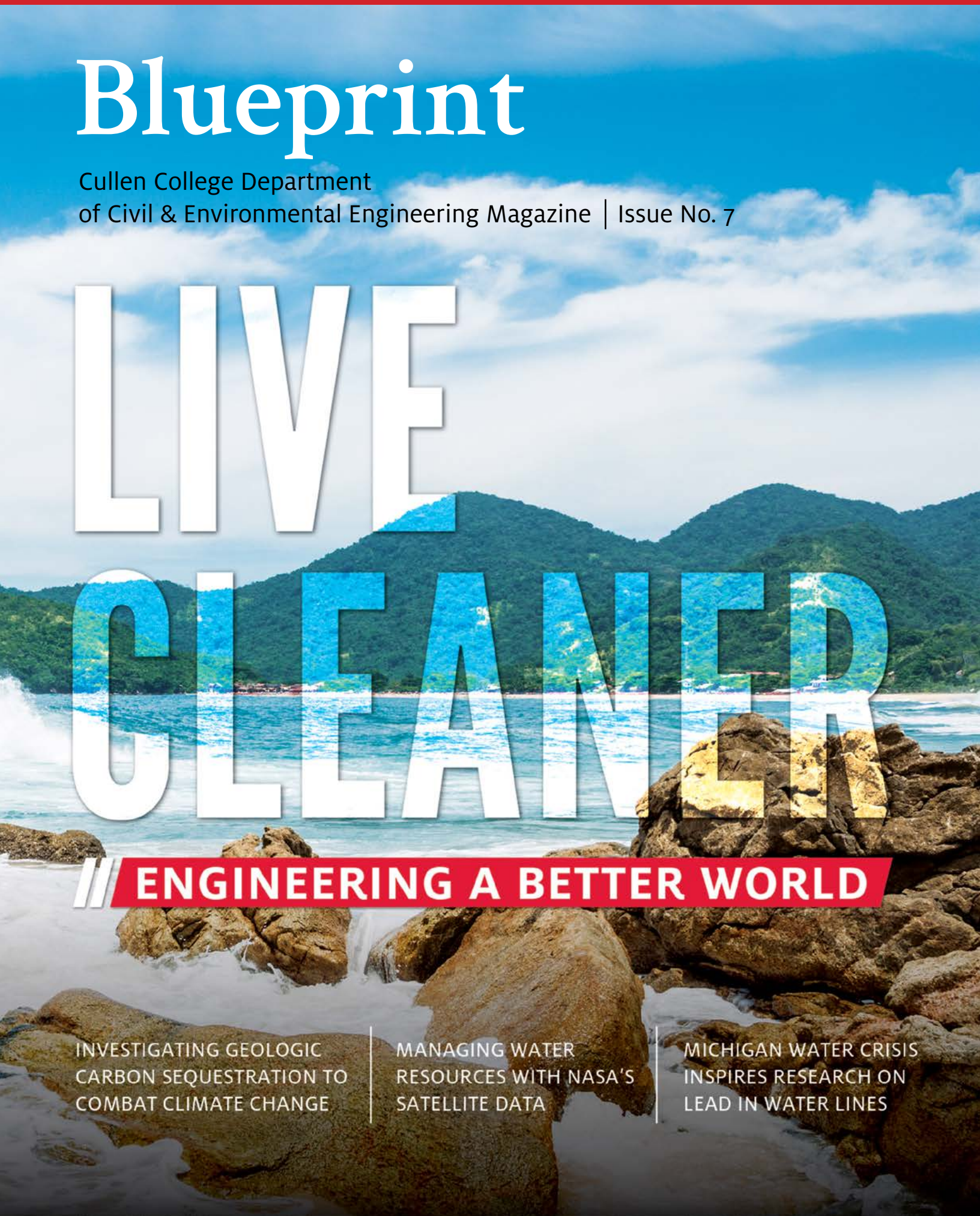
# Blueprint

Cullen College Department
of Civil & Environmental Engineering Magazine | Issue No. 7



# LIVE CLEANER

## // ENGINEERING A BETTER WORLD

INVESