industry collaborators pay $50,000 a year to partner with faculty, using university laboratories to co-develop and validate new technologies.

With dedicated space on both campuses, the center will host two meetings a year. The inaugural meeting in Phoenix was held in

June and a second meeting in Houston will be held this fall. Industry/faculty teams will present proposals for developing collaborative research projects. Research areas range from big data to neurorehabilitation and neuromodulation device development, to robotic-assisted therapy and regulatory science.

The NSF grant also includes a workforce training component, with a focus on recruiting and training students from underrepresented communities in undergraduate programs.

"We are training the next workforce," said Contreras-Vidal. "The technology is so new, we don't have enough people to design, repair, validate and prescribe these technologies."

LEARN MORE ABOUT THE BRAIN CENTER AT
brain.egr.uh.edu

TAKING BETTER PICTURES

New Superconducting Coil Improves MRI Performance

BY JEANNIE KEVER

A multidisciplinary research team led by University of Houston scientist **Jarek Wosik** has developed a high-temperature superconducting coil that allows magnetic resonance imaging (MRI) scanners to produce higher resolution images or acquire images in a shorter time than when using conventional coils.

Wosik, a principal investigator at the Texas Center for Superconductivity at UH, said test results show the new technology can reveal brain structures that aren't easily visualized with conventional MRI coils. He also is a research professor in the Cullen College's department of electrical and computer engineering.

The cryo-coil works by boosting the signal-to-noise ratio (SNR) – a measure of the strength of signals carrying useful information – by a factor of two to three, compared with conventional coils. SNR is critical to the successful implementation of high resolution and fast imaging.

Wosik said the cryo-coil reveals more details than a conventional coil because of its enhanced SNR profile. Where a conventional coil does not have enough sensitivity to "see," a superconducting coil can still reveal details. These details will remain hidden to conventional coils even when image acquisition is repeated endlessly.

For the initial tests, the probe was optimized for rat brain imaging, useful for biomedical research involving neurological disorders. But it also has direct implications for human healthcare, Wosik said.

"Research in animal models yields critical information to improve diagnosis and treatment of human diseases and disorders," he said. "This work also has the potential to clearly benefit clinical MRI, both through high quality imaging and through shortening the time patients are in the scanner."

Results from preliminary testing of the 7 Tesla MRI Cryo-probe were presented at the International Symposium of Magnetic Resonance in Medicine annual meeting last May. The coil can be optimized for experiments on living animals or brain tissue samples, and researchers said they demonstrated an isotropic resolution of 34 micron in rat

brain imaging. In addition to its use in MRI coils, superconductivity lies at the heart of MRI scanning systems, as most high-field magnets are based on superconducting wire.

In addition to Wosik, collaborators on the project include Ponnada A. Narayana, director of the Magnetic Resonance Imaging Center and a professor in the department of diagnostic and interventional imaging at the University of Texas Health Science Center at Houston; Kurt H. Bockhorst, senior research scientist at UT Houston; Kuang Qin, a graduate student working with Wosik; and I-Chih Tan, assistant professor in the department of neuroscience at Baylor College of Medicine.

"Compared to corresponding standard room temperature MRI coils, the performance of the cooled normal metal and/or the high-temperature superconducting receiver coils lead either to an increase in imaging resolution and its quality, or to a very significant reduction in total scan time," Wosik said.

UH Engineers Study the

Creative BRAIN

BY ASHLEY SCHWARTZ

In an innovative collaboration between scientists and artists, "Your Brain on Art" is a series of studies that seeks to understand what happens in the brain as people create and contemplate art.

To explore this mystery, **Jose 'Pepe' Luis Contreras-Vidal,** professor of electrical and computer engineering at UH and director of the University's Non-Invasive Brain Machine Interface Systems Laboratory, has teamed up with Houston-based sculpture installation artist **Jo Ann Fleischhauer** in an 18-month-long study on the creative process.

For the study, Fleischhauer wears a mobile brain-body imaging (MoBI) system, which is comprised of a portable electroencephalography (EEG) headset, motion sensors and a video camera, while researching and working on her current art project. She also wears the headset while conducting her daily activities, such as going to the gym and cleaning her house – activities that can sometimes lead to creative inspiration for Fleischhauer. The goal of the project is to create spatial and temporal maps of neural activity in Fleischhauer's brain linked to the aesthetic and creative experiences.

"This is the first experiment, at least to my knowledge, wherein researchers have been tracking EEG data for such a long period of time," said Ph.D. student and UH-Houston Methodist Fellow Jesus Cruz-Garza. "We are collecting data in a very unconstrained setting, which is not typical in neuroscience."

Contreras-Vidal is hopeful that the results of this study will further bridge the gap between art and science, and lead to broader impacts in science, technology, engineering, art and math (STEAM).

"We know that creativity is important in the arts. What we would like to say is that creativity is also important in engineering and science," he said.

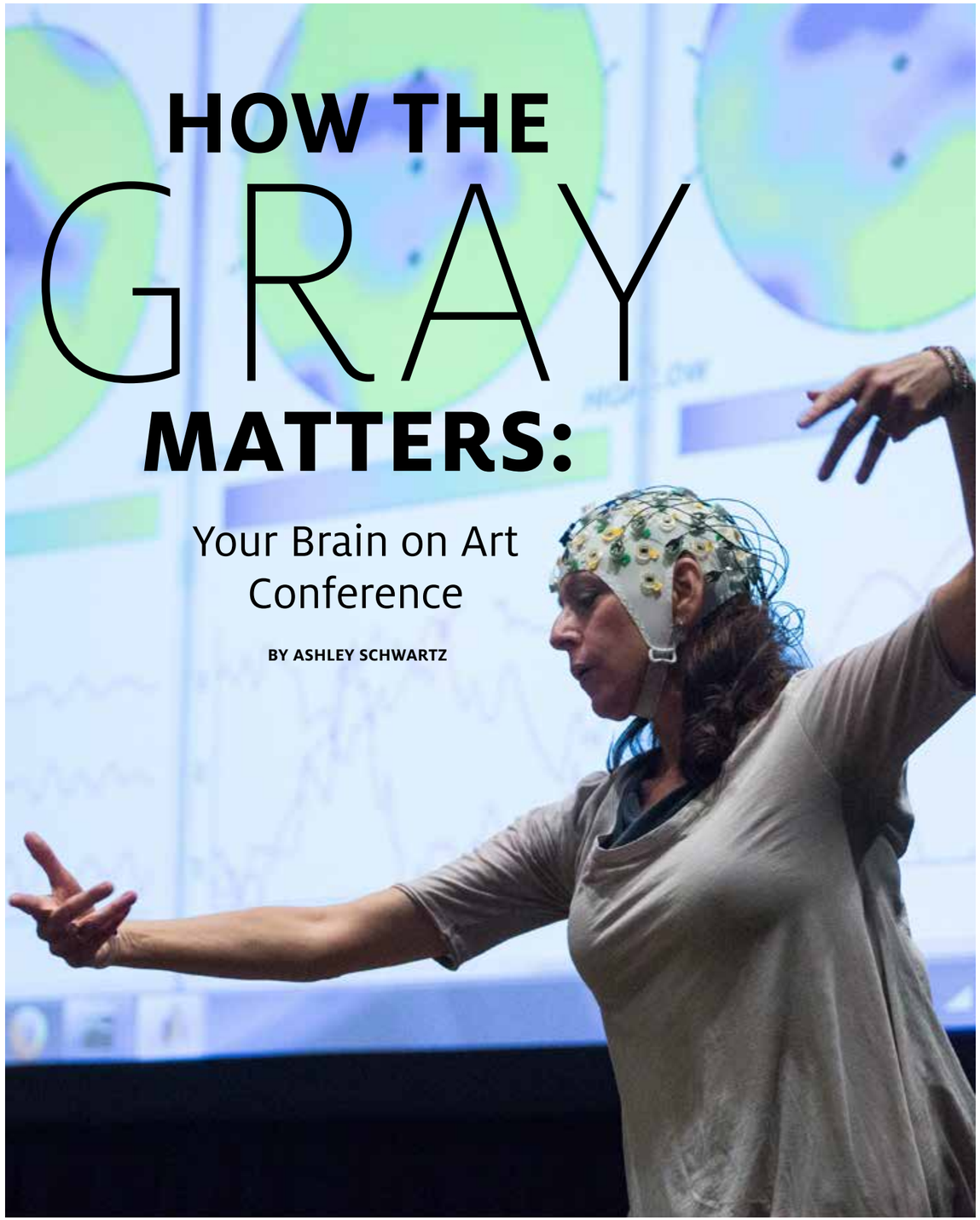
WATCH OUR VIDEO ABOUT THIS RESEARCH AT
www.egr.uh.edu/creative-brain-video

Artist Jo Ann Fleischhauer creates art while wearing mobile brain-body imaging (MoBI) system

HOW THE GRAY MATTERS:

Your Brain on Art Conference

BY ASHLEY SCHWARTZ



> "Creativity and aesthetic experience are essential qualities in the arts, science, engineering and medicine, and thus it is important to understand, measure and promote neural activity associated with creativity."
>
> *- Jose Luis Contreras-Vidal*

The human brain weighs only about 3 pounds, but inside that small compartment are 86 billion neurons – gray matter as they are known – ruling the entire universe of your body. One of the most curious studies of the brain delves into what happens inside it when you're thinking of art or creating it. That's how the "Your Brain on Art" research series got its name and why more than 100 engineers, scientists, artists and media representatives gathered for the 2016 International Conference of Mobile Brain-Body Imaging and the Neuroscience of Art, Innovation and Creativity ("Your Brain on Art" conference) in Cancun, Mexico.

The invitation-only conference encouraged leaders in the science and art fields to collaborate and discuss the future of neuroaesthetics and neurocreativity, as well as the potential applications of this research in medicine, science, engineering, education and the creative arts.

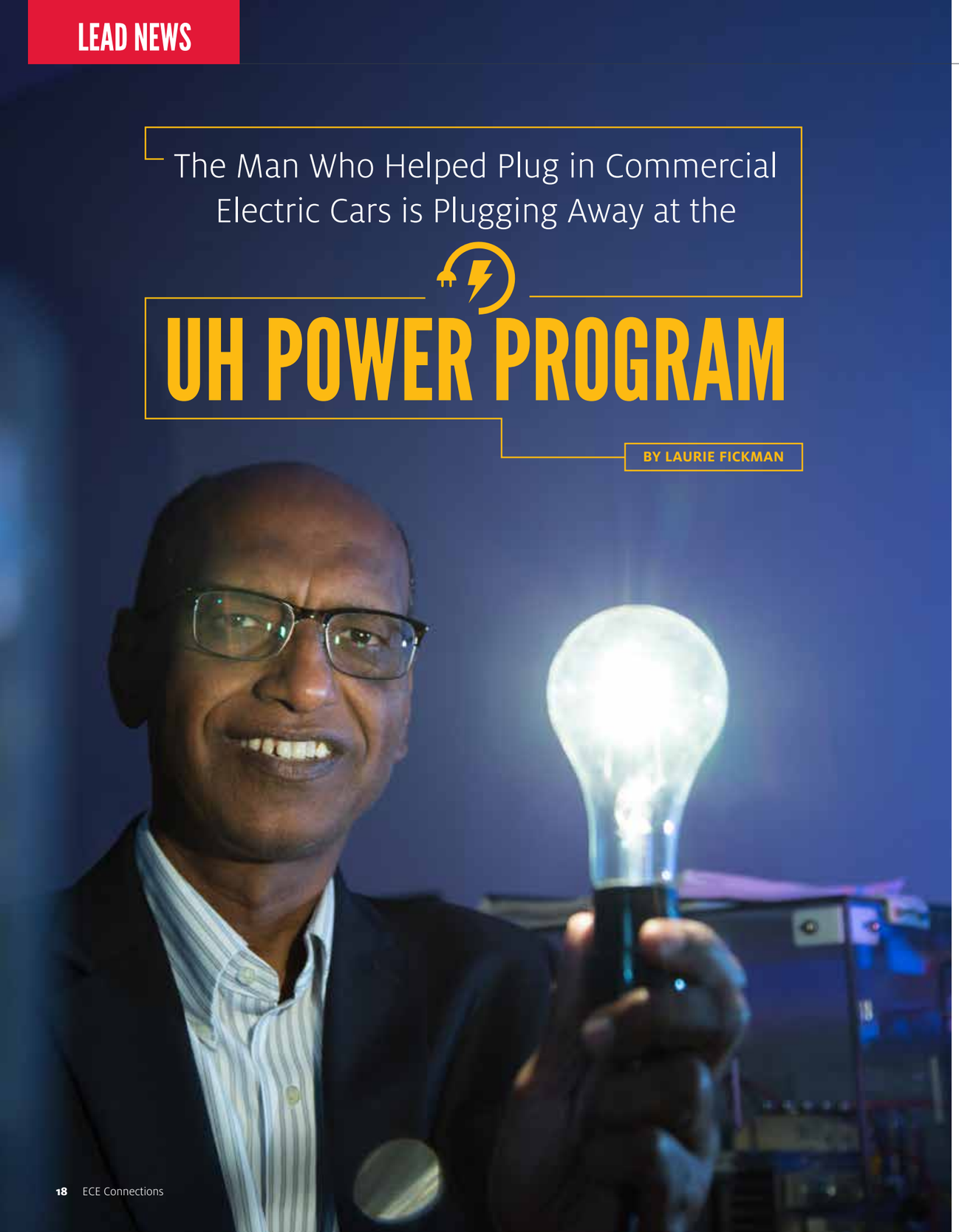
"Your Brain on Art" is a partnership between the University of Houston's Non-Invasive Brain Machine Systems Laboratory and Blaffer Art Museum. **Jose Luis Contreras-Vidal,** Hugh Roy and Lillie Cranz Cullen University Professor of electrical and computer engineering, pioneered the "Your Brain on Art" partnership and served as chair of the conference. Klaus Gramann, professor of biological psychology and neuroergonomics at the Berlin Institute of Technology, served as the co-chair of the conference.

LEARN MORE ABOUT THE ANNUAL CONFERENCE AT
yourbrainonart2017.egr.uh.edu

WATCH OUR VIDEO OF THE 2016 YOUR BRAIN ON ART CONFERENCE AT
www.egr.uh.edu/yourbrainonart-2016-video

The Man Who Helped Plug in Commercial Electric Cars is Plugging Away at the UH POWER PROGRAM

BY LAURIE FICKMAN



There are many ways to describe electrical and computer engineering Professor Kaushik Rajashekara, who heads the Cullen College power and energy systems program and is director of the Power Electronics, Microgrids and Subsea Electrical Systems (PEMSES) Center at UH: Member of the National Academy of Engineering, Fellow of the National Academy of Inventors, inductee of the Delphi Innovation Hall of Fame or, even, a member of the team that developed the General Motors EV1, the first mass-produced electric car from a major automaker.

But the title Rajashekara likes most is "futurist."

"When people ask me what I work on, I always say, 'The future,'" said Rajashekara, former chief scientist at General Motors/Delphi and chief technologist at Rolls-Royce.

It's a spot-on answer for the scientist who has consistently worked on futuristic projects and brought them to life. After ushering in the era of electric and hybrids cars from 1989-2006 by advancing the technologies including the EV1, he left his position at GM/Delphi for his next revolutionary project.

At Rolls-Royce, he worked on advanced architectures for more electric and hybrid electric aircraft, bringing to life his notions of converting ancillary equipment used on aircraft (like air conditioning and cooking devices) to electricity, leading to next generation aircraft beyond the 787 Dreamliner-type.

Now, with those futuristic projects in the past, he says the next big thing will be flying cars – and he's all in. If his track record is proof, it may be time to look skyward for a parking spot.

"Just recently I gave a lecture in India about flying cars. I give talks about them all over the world," said Rajashekara. He is propelled in his pursuit by his desire to preserve the environment. "If you have a flying car, you don't have to build as many bridges or cut as many trees," he offers, with a logic that makes his science fiction-sounding future appear to be just plain practical.

Down to earth at UH

His pursuits at the Cullen College are a bit more terrestrial.

"I'm a power and energy guy," said Rajashekara, who points out that most energy courses and majors at UH and other universities are related to petroleum or chemical engineering.

But to him, power means the energy of electricity, the magic that happens after converting the various petrochemicals and turning on the light switch.

> "When people ask me what I work on, I always say, **'The future.'**"
>
> - KAUSHIK RAJASHEKARA

"It is very important that electric energy gets importance at the University of Houston," he said. And so, in the past year since he's been at the Cullen College, Rajashekara has gone about creating the certificate program to prepare students to design electrical systems for the power and energy industry. The program offers two certificates – one in power electronics and renewable energy technologies and the other in power systems and the smart grid. The next step is to launch a curriculum offering a master's of science in electrical engineering in power and energy systems.

He hopes to grow his small lab and the program and welcome industry representatives to the lab to witness students tackling some of the greatest challenges in the power industry, like making the power grid smart and incorporating renewable energy into it.

"There is so much evolving in the infrastructure," said Rajashekara. But U.S. industry hasn't approached its biggest challenge, which, according to him, is burying the wires.

"The cables should be buried," he said, definitively, of the hundreds of thousands of miles of power lines that crisscross the cities. He notes safety from weather events, better security and a nicer landscape as benefits of burying cable.

He notices the sagging lines wherever he travels.

Amazing journey

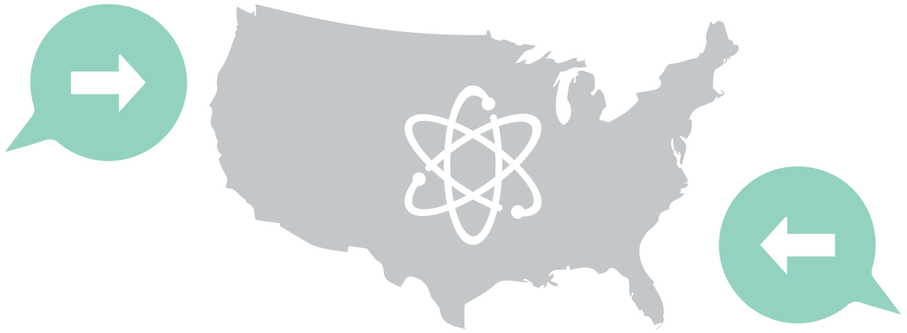
And he has traveled a long way. As a little boy growing up in a village in India with his parents and two brothers, Rajashekara lived in a one room lean-to that he said was smaller than the office he now occupies at UH. He read by kerosene lamplight and though neither of his parents had any education, his mother was determined that her children do better and be the best at whatever they pursued. High school came to his village in time for him to attend.

His biggest challenge was money. In today's dollars, the salary his father made per month would equal about $175. But his circumstance held neither he nor his siblings back. One, like him, is an engineer and the other is a doctor. Scholarships played a big part in his life.

Coming from such humble beginnings, Rajashekara says he is proud to have worked for such large companies and of his role in convincing a skeptical society that electric cars could become reality.

But he says he's proudest of his ability to help students, colleagues and friends succeed. "To help them succeed in their lives and professions is what I want to see," he said.

That, and them flying to work in their cars over an expanded UH power program.



UH Professors May Create Safe, Affordable Nuclear Energy,

CHANGING THE NATIONAL CONVERSATION

BY LAURIE FICKMAN

Research underway in a UH Cullen College of Engineering laboratory to make "heavy water" less expensively could soon make nuclear energy safer, eliminating real-life disasters like those that have occurred at the Fukushima and Chernobyl nuclear power plants.

It may seem impossible, but **Stanko Brankovic,** associate professor of electrical and computer engineering, **Lars Grabow,** assistant professor of chemical and biomolecular engineering and Ognjen Miljanic**,** associate professor of chemistry, have received a $400,000 grant from the National Science Foundation to make the impossible come true.

Their mission is to find a way to make heavy water, the coolant used in wet nuclear reactors, as accessible as, well, water.

Reactor safety: wet vs. dry

When it comes to nuclear energy and safety, it all boils down to the type of nuclear reactor that's powering the plant. In the cases of Fukushima, Chernobyl and 66 percent of all nuclear reactors in the world, the reactors are classified as light water, or dry reactors. They use weapons-grade enriched uranium or plutonium as fuel, and their primary coolant is water. They are hard to control and can go supercritical, which means the nuclear chain reaction cannot be stopped and the reactor core can melt down.

On the other hand, no nuclear spills or emissions involving heavy water reactors, also known as wet reactors, have ever occurred. Heavy water nuclear reactors use either mildly-enriched uranium, which contains about 4 percent of the radioactive isotope, or natural uranium, which only has about 0.7 percent.

"The nuclear fuel used in a wet reactor cannot be used for a nuclear bomb, so proliferation of this technology to the world is a safe way of securing affordable energy for everybody," said Brankovic. "Wet reactors cannot go supercritical, and their operation and control involves less risk for nuclear pollutant emission."

The heavy water used as coolant in wet reactors is made with a heavy isotope of hydrogen; this kind of water is literally heavier than the H20 that runs out of our water faucets.

For every 10,000 molecules of regular water, only one molecule will actually contain an element known as deuterium which, with oxygen, makes D2O, or deuterium oxide. This is the heavy isotype of hydrogen, or the heavy water so in demand.

With something as rare as D2O, the cost to separate it far surpasses the cost of enriching the nuclear fuel or making plutonium. That's why the wet reactors are less popular, even though they are much safer.

"Therefore, making the heavy water more affordable will make safe nuclear energy more affordable and more widespread across the United States and world," said Brankovic.

Breaking up is hard to do

Separation of water molecules doesn't come cheaply. "But if we can have a catalyst that is more efficient in separating D2O from regular water, we're saving energy, which means the price of the heavy water will go down and wet reactors will be more financially beneficial," said Brankovic.

Brankovic is no stranger to the catalyst design business. In 2001, he was highly cited for his work on creating a catalyst for fuel cells, the kind that ultimately brought us the electric car.

The catalysts Brankovic, Grabow and Miljanic are making are special strained platinum and palladium monolayers that will increase the strength of the adsorbed hydrogen bond, leading to better isotope separation efficiency.

Nuclear safety and world peace?

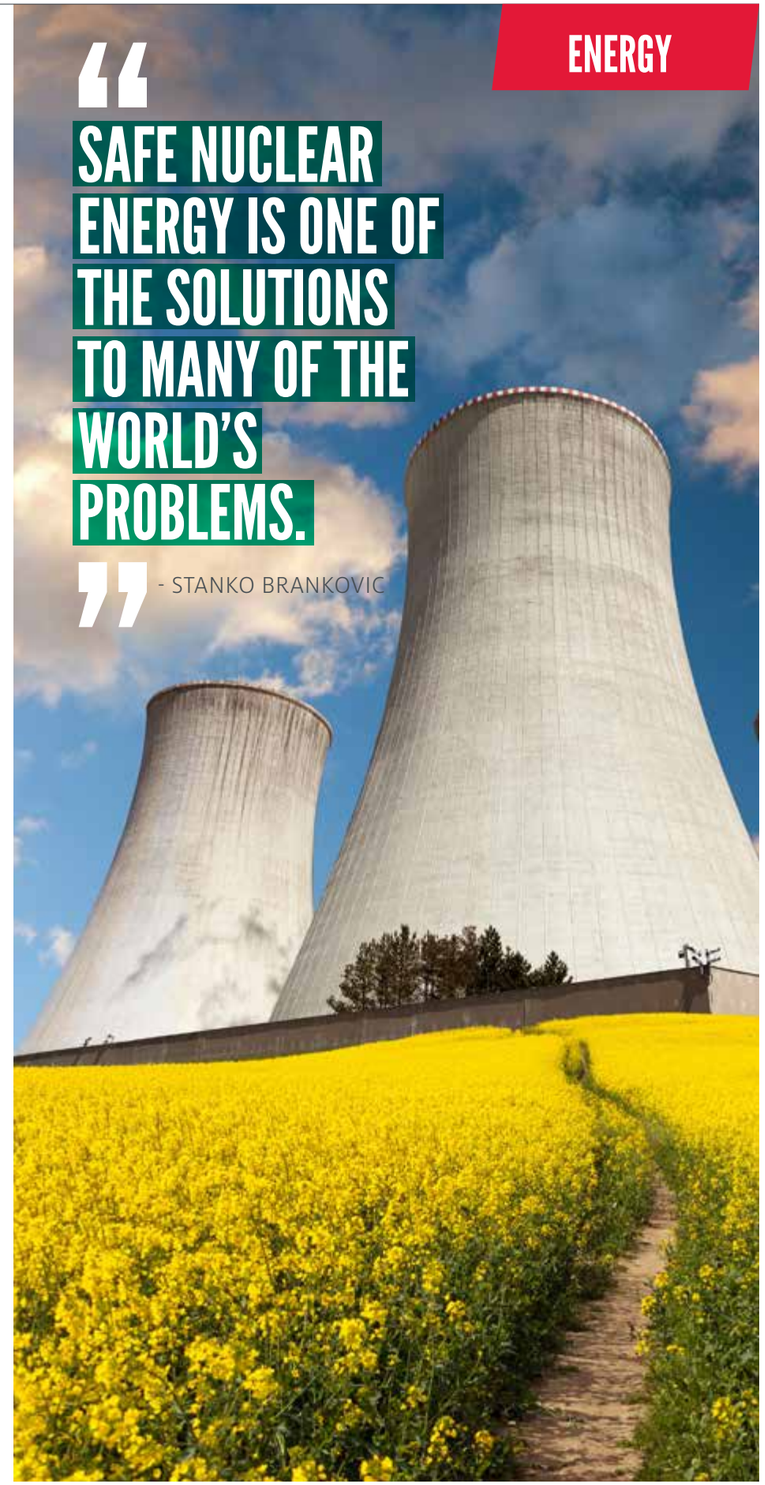
"Safe nuclear energy is one of the solutions to many of the world's problems," said Brankovic. He talks about a world where more wet nuclear reactors are online using the heavy water that he will create so inexpensively. Those reactors will also be using natural uranium.

"The whole problem now is that you don't know if anyone is enriching uranium for their reactors to produce electricity or because they want to make nuclear bombs," said Brankovic. "How do you police this?"

He thinks there is one certain way. By using heavy water reactors and providing methods to collect enough heavy water affordably. When heavy water is plentiful, dry reactors will no longer be needed and neither will the enriched uranium or plutonium used to make nuclear bombs.

"Ideally we can make the world a safer place," said Brankovic. That global safety may one day be traced back through Brankovic and his team to the UH Grants to Enhance and Advance Research (GEAR) program, which provided funding as they were preparing grant proposals.

"This allowed my colleagues and I to create a competitive proposal that will lead to breakthrough research," said Brankovic.



UH Researchers Discover Key Mechanism for Producing

SOLAR CELLS

BY JEANNIE KEVER

Researchers from the University of Houston have reported the first explanation for how a class of materials changes during production to more efficiently absorb light, a critical step toward the large-scale manufacture of better and less-expensive solar panels.

The work, published as the cover story for *Nanoscale*, offers a mechanism study of how a perovskite thin film changes its microscopic structure upon gentle heating, said **Yan Yao,** assistant professor of electrical and computer engineering and lead author on the paper. This information is crucial for designing a manufacturing process that can consistently produce high-efficiency solar panels.

Last year Yao and other researchers identified the crystal structure of the non-stoichiometric intermediate phase as the key element for high-efficiency perovskite solar cells. But what happened during the later thermal annealing step remained unclear. The work is fundamental science, Yao said, but critical for processing more efficient solar cells.

"Otherwise, it's like a black box," he said. "We know certain processing conditions are important, but we don't know why."

Other researchers involved with the project include first author Yaoguang Rong, previously a postdoctoral fellow at UH and now associate professor at Huazhong University of Science and Technology in China; UH postdoctoral fellows Swaminathan Venkatesan and Yanan Wang; **Jiming Bao,** associate professor of electrical and computer engineering at UH; Rui Guo and Wenzhi Li of Florida International University, and Zhiyong Fan of Hong Kong University of Science and Technology.

Yao is also a principal investigator at the Texas Center for Superconductivity at UH, which provided funding for the work.

The work also yielded a surprise: the materials showed a peak efficiency – the rate at which the material converted light to electricity – before the intermediate phase transformation was complete, suggesting a new way to produce the films to ensure maximum efficiency. Yao said researchers would have expected the highest efficiency to come after the material had been converted to 100 percent perovskite film. Instead, they discovered the best-performing solar devices were those for which conversion was stopped at 18 percent of the intermediate phase, before full conversion.

"We found that the phase composition and morphology of solvent engineered perovskite films are strongly dependent on the processing conditions and can significantly influence photovoltaic performance," the researchers wrote. "The strong dependence on processing conditions is attributed to the molecular exchange kinetics between organic halide molecules and DMSO (dimethyl sulfoxide) coordinated in the intermediate phase."

Perovskite compounds commonly are comprised of a hybrid organic-inorganic lead or tin halide-based material and have been pursued as potential materials for solar cells for several years. Yao said their advantages include the fact that the materials can work as very thin films – about 300 nanometers, compared with between 200 and 300 micrometers for silicon wafers, the most commonly used material for solar cells. Perovskite solar cells also can be produced by solution processing at temperatures below 150 degrees Centigrade (about 300 degrees Fahrenheit) making them relatively inexpensive to produce.

At their best, perovskite solar cells have an efficiency rate of about 22 percent, slightly lower than that of silicon (25 percent). But the cost of silicon solar cells is also dropping dramatically, and perovskite cells are unstable in air, quickly losing efficiency. They also usually contain lead, a toxin.

Still, Yao said, the materials hold great promise for the solar industry, even if they are unlikely to replace silicon entirely. Instead, he said, they could be used in conjunction with silicon, boosting efficiency to 30 percent or so.

> "THE MATERIALS HOLD GREAT PROMISE FOR THE SOLAR INDUSTRY."
>
> - YAN YAO

Technology Allows Smartphone-based Water Testing

BY JEANNIE KEVER

Ever wondered what's in the neighborhood pond? Technology developed by engineers at the University of Houston will allow you to test for waterborne pathogens by using your smartphone.

"The goal is to have citizens help to investigate and monitor water quality near where they live, while educating people about potential threats in environmental or drinking water," said **Wei-Chuan Shih,** associate professor of electrical and computer engineering at UH. "This type of citizen science is a priority for the National Science Foundation (NSF), to increase awareness of science and technology through individual participation."

Shih received a $100,000 grant from the NSF citizen science initiative to develop the technology, which builds upon an inexpensive lens his lab created last year, allowing people to turn their smartphones into microscopes.

"Almost everyone has a smartphone," he said. "Our goal is simple components that work with commercially available test kits, so people can order what they need to engage in this activity."

He and members of his lab created DotLens to produce and distribute the inkjet printed lenses, which attach directly to a smartphone camera lens. The researchers now are using 3D printing to create an attachment that provides a narrow-band light source, which will allow people using commercial water testing kits to see and identify waterborne pathogens.

> "THE GOAL IS TO HAVE CITIZENS HELP TO INVESTIGATE AND MONITOR WATER QUALITY NEAR WHERE THEY LIVE."
>
> - WEI-CHUAN SHIH

The attachment allows the user to control the light spectrum emitted, fine-tuning it to make different pathogens visible under magnification, said Yulung Sung, a doctoral candidate working in Shih's lab.

Shih said the system initially will test for two types of pathogens: Giardia lamblia and Cryptosporidium parvum, both of which can enter the body through the nose and mouth and cause intestinal infection. They can be serious – a 1993 outbreak of Cryptosporidium parvum in Milwaukee affected more than 400,000 people, according to a study by the U.S. Centers for Disease Control and Prevention.

Test kits are already available to allow people to detect pathogens in water, but without fluorescent microscopy – a microscopic technique that employs a narrow spectrum of light – those pathogens aren't visible, even under magnification. The kits target specific pathogens, and if those pathogens are present when exposed to the light, they become visible. If there are no pathogens in the water sample, there's nothing to see.

But most people don't have access to fluorescent microscopy. The DotLens and Shih's attachment serve as a low-cost alternative. The lenses sell for $12.99 and up; a price for the light source hasn't been set.

By changing the light spectrum, researchers – and nonscientists armed with the attachment and a smartphone – could use the same system for other water contaminants, including lead, Shih said.

Sung and Hoang Nguyen, who also is a Ph.D. student working in Shih's lab, are currently testing the device on water samples collected from around the region in order to refine its performance and record what they find. She said that two undergraduates, Fernando Campa from the University of Texas at Arlington and Kelly O'Shaughnessy from the University of Cincinnati, worked as the lab's first "citizen-scientists" under a NSF Research Experiences for Undergraduates grant.

Ultimately, Shih said he envisions an online map to be drawn collaboratively with citizen scientists, posting and sharing their findings.

"This is like completing a puzzle with a community of citizen scientists who share similar interests," he said.

UH Researcher Pursues New Applications for

"HOT" ELECTRONS

BY JEANNIE KEAVER

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

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

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

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

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

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

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

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

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

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

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

For Stanko Brankovic,

LIFE IS SPEEDING UP

BY LAURIE FICKMAN

That exciting feeling you get when you've made a breakthrough discovery and you know that something that seemed impossible yesterday is now completely clear –

that's the feeling that **Stanko Brankovic,** professor of electrical and computer engineering, has about his recent discovery of the speed in which catalysts are formed.

"I'm in the same position as Sir Isaac Newton was when the apple hit him in the head! It's that same excitement, a 'Wow!' moment," said Brankovic.

Newton's not-too shabby discovery resulted in nothing less than an understanding of gravity; Brankovic's may result in building better catalysts, the fundamental substance that speeds up reactions in all industries from petrochemical to manufacturing.

Brankovic is not alone in his excitement. The *Journal of the Electrochemical Society* selected Brankovic's paper as the "editor's choice" article, a distinction reserved for research highlighting transformative scientific discoveries. According to the journal, the designation is awarded for work showing extraordinary direction, concept, interpretation or way of doing something. The journal is the most acclaimed publication in its field.

Brankovic's article is titled "Reaction kinetics of metal deposition via surface limited redox replacement of underpotentially deposited monolayers studied by surface reflectivity and open circuit measurements."

Building a better catalyst

Brankovic and his group studied what affects the speed in which catalysts are formed by examining how quickly the thin-film monolayers are placed on top of each other to build them. Their results showed clearly that reaction kinetics of metal deposition is significantly impacted by the design of the reaction solution and ion concentrations.

Nobody understood this before Brankovic.

"The speed in how quickly you put these monolayers down effects their morphology, and that effects the monolayer quality in terms of their catalysis performance," said Brankovic, noting that a catalyst will become something different depending on the speed with which the layers are stacked.

Knowing that catalysts become different dependent on the speed of their architecture gives scientists more control over what they are creating.

"We discovered some fundamentally important things that will eventually help people who use this method to design even better catalysts and control the design process better," said Brankovic.

Body of work

Although Brankovic has toiled away at thin film deposits for more than a decade, they still absorb much of his brilliant mind.

"Everywhere you look is a thin film," he said, pointing to his surroundings. "Paint is a thin film, windows are coated with thin films; in technology they exist everywhere. The world is made of thin films."

His enthusiasm over thin-film layered catalysts has translated to hard work and lots of success in his field. In 2001, he was highly cited for his work on creating a catalyst for fuel cells, the kind that ultimately brought us the electric car. Recently the National Science Foundation awarded him a grant to make "heavy water" less expensively, which could lead to safer nuclear energy (spoiler alert: his method involves catalysts).

Despite his stature in the field, Brankovic credits his students with the latest accomplishment. "Together we have opened this door for others to follow," he said.

His group includes his Ph.D. students Wu Dongjun, Ela Bulut, who has graduated and is now a professor in Turkey, Nikhil Dole, now graduated and employed by Lam Research, and the visiting scholar Dr. Hasan Kilic.

Brankovic is ultimately concerned about his students' success. "This is the type of recognition that increases the visibility not only of UH, but of my students in their pursuit of excellence in academics and research."

A catalyst for success you might say.

"I'm in the same position as Sir Isaac Newton was when the apple hit him in the head! It's that same excitement, a 'Wow!' moment."

- STANKO BRANKOVIC

UH Engineers Invent

GLUCOSE-SENSING CONTACT LENS

BY JEANNIE KEVER

Blood testing is the standard option for checking glucose levels, but a new technology could allow non-invasive testing via a contact lens that samples glucose levels in tears.

"There's no noninvasive method to do this," said **Wei-Chuan Shih,** associate professor of electrical and computer engineering at the Cullen College who worked with colleagues at UH and in Korea to develop the project, described in the high-impact journal *Advanced Materials*. "It always requires a blood draw. This is unfortunately the state of the art."

But glucose is a good target for optical sensing, and especially for what is known as surface-enhanced Raman scattering spectroscopy, said Shih, whose lab, the NanoBio-Photonics Group, works on optical biosensing enabled by nanoplasmonics.

This is an alternative approach, in contrast to a Raman spectroscopy-based noninvasive glucose sensor Shih developed as a Ph.D. student at the Massachusetts Institute of Technology. He holds two patents for technologies related to directly probing skin tissue using laser light to extract information about glucose concentrations.

The paper describes the development of a tiny device, built from multiple layers of gold nanowires stacked on top of a gold film and produced using solvent-assisted nanotransfer printing, which optimized the use of surface-enhanced Raman scattering to take advantage of the technique's ability to detect small molecular samples.

Surface-enhanced Raman scattering – named for Indian physicist C.V. Raman, who discovered the effect in 1928 – uses information about how light interacts with a material to determine properties of the molecules that make up the material.

The device enhances the sensing properties of the technique by creating "hot spots," or narrow gaps within the nanostructure which intensified the Raman signal, the researchers said.

Researchers created the glucose sensing contact lens to demonstrate the versatility of the technology. The contact lens concept isn't unheard of – Google has submitted a patent for a multi-sensor contact lens, which the company says can also detect glucose levels in tears – but the researchers say this technology would also have a number of other applications.

"It should be noted that glucose is present not only in the blood but also in tears, and thus accurate monitoring of the glucose level in human tears by employing a contact-lens-type sensor can be an alternative approach for noninvasive glucose monitoring," the researchers wrote.

"Everyone knows tears have a lot to mine," Shih said. "The question is, whether you have a detector that is capable of mining it, and how significant is it for real diagnostics."

In addition to Shih, authors on the paper include Yeon Sik Jung, Jae Won Jeong and Kwang-Min Baek, all with the Korea Advanced Institute of Science and Technology; Seung Yong Lee of the Korea Institute of Science and Technology; and Md Masud Parvez Arnob of UH.

Although non-invasive glucose sensing is just one potential application of the technology, Shih said it provided a good way to prove the technology. "It's one of the grand challenges to be solved," he said. "It's a needle in a haystack challenge."

Scientists know that glucose is present in tears, but Shih said how tear glucose levels correlate with blood glucose levels hasn't been established. The more important finding, he said, is that the structure is an effective mechanism for using surface-enhanced Raman scattering spectroscopy.

Although traditional nanofabrication techniques rely on a hard substrate – usually glass or a silicon wafer – Shih said researchers wanted a flexible nanostructure, which would be more suited to wearable electronics. The layered nanoarray was produced on a hard substrate but lifted off and printed onto a soft contact, he said.

Mini-Robots Marching Through Your Veins Could Offer

TARGETED TREATMENT

BY JEANNIE KEVER

Invasive surgical techniques – cutting through the breastbone for open heart surgery or making a large incision to inspect an abdominal tumor – allow physicians to effectively treat disease but can lead to sometimes serious complications and dramatically slow healing for the patient.

Scientists instead want to deploy dozens or even thousands of tiny robots to travel the body's venous system as they deliver drugs or a self-assembled interventional tool. Researchers from the University of Houston and Houston Methodist Hospital are developing control algorithms, imaging technology, ultrafast computational methods and human-machine immersion methods to harness the force from a magnetic resonance imaging (MRI) scanner to both image and steer millimeter-sized robots through the body.

"We want to move from science fiction to science feasibility," said **Aaron Becker,** assistant professor of electrical and computer engineering at the UH Cullen College and principal investigator for a $608,000 Synergy Award from the National Science Foundation (NSF) to develop prototypes for testing.

To tackle this unprecedented challenge, the award involves two additional investigators: Nikolaos Tsekos, associate professor of computer science and director of the Medical Robotics Laboratory at UH, who has expertise in MRI and computational methods, and Dipan J. Shah, a cardiologist and director of cardiovascular MRI at Houston Methodist Hospital, who brings expertise in clinical MRI and focusing the efforts to find solutions that

are clinically necessary and valuable.

While MRI has traditionally been used for noninvasive diagnosis, the next frontier is its use as a tool to offer noninvasive or minimally invasive treatment.

The milli-robot development and control work is an outgrowth of Becker's previous research, which was funded in part with an NSF CAREER award and demonstrated the theory behind the proposal. This grant, awarded through NSF's Cyber-Physical Systems (CPS) program, will fund work to build a prototype suitable for animal testing. The MRI control and computational methods follow a previous CPS award in image-guided robotic surgeries led by Tsekos and Shah.

Their current models are up to 2 centimeters; Becker said the goal is robots that range from 0.5 millimeters to 2 millimeters. The average human hair, in comparison, is about 0.08 millimeters wide.

MRI provides enough magnetic force to steer the robots through the body's blood vessels but can't penetrate tumors or other tissue. This project is working with two designs, both powered by the MRI scanner, to address that problem, one based on the principle of mechanical resonance and the second modeled after a self-assembling surgical tool, a Gauss gun.

A key issue is real-time control, Becker said, noting that blood vessels move around in the body, making it crucial to be able to see both the anatomy and the robot as it moves in order to keep it moving correctly. Even the fastest current MRI scans are too slow for such control and have a time lag before the information is available. Developing such a system is a multidisciplinary task that must seamlessly integrate sensing with the MRI scanner, milli-robot control and close the loop by controlling the scanner to drive the milli-robots.

Ultimately, Becker said, the goal is to use the power of an MRI to steer large numbers of robots throughout the body. While one milli-robot could target a single lesion, delivering chemotherapy or another intervention, that isn't practical for a late-stage cancer, for example.

"Targeting delivery with dozens of microsurgeons is my goal," he said. In this case, those "microsurgeons" would be robots, guided by a physician.

NEW METHOD TO DESTROY BACTERIA

May Revolutionize Treatment of Infection

BY ASHLEY SCHWARTZ

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

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

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

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

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

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

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

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

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

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

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

MAKING THEM DANCE:

Jiming Bao Discovers How to Rotate and Align Graphene Flakes, Opening the Door for a FASTER WORLD

BY LAURIE FICKMAN

In 2010 graphene took center stage when the Nobel Prize in physics was awarded to two scientists in the UK "for groundbreaking experiments regarding the two-dimensional material graphene." At the UH Cullen College of Engineering, that same passion over pencil lead is shared by **Jiming Bao,** associate professor of electrical and computer engineering, but he's taken it to a whole new dimension, with a patent filed on his process to rotate and align graphene flakes in 3D by using a magnetic field. You can read about it in the January 2017 issue of the journal *Advanced Materials*.

"It's a breakthrough," said Bao. "No one has ever thought to rotate and align graphene or the magnetic properties of graphene. It's so strong. No one thought it could be rotated by a tiny magnet."

Editors at *Advanced Materials* must have agreed, Bao said, noting the unusually short time it took for his article to be accepted for publication.

"Sometimes it takes six months to get an article published. They accepted this one in two weeks," Bao said.

For the uninitiated, graphene is made of carbon, just like graphite (the lead in pencils) and diamonds (the beautiful treasures that sparkle in your jewelry). Though all are made of the same stuff, the atoms are arranged differently in each.

Scientists seem to gush over graphene, touting it as one of the lightest, strongest conductors of heat and electricity. According to Bao, it could make computers faster, microwave ovens safer and everything much cheaper.

"It's much cheaper than metal to produce and opens enormous application possibilities," said Bao. "Graphene is very conductive, even more conductive than copper." It can replace copper wire or the magnetic shield in front of the microwave. It can also dissipate heat much faster than the commonly-used materials of today. It is a diamagnetic material, meaning it can create a magnetic field and, at the same time, oppose one.

If you're keeping score, that means graphene will be another material (like a superconductor) that will make things, like trains, levitate. At extremely low temperatures, superconductors allow current to flow without resistance and repel a magnet, but with more strength, a superconductor and magnet will repel against gravity, causing stable magnetic levitation.

In Bao's experiments he found that aligning the graphene flakes makes them powerful. "When graphene flakes are assembled in the same planar direction, they show excellent thermal, optical, electrical and electromagnetic shielding properties," said Bao.

Another example of the powers of graphene involves lithium-ion batteries, the kind that power electronic cars. Currently the graphite used in those batteries is not aligned.

"Once we align it, this battery can last longer, have higher capacity and charge faster," said Bao.

It's no wonder the Nobel Prize Committee believes it can change the world.

For Bao's part, he'd like to see graphene in a science museum one day. "Instead of using iron filings to play with magnets they will be using graphene. I'd like to see it become that important and historic," said Bao. .

IMAGINE A WORLD CHANGED BY GRAPHENE

LONGER BATTERY LIFE

FASTER COMPUTERS

SAFER MICROWAVES

AND SO MUCH MORE

WHEN THE COATING CRACKS:

Professor Explores Fundamentals of Fracturing in Thin-Film Coatings

BY ASHLEY SCHWARTZ

Although almost invisible to the naked eye, thin-film coatings are ubiquitous and necessary in millions of people's day-to-day lives. Found in everything from smartphone touchscreen displays to implantable medical devices, surface coatings add value to products by making them last longer and perform better.

An industrial example of an application of the thin film coating is an airplane wing. The coating plays an essential role in the lifespan of the aircraft by allowing the thin film to be more durable, lightweight and resistant to the elements.

Thin-film coatings play a vital role in the manufacturing, aerospace, electronics, automotive, security, healthcare, energy, agriculture and consumer products industries. Until now, research into the fundamental science guiding how these coatings work – and more importantly, how and why the coatings fail – had not been performed.

Stanko Brankovic, associate professor of electrical and computer engineering, was recently awarded a $100,000 grant from the National Association for Surface Finishing (NASF) to uncover the fundamentals of electrodeposited thin-film cracking.

"There is no fundamental understanding as to what controls this process and how you can mitigate why these cracks occur in electrodeposited thin-film coatings," said Brankovic.

By the end of the four-year grant, Brankovic will be the first researcher to provide a comprehensive framework that explains fracturing of electrodeposited thin-film coatings across all applications of technology. His work will also explore methods for preventing cracks in surface coatings.

"This is very important in every aspect of civil life because once we learn fundamentally what happens when these cracks occur, with simple modifications we can widen the variety of applications," said Brankovic.

Brankovic was approached to receive this award based on his past research in electrochemical material science and nanofabrication, and corrosion. The award has the potential for renewal to continue the research in the future.

NASF represents the interests of businesses, technologists and professionals in the surface coatings industry. Its mission is to advance an environmentally and economically sustainable future for the finishing industry and promote the vital role of surface technology in the global manufacturing value chain.

UH PROFESSORS TO ROBOTS: SWIM, COMMUNICATE AND BRING US DATA – FAST!

BY LAURIE FICKMAN

Deep below the sea, thousands of sensors collect crucial oceanic data used in environmental monitoring, offshore exploration, disaster prevention and military surveillance. However, there exists a problem underwater that was conquered on land decades ago: From the ocean depths, communication is severely delayed. There is no internet or clear and powerful signal. But, a new $600,000 award from the National Science Foundation to UH Cullen College professors has them diving in deep to create an underwater communication relay that will outperform anything yet available.

And it starts with robots

“We can now build these robots that go underwater, swim around and drop off sensors to monitor what happens in our waters,” said assistant professor of electrical and computer engineering **Aaron Becker**, who serves as a co-principal investigator (co-PI) on the project.

To be clear, these are not yesterday’s science fiction robots that look human – no C-3Pos here. These robots are autonomous underwater vehicles (AUVs), sometimes referred to as underwater drones.

“My part of the project is to make the robots that are going to shuttle information from the sensors to the surface,” said Becker. “My robots are going to swim down, figure out which sensors to monitor, which information to gather and the fastest way to bring that back to our mother ship.”

That description encapsulates the project that intends to create a viable cyber interconnection scheme. The project is called “DEUS: Distributed, Efficient, Ubiquitous and Secure Data Delivery Using Autonomous Underwater Vehicles.”

“We want to collect data from underwater sensor networks in the most efficient, intelligent, secure and cost-effective way,” said the project’s PI **Miao Pan**, assistant professor of electrical and computer engineering. “And we can do that with the energy of our entire team.”

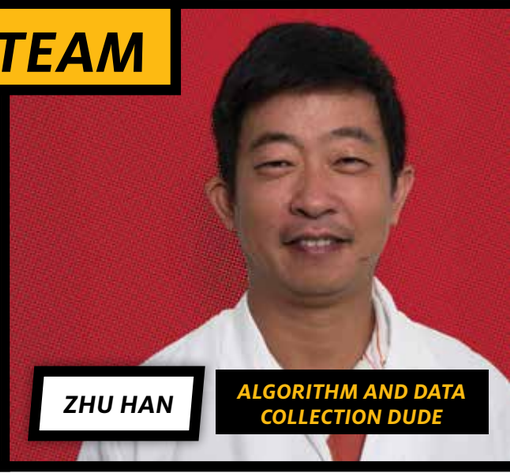
Underwater super scientists

Rounding out the team from the Cullen College’s department of electrical and computer engineering are Professor **Zhu Han** and Assistant Professor **Jiefu Chen**.

TECHNOLOGY

"IT'S ALL ABOUT ASSEMBLING THE RIGHT TEAM, LIKE 'THE AVENGERS.'"

THE TEAM



Think of them all as a band of superheroes, each member with a special skill. Becker is the robot expert, Pan is the data and super security man, Han is the algorithm and data collection dude, and Chen is an antenna ace.

"It's all about assembling the right team, like 'The Avengers,'" said Becker. Pan concurs: "Our success depends on this team. The most important thing is our synergy."

Listening in

The robot expert, Becker, is working first on a task called localization, or getting the robots underwater to recognize where they are.

"Robots in water are like us before GPS," said Becker. That takes a moment to digest, until you remember how often you got lost before GPS.

"Once your robot goes more than a few inches underwater it doesn't have a GPS signal, so the first problem my students and I are working on is how to figure out where you are. It doesn't know where it is, so it can't shuttle information back from those sensors."

Traditionally, scientists used acoustic communication to determine location, the same way we hear whales when they sing underwater. "But the problem with acoustic communication is it has a very low data or transmission rate, a very high delay and a very high error rate," said Pan.

Said Becker, "It's also hard to be discreet with acoustic communication – when a whale sings his love song, everyone knows he is in love. Underwater sensors are expensive, so often we don't want to share our data with the world."

Electromagnetic antennas, the kind commonly in use today, wouldn't work either because they don't do much good underwater. So the team needed a new antenna and turned to their antenna ace, Chen.

This is not the first time Chen has had his antenna up. The antenna work in this NSF proposal was based on Chen's previous work in the private sector where he designed antennas for underground oil and gas exploration.

"It is a similar concept, but one is underground and one is underwater," said Chen. "We want to make a new antenna, which we hope to boost to the maximum extent that can reach further than existing antennas for underwater communication."

For this type of antenna, with the robot moving everywhere, he is using magnetic induction, a process where the entire robot becomes magnetized by a magnetic field. But a big antenna attached to a robot would make it become too heavy to move. "So we make an antenna that can conform to the side of the drone – we integrate it to the body of the drone," said Chen. That means it's pliable, bendable and flexible.

Information selection and security

When Becker said his robots were going to "figure out which sensors to monitor" from so many streams of information coming from the ocean, he was talking about an old-fashioned math problem. Algorithm and data collection dude, Han, has it solved, though.

"Our algorithm will keep balance between exploitation versus exploration, basically telling us where to go to collect data and from which sensors," said Han.

He likens the process to slot machines in Las Vegas.

"Imagine you're in a room of slot machines," Han explains. "You look around and wonder which one will win. Could it be one that's already paid out a lot of money? Should I exploit that one? Or should I explore a new one? Our algorithm tells us which sensors will give us the best information."

He's working on that winning formula, plus new ways to keep the information confidential. To keep it secure, Pan works with Han on another algorithm and protocol development. "Our goal is to find the way to deliver information privately, with faster transmission rates and lower error and delay rates," said Pan.

Once the data is back on land, Han processes it with yet more algorithms, reconstructing it and making it as accessible and pristine as possible.

Full speed ahead

The team's success, with tentacles that touch offshore oil spill response, fisheries management and storm preparedness, will likely impact the economy and well-being of not only coastal regions, but also inland states.

Pan foresees long-range success from this grant for the Cullen College of Engineering, too. Since this is the first-such underwater award from the NSF to the electrical and computer engineering department, he predicts the project will kick off further underwater research in the department.

Becker sees "the big win," he says, if the team's breakthroughs become underwater infrastructure.

"This infrastructure includes mathematical theory, antenna design and robot motion-planning," said Becker. "We share this through research papers, patents, training students and sharing code."

So far, they're doing swimmingly.

UH Engineers Discover

NEW CHEMICAL SENSING TECHNIQUE

BY JEANNIE KEVER

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

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

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

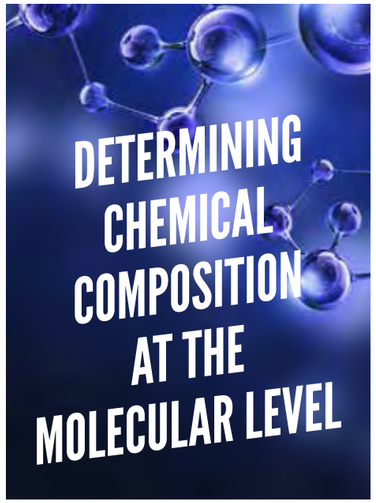
That means substances, which can't be accurately measured by sensors operating on the infrared spectrum, can now be studied in far more detail than that provided by current techniques using the near-infrared spectrum.

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

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

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

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



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

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

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

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

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

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

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

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

Professor Improves

CELL PHONE USER EXPERIENCE

With NSF Grant

BY ASHLEY SCHWARTZ

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

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

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

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

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

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

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

> *"The goal of this research is to improve the user experience by learning individual users' preferences."*
> - XIN FU

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

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

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

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

Lots of Things in the ‘INTERNET OF THINGS’ Need to Speed Up

BY ASHLEY SCHWARTZ

How many ways are you connected?

Miao Pan, left, and Zhu Han are cramming more efficiency into the Internet of Things

The National Science Foundation has awarded Cullen College’s **Miao Pan,** assistant professor of electrical and computer engineering, and **Zhu Han,** professor of electrical and computer engineering, $300,000 to speed up the way your electronic ID badge communicates through the Internet of Things (IoT).

As life-changing events occurred over the last couple decades, the order seems simple. First came the internet. Then there were smart devices and then – linking them together – was the Internet of Things. Take for example the temperature in your home. Perhaps it’s a hot Houston day and you’re toiling from your desk at the University of Houston. As the clock slips closer to the end of the day, you decide you’d like your home cooled off before you walk through the door. So you grab your smart phone, open the app that accesses your smart thermostat and remotely program it for coolness.

You have not only set yourself up for a night of comfort, you’ve stepped through the magic Internet of Things to do so. Its name is pretty spot on: It’s the internet connected to your things and it doesn’t need human-to-human interaction, nor do your things need to be as grandiose as a thermostat and smart phone. They can be as simple as your card key. According to Gartner, Inc., a technology research and advisory corporation, there will be nearly 20.8 billion devices on the Internet of Things by 2020.

Through this grant, Han and Pan will zero in on enhancing connectivity and communication of ultra-low power applications.

They will be working alongside colleagues Riku Jantti, Kalle Ruttik and Ruifeng Duan of Aalto University in Espoo, Finland and Jukka Lempiainen of Tempere University of Technology in Tampere, Finland.

“The Internet of Things needs to incorporate almost everything, including simple sensors and devices,” said Pan. “We often find ourselves at a paradox between needing high transmission speeds using simple, low-power devices while guaranteeing the sent messages are secure.”

The project will specifically investigate ID card technology and how signals transferring to and from these simple cards can be transmitted more efficiently.

“The ID cards make everything more complex because there are a large number of cards communicating on the same network. We need to consider how we will be able to decipher between individual cards and if we want each one to access different things,” said Pan.

The researchers hope to enhance IoT applications by creating new communication systems to pair with the ultra-low power devices, and then uncover the challenges of the signals, performance and security.

“Our team at UH will be developing and analyzing the new communications networks to find the best and most efficient design, while our colleagues in Finland will test if our designs will work in the marketplace,” said Han.

This international project will also serve as a unique opportunity for UH engineering students to gain knowledge and develop their research skills abroad.

“We are excited about the prospect of our students participating to have the chance to learn from such accomplished researchers from other parts of the world,” said Pan.

TECHNOLOGY

UH Engineer Changes How We Interpret

GEOSPATIAL IMAGES

BY LAURIE FICKMAN

Saurabh Prasad, Cullen College assistant professor of electrical and computer engineering, is reporting a breakthrough in image interpretation that could overcome hurdles that prohibit accurate interpretation of imagery data. His work, tackling the challenges of object rotation, is featured on the cover of the journal IEEE Transactions on Geoscience and Remote Sensing, which showcases his article "Morphologically decoupled structured sparsity for rotation-invariant hyperspectral image analysis."

Hyperspectral imagery, which delivers intensely miniscule details over hundreds of wavelengths (colors) from hyperspectral cameras, presents interpretational challenges that Prasad is navigating around.

"You can't simply use off-the-shelf techniques to analyze such images effectively." A big part of his work is designing new algorithms to leverage the potential in such data.

The challenge begins when the algorithms interpreting data are being created. To create an algorithm-based program that recognizes objects in images, the program must be fed hundreds, if not thousands, of examples of the object to learn recognizable features. But the program is stymied if the object under review is oriented a different way than its cache of training library photos. The "nuisance factors," as Prasad calls them, include varying illumination, sensor viewpoints, scales and orientation of objects in the images. Prasad's Hyperspectral Image Analysis Laboratory focuses on machine learning and image analysis algorithms that are robust to these confounding conditions.

Saurabh Prasad

"In this paper we developed a method to specifically account for orientation variability. With this work, we make new inroads into the field of sparse representation-based image analysis, where optimal image analysis can be undertaken by exploiting the underlying sparsity in signal representations," said Prasad. He can train the machine using any orientation of an object and apply the sparse representation based model to any other orientation. The method includes partitioning an image into its geometric components, which enables Prasad to design algorithms to ensure robustness to orientation changes.

Intense images need intense interpretation

Reviewing satellite (or aerial) images from hyperspectral cameras, scientists can tell whether a soccer field is covered with natural grass or Astroturf. The images are that precise and detailed.

"In a sense, every pixel has a chemical fingerprint," said Prasad. Examples of this intense ability to peer into chemicals on the ground are the NASA images collected over ground zero after 9/11, in which the extent of the debris field was interpreted by remote sensing.

"That is the power of hyperspectral imaging," said Prasad "Because of such images, they had an idea of how far the concrete and different kinds of dust, like gypsum and wallboard, had spread, something that would be very challenging with traditional color images."

Color camera images provide information on three colors: red, green and blue. Hyperspectral cameras provide information on hundreds of thousands of colors and are not constrained by the visible part of the spectrum; they peer beyond the visible into the infrared portion of an image.

It's so complicated it's beyond human interpretation, especially with images spanning a wide geospatial scale.

"At the end of the day we want machines (algorithms) to assist us in understanding such images," said Prasad. "Humans are limited in capacity to interpret such large and complex data. It requires an algorithm-based approach."

And so he wrote one.

SIX NEW FACULTY

Join ECE Department, Including National Academy of Engineering Member

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

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

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

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

HARISH KRISHNAMOORTHY

ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING

Krishnamoorthy joins UH as an assistant professor of electrical and computer engineering. His specialization is in power and energy and his major areas of research and teaching focus on subsea/downhole power systems, power electronics for extreme environment applications, renewable energy power conversion, power electronics for utility interface and medium and high frequency magnetics-based power converters.

In 2014 Krishnamoorthy earned his Ph.D. in electrical and computer engineering at Texas A&M University, where he remained as a research assistant performing research in high density power electronics energy conversion.

WELCOME TO ECE!

ROHITH REDDY

ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING

Reddy is a new Cullen College assistant professor of electrical and computer engineering with a keen interest in biomedical imaging. Reddy served as a post-doctoral fellow at Harvard Medical School and Massachusetts General Hospital in Boston. He completed his Ph.D. in bioengineering in 2013 at the University of Illinois at Urbana-Champaign.

Reddy has a compelling interest in building new medical devices for early cancer detection based on infrared optics. Reddy believes that by studying the reflected light (laser or other types) off human tissue, a picture of what is happening inside the tissue can be painted. By studying the microscopic cellular structures and creating high resolution images, he says it is possible to determine if the tissue has a certain disease.

In 2016 he won an innovation award from the Federation of Analytical Chemistry and Spectroscopy Societies (FACSS) for the most innovative and outstanding new research advancement for his postdoctoral work on a swallowable capsule endoscopy for Barrett's esophagus diagnosis based on optical coherence tomography.

ROSE FAGHIH

ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING

Research interests: Control, estimation, system identification, and modeling neural and physiological systems in health and disease, personalized medicine and biomedical data science with a focus on neuroendocrine hormones.

HIEN NGUYEN

ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING

Research interests: Machine learning, medical imaging and healthcare technology.

XIAONAN SHAN

ASSISTANT PROFESSOR OF ELECTRICAL AND COMPUTER ENGINEERING

Research interests: Developing novel plasmonic and photonic imaging and measurement techniques for energy and biology research.

ECE Professor Receives

RALPH E. POWE JUNIOR FACULTY ENHANCEMENT AWARD

BY ASHLEY SCHWARTZ

Xiaonan Shan, assistant professor of electrical and computer engineering, received the Ralph E. Powe Junior Faculty Enhancement Award from Oak Ridge Associated Universities (ORAU). The award will help fund Shan's research into developing a novel plasmonic imaging system to map the local photocatalytic efficiency of nanomaterials.

Shan is one of 36 recipients out of 125 applicants for the one-year award, which provides seed money to junior faculty at ORAU-associated institutions. The award is designed to enrich the research and professional growth of young faculty and result in new funding opportunities.

Shan is the second UH faculty member to receive the prestigious award. Another UH electrical and computer engineering professor, Yan Yao, received the award in 2013.

"I feel very honored to be one of the applicants chosen for this award and to bring it back to the University of Houston," said Shan. "I hope that this will open doors and give me the opportunity to collaborate with other researchers and national labs."

Shan is the principal investigator of the Advanced Imaging and Sensing Lab, where he focuses on solving critical problems in energy and biomedical research by developing novel optical imaging and sensing techniques. He hopes to expand the capabilities of optical imaging microscopes to measure and map the local electrical, mechanical, chemical and thermal properties of biological and nano samples in ways that were previously not possible.

Xiaonan Shan (second from left) receives his award. Also pictured (from left): Ramanan Krishnamoorti, Dean Joseph W. Tedesco and Badri Roysam

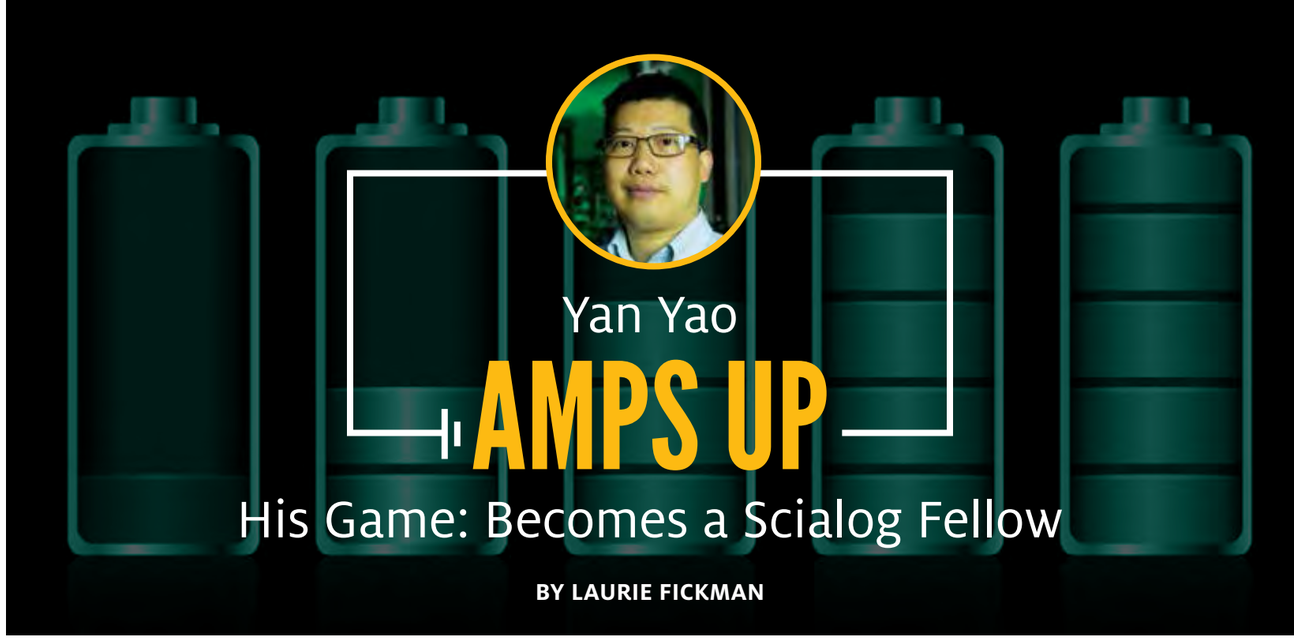
> "I hope that this [award] will open doors and give me the opportunity to collaborate with other researchers and national labs."
>
> - XIAONAN SHAN

The traditional approach to determining the catalytic activity of a nanoparticle is to measure the average response of a large number of particles, but this method does not recognize individual particle differences such as size, shape and surface sites. Shan's novel imaging system will use light to visualize and map the local catalytic reactions of water splitting, a chemical reaction in which water is split into a single oxygen molecule and a single hydrogen molecule. Once Shan masters splitting water molecules, he hopes to use the same approach to – quite literally – shed new light on how nanomaterials perform as catalysts.

Shan joined the Cullen College of Engineering in August of 2016. Previously, he was an assistant research professor at Arizona State University's Biodesign Institute.

"Xiaonan has been an excellent addition to our department and we feel that this award is a public recognition of the quality and promise of his research," said Badri Roysam, chair of the department of electrical and computer engineering.

Oak Ridge Associated Universities is a university consortium that combines the scientific strength of 121 major research institutions to advance science and education by partnering with national laboratories, government agencies and private industry.



Yan Yao

AMPS UP

His Game: Becomes a Scialog Fellow

BY LAURIE FICKMAN

If there's one thing **Yan Yao** gets a charge out of, it's the idea of creating a better battery.

The Cullen College assistant professor of electrical and computer engineering is known for being the most current in the battery industry. A Google search yields more than 16,000 citations of papers by Yao. If you read any of them, you'll learn that if all goes as Yao has it planned, soon there will be safer batteries that last longer. In fact, he may just be responsible for saying goodbye to your old jumper cables and stopping your hover board from exploding.

Having built this kind of reputation in the energy storage field, it's no surprise that the Research Corporation for Science Advancement came calling, naming Yao a Scialog Fellow in their newly created category – wait for it – "Advanced Energy Storage" (AES). According to Scialog (a mixture of science and dialog), AES is a program involving early career rising stars interested in pursuing collaborative, high risk, highly impactful discovery research on untested ideas applicable to creating breakthroughs in energy storage. "I am honored to be named a Scialog Fellow. The program director invited me to apply. A senior professor in the battery community had nominated me based on my work over the last five years," said Yao. "I think it's recognition of my prior work."

Beyond Lithium-Ion

For his work in creating better, safer batteries, Yao has won the Robert A. Welch Professorship by UH's Texas Center for Superconductivity (TcSUH), the Ralph E. Powe Junior Faculty Enhancement Award from the Oak Ridge Associated Universities and the 2013 Office of Naval Research Young Investigator Award. His battery research program has been well funded through the National Science Foundation, Department of Defense, Department of Energy and, most recently, NASA.

Now, as a Scialog Fellow, Yao will set out to meet their challenge – to search for and discover truly transformative energy storage systems. Fortunately, he's already on track. In his laboratory he's already developing the next generation of aqueous (water-based) batteries, which will last 10 times longer and be five times more powerful than the ones currently in your car.

No battery slips his attention

"The traditional lithium-ion battery technology is approaching its limits and could be dangerous in situations when the flammable electrolyte catches fire," said Yao, seemingly disturbed by the mere thought. He is working with those and the aqueous batteries, which are safer but have a limited life cycle. Think, again, of your car battery, which never fails to surprise you with its need to die at the completely wrong time.

"The energy is not dense enough," said Yao. "You want to combine the safety of aqueous batteries with the high energy density of lithium-ion batteries – that would be ideal." Yao will work with a team of other Scialog Fellows to use computational analysis and experiments to add more perspective on the fundamentals of his research on aqueous batteries, magnesium batteries and all-solid-state lithium metal batteries.

And eventually he will, no doubt, reach his ultimate albeit high-powered goal: "To not only change technology, but to change people's lives and the world," he says.

Zhu Han, professor of electrical and computer engineering at the UH Cullen College of Engineering, along with colleagues Mingyi Hong of Iowa State University and Dan Wang of Hong Kong Polytechnic University, have published the first comprehensive book on the use of signal processing for big data applications.

The book, titled "Signal Processing and Networking for Big Data Applications," was published by the Cambridge University Press last April.

This unique text helps make sense of big data in engineering applications using tools and techniques from signal processing. It presents fundamental signal processing theories and software implementations, reviews current research trends and challenges and describes the techniques used for analysis, design and optimization.

When asked why a comprehensive book on signal processing for big data is so important, Han explained, "Different researchers have different perspectives for big data analysis. This book is the first one to give a comprehensive view for the story, so that the researchers can select the appropriate signal processing tools for specific problems."

The book is ideal for researchers and practicing engineers looking to solve practical problems involving large amounts of data, and for students looking to grasp the fundamentals of big data analytics.

"We hope that this book is a great resource for graduate students who want to pursue big data analysis, as well as engineers and data scientists who want to know the current state-of-the-art data applications," said Han.

Just as with any unprecedented venture, the authors experienced a few bumps in the road along the way. "It was quite a learning curve for such a dynamic and diverse field. I was lucky to have two active, young researchers involved with whom I have collaborated and studied on many occasions."

Han has published an impressive eight books by prestigious publisher Cambridge University Press and plans to release another soon.

"I hope to continue to create books that not only serve as valuable resources to students and professionals, but also contribute to the field," he said.

NATIONAL RADIO SCIENCE ORGANIZATION

Names ECE Professor as Chair

BY ASHLEY SCHWARTZ

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

The International Union of Radio Science (URSI) is a non-governmental and non-profit organization under the International Council for Science. It is responsible for stimulating and coordinating international studies, research, applications, scientific exchange and communication in the field of radio science.

The organization is comprised of member committees representing over 40 countries including the United States. The United States National Committee (USNC) of URSI is appointed by the National Academy of Sciences to represent the United States to URSI.

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

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

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

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

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

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

ECE PROFESSOR SERVES AS EDITOR

of Electrochemical Journal Special Issue

BY ASHLEY SCHWARTZ

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

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

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

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

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

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

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

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

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

Journal Features

DOCTORAL STUDENT'S BATTERY RESEARCH ON COVER

BY ASHLEY SCHWARTZ

Yifei Li, a former doctoral student in the Cullen College's department of electrical and computer engineering (ECE), was garnering international attention for his battery research before he'd even earned his degree.

Li's research on developing safer, cheaper and more efficient alternatives to traditional lithium-ion batteries was featured on the cover of the journal *ChemNanoMat* in a special issue on nanomaterials for energy conversion and storage.

In his article titled "Intercalation pseudocapacitance of exfoliated molybdenum disulfide for ultrafast energy storage," Li discusses how he and his fellow researchers – including his advisor, assistant professor of electrical and computer engineering Yan Yao – expanded the layers of a two-dimensional material to improve the performance of a supercapacitor.

"We needed to break down the material into single layers in order to approach its theoretical limit," said Li. "By exfoliating the two dimensional material, the material delivers higher capacitance per volume due to enhanced electric conductivity."

This research was also the focus of Li's doctoral dissertation at the Cullen College, which received the best materials program dissertation award from the college's materials engineering and sciences program.

"In his dissertation, Yifei was able to pull together past research to design better materials for battery systems and because of this we now have the ability to modify and tailor the design to the system we are trying to create," said Yao.

Li's dissertation, titled "Developing beyond lithium ion batteries for electrical energy storage," discusses creating safer and more efficient alternatives to lithium-ion batteries, such as sodium-ion batteries, magnesium-ion batteries, hybrid magnesium/sodium-ion batteries and magnesium-air batteries. His dissertation reports four strategies to address the issues that often arise when utilizing big sodium ions and divalent charged magnesium ions.

Li said he felt honored to receive this recognition from the college. "I hope that I can represent the students of our department by showing the importance of materials science and that we can make great contributions to the scientific field," he said.

In Yao's eyes, Li has already made great strides towards these goals.

"Yifei is the first Ph.D. student graduated in my group. He worked very hard and is very productive – he has authored 13 publications in the past four years," said Yao. "I have seen him transform from a student to a scholar. I congratulate him on receiving the best dissertation award from the materials engineering program."

ECE Students Place Second

AT NASA SWARMATHON COMPETITION

BY ASHLEY SCHWARTZ

Last April a team of four undergraduate students from the UH Cullen College of Engineering's electrical and computer engineering (ECE) department competed in the 2017 NASA Swarmathon at the Kennedy Space Center in Florida. The team placed second out of 19 teams.

The team was made up of undergraduate students **Austin Dodge**, **Luis Robles**, **Steven Ventura** and **Vinh Vu**. Master's student **An Nguyen** and Assistant Professor Aaron Becker advised the students.

The NASA Swarmathon challenges college and high school students throughout the country to compete in developing algorithms and computer code to control large numbers of small robots, known as "swarms," to perform specific tasks on the surface of Mars.

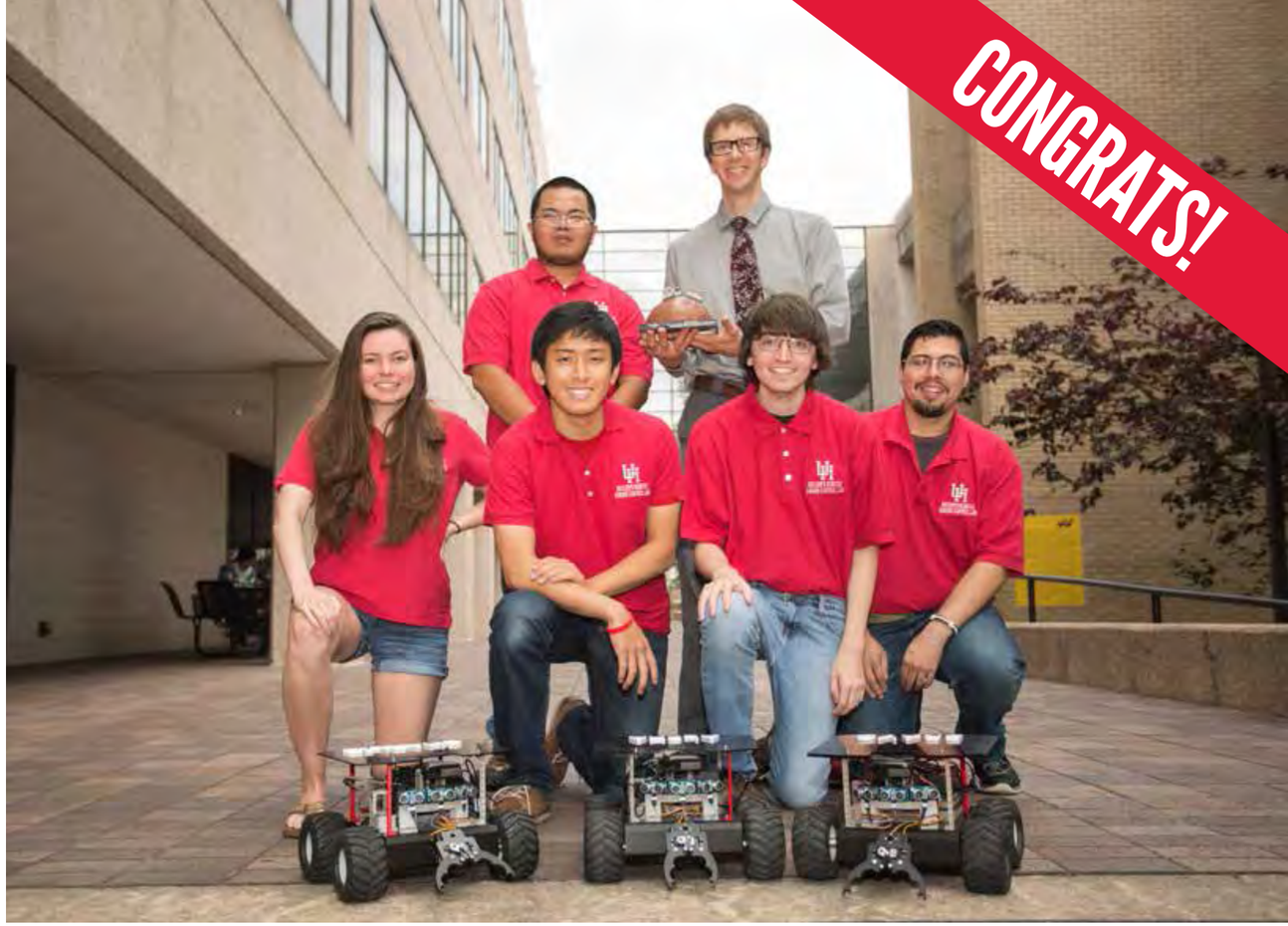
"Every year the competition organizers add a new element to the contest, so this year our swarmies had to pick up cubes and deliver them to a home base while roaming the surface of mars," said Dodge.

This year's competition required teams to use the swarms to find and collect resources without using maps. Provided only with robots that are programmed for specific uses, such as cleaning up hazardous waste or rescuing people in disaster areas, the competitors had to write algorithms that allowed the robotic swarms to perform the new tasks.

With only two months to prepare for the competition, the UH team found the project to be a crash course in engineering, computer science and robotics.

"In two months we had to learn about the robot operating system," said Vu. "Since you cannot modify the robot, we had to rely solely on our software skills."

The Swarmathon competition also doubled as the UH team's senior design project, helping the undergrads connect-the-dots between classroom lessons and their real-world applications.



"I liked the connection to NASA and that the project went beyond hardware and explored the programming of robots," said Robles.

The team also appreciated the opportunity to meet fellow future engineers while attending the competition.

"I made friends with other students and we talked about the algorithms and the code we were given by NASA, so that was great" said Ventura. "We were also able to talk to the NASA engineers and that made me want to work with NASA one day."

Becker said the most rewarding part of working with the team was watching the students work through the problems and grow in the process.

"I love when the students say, 'We got this demo ready and it works!' Seeing their victories is the fun part. They broke down a big problem into a set of small challenges, then added these components together to build a winning combination," Becker said.

Top: UH Swarmathon team with advisors Aaron Becker, top right, and An Nguyen, top left. Bottom: credit - NASA/Dmitri Gerondidakis

From HOUSTON *to* HAWAII:

Two Cullen College Ph.D. Students Speak at Prestigious Conference

BY LAURIE FICKMAN

Two Cullen College of Engineering Ph.D. students, studying under the direction of Associate Professor of electrical and computer engineering Stanko Brankovic, presented talks on their groundbreaking work in Honolulu, Hawaii at the biggest conference in the electrochemistry field.

Kamyar Ahmadi and Dongjun Wu were not only invited to share their scholarly works, they were also awarded travel grants from the Electrodeposition Division of the Electrochemical Society to attend the 230th Electrochemical Society Fall Meeting in Honolulu Oct. 2-7.

Wu presented his paper "Electroless deposition of high quality Co films on Cu polycrystalline substrate assisted by Pb UPD monolayer," in which he demonstrated a new approach to high quality cobalt thin-film growth using lead atomic monolayer as a surfactant, to lower tension between layers. This could have a direct impact on nanofabrication of metallic interconnects for future microchip technology development.

Ahmadi's lecture, titled "Thin film surface chemo-resistivity tuning using metal deposition via SLRR," describes his work on a design of new thin-film sensors to measure the concentration of corrosive chemicals in water-oil slurries. This work could be most helpful in the oil and gas industry to measure content of hydrogen sulfide, a chemical that could destroy the expensive tools used for drilling.

Both students were overwhelmed with the opportunity to attend the meeting.

"It was great for me, my first experience at a big conference and a good opportunity because it's the biggest in the field," said Ahmadi. "We met the biggest experts in the field."

Wu concurred. "All the people in the electrochemistry field are there and you can network with them and gain opportunities," he said. "Also you meet other students from all over the world and see what they're doing and compare yourself to them."

Their proud professor Brankovic will tell you that there is no comparison to their success, which increases his own.

"My personal opinion is that one's success is measured by the highs reached by his students," said Brankovic. "I always try to motivate my students to dream big, and to never subjugate to mediocrity and compromise their high standards no matter what. For this reason, I am very proud that two of my students are awarded travel grants to attend the most important meeting in the year in our field. Both of them are exemplary Ph.D. students, and I hope that their success serves to other students as a motivation to work hard and keep their goals high in their career and personal pursuit of success."

> ***I always try to motivate my students to dream big, and to never subjugate to mediocrity and compromise their high standards no matter what.***
>
> - STANKO BRANKOVIC

SECRET LIVES OF ENGINEERS:

Meet Michael Pincus, Electrical Engineering Student and Professional Cyclist

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 classroom and workplace. The series highlights the wealth of diverse talents, ambitions and passions that engineers embody.

The second installment of the series introduces electrical and computer engineering student **Michael Pincus,** a professional cyclist who races in competitions all over the world when he's not in the classroom.

For Pincus, who serves as coach for the UH collegiate cycling team, cycling isn't just a way to blow off steam while earning his engineering degree – bicycles and cycling are a natural extension of his passion for engineering.

"Cycling and engineering are quite similar," he said. "Cycling is actually a very engineering-friendly sport."

Pincus said many of his engineering peers find cycling to be a natural fit because of the focus and regimented training required to succeed at a professional level – qualities that are also required for completing an engineering degree. Some engineering and cycling enthusiasts take it a step farther, Pincus said, by studying and perfecting the aerodynamics of their bicycle.

WATCH OUR VIDEO
about Pincus in the "Secret Lives of Engineers" series at www.egr.uh.edu/secret-lives-cyclist

WE'RE NUMBER 1!

IEEE-UH is Outstanding Large Branch

BY ASHLEY SCHWARTZ

The Institute of Electrical and Electronics Engineers (IEEE) student chapter at the University of Houston Cullen College of Engineering (IEEE-UH) received high honors at the 2017 IEEE Region 5 Annual Conference and student competitions held in Denver, Colorado in April.

IEEE-UH received the Outstanding Large Student Branch Award for achievements in outreach and programming in 2016, beating out branches from the University of Texas, Rice University and the Colorado School of Mines.

The award is based on overall branch activity, including social events, fundraising, service projects, academic performance and participation in IEEE initiatives.

IEEE-UH graduate chair, **Jesus Cruz-Garza**, spearheaded the application process.

"We have been working closely with the IEEE Houston Section in event programming, so they were well aware of our work and recommended that we apply for the IEEE Region 5 award," said Cruz-Garza.

According to the group's president, **Moriah Hargrove-Anders**, IEEE-UH plays an integral role in the Cullen College's electrical and computer engineering department.

"We serve as a source of student opinion, both in department affairs through our Student Advisory Committee, as well as with outreach events by providing university students the opportunity to teach younger students about electrical engineering," Hargrove-Anders said.

"Our organization works as a bridge for IEEE national to work with undergraduate, graduate, national and international students at the University of Houston," said Cruz-Garza. "We host engineering workshops, seminars and international competitions on campus, spread the word for grants and scholarships and provide our members a link with industry representatives."

Len Trombetta, associate chair of electrical and computer engineering and faculty advisor of IEEE-UH, is impressed by the achievements of the organization and believes it is a testament to the consistent dedication of the students. "This year's IEEE-UH members and officers have exceeded my expectations. I have enjoyed advising these students as they transform into leaders," he said.

When asked about her hopes for the future of IEEE-UH, Hargrove-Anders explained, "As a student organization, I hope that we can continue to show our classmates and the electrical and computer engineering department that IEEE-UH is an indispensable resource."

TO LEARN MORE ABOUT IEEE-UH AND HOW YOU CAN BECOME A MEMBER, VISIT
http://ieee.ece.uh.edu/

GENEROUS ENGINEERING ALUMNUS WILLIAM A. BROOKSHIRE

Funds $1M Award Endowment for Teachers †

BY LAURIE FICKMAN

In his continued spirit of generosity, UH Engineering alumnus **William A. Brookshire** donated $1 million to the Cullen College of Engineering to create the William A. Brookshire Teaching Excellence Award Endowment. According to the endowment agreement, the annual distributed income will honor faculty members in the Cullen College "who demonstrate an unwavering commitment to exemplifying the highest levels of teaching excellence inside the classroom."

More than many others, Brookshire clearly understood the significance of high caliber mentors inside the classroom. Raised without means, he was the first in his family to earn a high school diploma. College wasn't encouraged, but he didn't need anyone to light his fire; his spark came from within.

He's often recounted his experience as a night student at UH.

"I had to work a full-time job during the day while attending night classes to finish my bachelor's degree in chemical engineering at the University of Houston," Brookshire has said.

He graduated in 1957 and later moved to Louisiana to earn his master's and doctoral degrees in the same discipline.

In the early 1960s, Brookshire put his degrees to work at Exxon. Then, in 1967 he took another big leap, investing his life savings – about $7,000 – to launch S&B Engineers and Constructors with partner James Slaughter, Sr.

The company flourished, expanding from just the two partners to more than 7,500 employees across the world. Today, S&B continues to provide a complete range of project services for the petrochemical, refining, chemical, midstream and power generation industries for clients worldwide.

This is not the first time Brookshire shined his very generous light on the Cullen College of Engineering. Prior to this gift, he founded two student scholarships. The William A. Brookshire Scholarship is for students taking a full course load (12 hours) and working at least 20 hours a week, and the William A. Brookshire IMPACT Scholarship is for students who are working, taking a full course load and paying for college on their own with no outside financial support.

One or more awards will be granted annually from the new endowment, with a minimum of $15,000 per recipient.

"The UH Cullen College of Engineering is home to some of the most devoted and innovative engineering educators in the world," said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the Cullen College. "Many of our engineering faculty members go above and beyond to provide UH engineering students with personalized attention, tailored lessons and mentorship in order to help them achieve their personal and professional goals. At many world-class research institutions, professors who are focused on the art of teaching and student engagement are the unsung heroes – but thanks to Dr. Brookshire's endowment, that will not be the case at the Cullen College of Engineering." ✹

William A. Brookshire meets the recipients of the William A. Brookshire Scholarship and the William A. Brookshire IMPACT Scholarship

† Dr. William A. Brookshire died on April 21, 2017. A memorial was held at the UH campus to honor his memory and long legacy of philanthropy.

Cullen College Alumnus HONORS WIFE WITH ENDOWMENT

BY LAURIE FICKMAN

When **Bertha "Bo" Lohec** passed away in November, her husband, UH mechanical engineering alumnus Ron Lohec, knew the perfect tribute – an endowment to the UH Cullen College to help students achieve their dreams of becoming engineers.

"Ron is one of our all-time great alumni and Bo was a staple at his side at every UH engineering event," said Russell Dunlavy, chief development officer at UH. "She meant so much to Ron and to all of us. It's a wonderful way to honor her."

The Bertha "Bo" Johnston Lohec Engineering Endowed Scholarship will be awarded to engineering majors who exhibit leadership qualities and maintain a 3.0 GPA.

About the namesake

Engineering flowed alongside Bo's life from a young age. When she married Ronald in 1953 at the age of 20, she got to work immediately, supporting him while he pursued his engineering degree from UH. Two years later, degree in hand, Ron went to work and Bo stayed home as their first of three children was born. Motherhood and grandmotherhood were her favorite occupations, say family members.

Still, she maintained an adventurous spirit, even finding a way to meet the Queen Mother while living in London. Throughout her life she valued engineering, joining her husband in his unwavering support of the Cullen College and constantly encouraging young people, especially young girls, to find a sense of purpose in that field of study.

Mr. Lohec serves on the Engineering Leadership Board at the Cullen College, providing respected counsel to the school in establishing priorities and objectives. In 2006, the couple was inducted into the Bridgebuilder Society, the highest honor bestowed on donors to the Cullen College. They were also early investors in the Multidisciplinary Research and Engineering Building (MREB).

WELCOME!

ECE Industry Advisory Board Welcomes

FIVE NEW MEMBERS

The electrical and computer engineering (ECE) department's Industry Advisory Board (IAB), which connects leaders in industry, government and academia with students and faculty in the department, recently welcomed five new members.

JEFF ANDERSON

Jeff Anderson is the electrical engineering authority (EA) at the Battleground Manufacturing Complex (BMC) for INEOS Olefins and Polymers (O&P) in La Porte, TX, an industrial site that produces high-density polyethylene and polypropylene plastic and has a state-of-the-art technical center that integrates research and development, technical services and quality assurance. Anderson has over eight years of experience in the power distribution field and was quickly promoted to his current position, which he has held since 2013.

As the electrical EA, he manages a team of power, instrumentation and safety instrumented systems engineers, designers, electrical specialists, high voltage electricians and summer interns. Under his tenure, the INEOS O&P BMC site has set new production and reliability goals by implementing new key performance indicators, expanding the preventative maintenance (PM) program by developing in-house expertise, transitioning his team to a predictive maintenance (PdM) organization and developing new project design standards. His team supports continued reliability improvement through Root Cause Failure Analysis, performing and analyzing PM's, troubleshooting, identifying obsolete equipment, initiating projects and providing subject matter experts for project development.

ROGER DALE BROWN

Roger Dale Brown is the manager for National Oilwell Varco's (NOV) Research and Development (R&D) Lab. NOV is a leading worldwide provider of equipment and components used in oil and gas drilling and production operations, oilfield services and supply chain integration services to the upstream oil and gas industry. The company conducts operations in more than 1,200 locations across six continents. The NOV R&D Lab has conducted greater than 10,000 tests since it opened in September 2011 across more than 25 different product lines.

Brown has lived long with the desire to serve others and ensure safety and readiness, having served as reactor control leading chief petty officer aboard several nuclear-powered submarines in the U.S. Navy. He completed his nuclear engineering degree from Thomas Edison State University while serving aboard the U.S.S. Harry S. Truman as the ship's testing coordinator in the Portsmouth Naval Shipyard.

With more than 25 years as a test engineer, Brown has worked with various engineering disciplines to determine the strategy and processes necessary to complete hundreds of projects with thousands of tests. He is passionate about learning and must stay on the ever-changing edge of emerging technologies in diverse fields so that NOV stays in the lead in the innovation of equipment in the oil and gas manufacturing industry.

Over the past five years Brown has represented NOV working with the University of Houston Cullen College of Engineering to sponsor students' Capstone Design projects. He enjoys working with young engineers to expand their abilities and broaden their understanding of how the world works and their place in that world.

Brown is a member of the Society of Petroleum Engineers and holds patents in oil and gas equipment.

TOMMY COOPER

In 1986 Tommy Cooper founded Cooper Consulting Service (CCS) located in Friendswood, Texas. CCS is an engineering design and development company focusing on medical devices. He earned his B.S. and M.S. in electrical engineering from the University of Houston in 1974 and 1981, respectively, and is a registered professional engineer in Texas. He has been the chair of the IEEE Houston Consultants Network for five years. He served for 12 years as the co-chairman of the Association for the Advancement of Medical Instrumentation (AAMI) Blood Pressure Transducer Committee that developed the ANSI-AAMI national standard for blood pressure transducers. He has written over 16 articles for publication in professional journals and holds 22 patents in the field of medical devices. He has designed and developed numerous products such as kidney dialysis machines, sleep study systems, electronic stethoscopes, disposable pressure transducers, a defibrillator-monitor, a laser based opto-acoustic patient monitor, wireless ambulatory patient monitors, an intracardiac pressure-volume monitor, teaching devices for physiological sound auscultation, automated test system and many others. He works with medical product companies of all sizes, start-up companies, medical schools and foundations. His focus is on new product development from concept to regulatory approval and production.

DAVID HANSON

David Hanson is currently president of the BOP Control Systems division of Axon Energy Products, a Houston-based oil and gas equipment manufacturer. He is responsible for managing the profit and loss for the business unit. Hanson joined Axon in 2013.

Prior to Axon, Hanson was with Stewart & Stevenson for almost 15 years where he designed control systems, electronics and software for a variety of oil well servicing equipment. He managed the control systems group and eventually became engineering manager, leading 25 mechanical and electrical engineers as well as designers, drafters and technicians. His most recent assignment with S&S was vice president of research and development where he was responsible for managing the product portfolio to maximize the utility of R&D funding.

Hanson worked full-time as a software developer for W. R. Biles & Associates, a SCADA software company, while working on his B.S. in electrical engineering from the University of Houston. Hanson gives enormous credit to UH for allowing commuter students the flexibility to work and study. It was a long, unconventional process, but he would not have been able to earn a degree without that accommodation.

In 2009 Hanson became a proud double-Cougar when he graduated from UH's Bauer School of Business with an MBA.

DON WALLER

Throughout his 22-year career with Hewlett Packard/Agilent/Keysight, Don Waller has held a variety of individual contributor and management roles including sales representative, product sales specialist, district sales manager and now regional universities manager. He also spent time at Exfo and Acterna as director of global sales to AT&T.

Waller's specific focus areas have included microprocessor development systems, copper and optical telecommunications systems as well as wireless network optimization and test.

Waller is a graduate of Texas A&M University and was a member of the Advisory Board for the Department of Engineering Technology for over five years. He is also a current member of the South Limestone County Hospital District Board of Directors.

YAN XU

Yan Xu has been a scientist in the machine learning team at PROS Inc. in Houston since February 2016. She is currently working on natural user interface and information retrieval. She earned her Ph.D. in electrical and computer engineering from UH in December 2015. She has been published in the highest-impact machine-learning IEEE journal, *Transactions on Pattern Analysis and Machine Intelligence*, with her work featured on the cover. She has a diverse machine learning background, especially in boosting algorithms, unsupervised learning, data visualization and computer vision. She has great experience in building data science solutions to solve real world challenges, from biomedical applications to business challenges. She is a Kaggle competition master and also the founder and leading speaker for a machine learning meet-up in Houston area. The non-profit organization is dedicated to making machine learning easy and accessible to everyone who has the interest and passion to learn!

LEARN MORE ABOUT THE ECE INDUSTRY ADVISORY BOARD AT
www.ee.uh.edu/people/industry-advisory-board

OUR VISION

To bring together leaders in industry, government and academia with UH Electrical and Computer Engineering (ECE) faculty and students in order to enhance the overall academic and research experience of UH ECE students and to aid the ECE Department in achieving its mission to educate the next-generation of global, world-class engineers.

NEED A JOB?

Leverage Your Networking Skills!

BY TREY MEBANE, PRESIDENT, CHASM VISIONS LLC

Many of us have heard the popular phrase, "It's not what you know, it's who you know." So why is this phrase popular? Is it true?

Most of us can easily agree "what you know" definitely matters – it's why we go to school and educate ourselves in hopes of earning a decent living or excelling at something we are passionate about. However, we must accept that "who you know" can be a force multiplier when creating value with "what you know." Who you know can help you land your first job. Who you know can help you solve some of the most difficult challenges you will face. It's who you know that may introduce you to the love of your life (okay, this last one may be a stretch as we have all known mothers willing to help and internet dating websites). This said, "who you know" matters, and it's critical you start considering how you're going to build, grow and manage your professional network now – not later, but now!

So, who is going to help you in developing your professional network? Is there an elective you can take at the University? The answer is simple: There is no elective, and there is no one else but you who can do this. School has taught you how to study and learn just about anything, and now is the time to apply your learning skills to the problem of developing yourself and your professional network.

Where to start? You need to construct your plan for developing your network. Specifically, you need to build your training program for creating, growing and managing your professional network. But don't worry, there are many tools. After all, if the internet can help us find true love, rest assured it can help you find resources and methodologies for getting started here, too.

Amazon and Google will aid you with many respected books and articles about professional networking – get at least one, preferably three, for comparison. LinkedIn.com is the professional community's networking site of choice, and will serve as your digital assistant in meeting others and helping you to expand your network. And as you may expect, there are multiple resources on how best to leverage LinkedIn and manage the digital "you."

These tools will help you prepare for reaching out to others by, for example, joining trade associations, establishing new friendships and connections in the form of a professional network and more. But make no mistake about it, just as you are looking to gain value from the network you are forming, that same network is going to look to gain value from you. So be prepared to return the favor!

To learn more about how to leverage your networking skills (including a detailed presentation on networking advice), please visit www.ece.uh.edu/people/industry-advisory-board/news/need-job-leverage-your-networking-skills

Chevron

human energy®

presents

CHEVRON INSPIRES GIRLS TO ENGINEER THE FUTURE AT UH

The second annual "Girls Engineering the Future: A STEM Event," sponsored by Chevron and hosted by the Cullen College last March, introduced over 500 Houston-area girls in grades 4-8 to complex engineering principles through fun, hands-on activities.

LEARN MORE AT
www.egr.uh.edu/girls-engineering-the-future

WOMEN IN ENGINEERING BECOME WOMEN IN RED AT SPRING EVENT

The Cullen College played host to the 3rd Women in Engineering spring event in March. The free event was funded by alumna Cynthia Oliver Coleman, P.E. (BSChE '71). The event took place at the UH Hilton and included female engineering students, faculty and alumnae. Aside from networking, those in attendance were inducted into the Women in Red Movement, which will serve as a registry of female students and alumnae to serve as mentors for one another. The Cynthia Oliver Coleman Rising Star Award was presented to Tam Nguyen for being named the outstanding senior at the Cullen College of Engineering.

VIEW MORE PHOTOS AT
www.flickr.com/photos/CullenCollege

ROBOTS TAKE OVER UH CHARTER SCHOOL

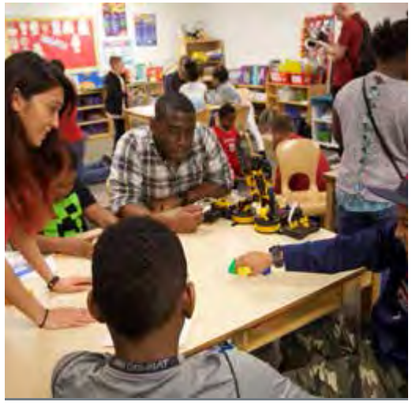
When **Aaron Becker,** assistant professor of electrical and computer engineering at the Cullen College, took seven engineering students to the UH Charter elementary school to play with robots, he wasn't just opening young minds – he was upholding the charter school's vision to help students fulfill their potential through wonder and discovery.

His college students came into the fourth grade class carrying robotic arms they had built in Becker's lab and little building blocks to show the youngsters how the robotic arm can pick up pieces. Each UH student had 3-4 youngsters in their small group, so each got plenty of chances to control the robotic arm.

"I believe the best way for students to learn is for them to teach," said Becker, who regularly takes his engineering students to the UH Charter School to show elementary students that science and engineering can be great fun.

His methods work, according to fourth grade teacher Gail Paul. "I see high-fives going around the room, so I know it's working," said Paul. "It's a totally beneficial and hands-on experience, which is highly engaging and motivates them to want to learn to do more."

Proof positive of what Paul says: Fourth grader Paula screams out, "Can you please come back?!" as the Becker group is leaving.

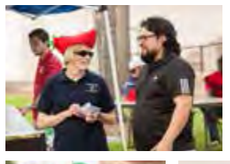


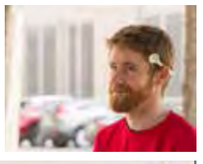
IEEE ANNUAL CHILI COOK-OFF

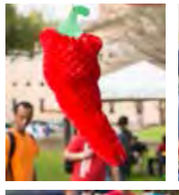
On March 10, Cullen College students, alumni and corporate sponsors brought their culinary chops to the table for the annual IEEE Chili Cook-Off.

While teams of engineers competed for the title of best recipe, students had the opportunity to network with industry representatives and learn about engineering student organizations.

In addition to sampling countless top-notch dishes, attendees enjoyed free beer, music and games on the lawn in front of engineering building 1.







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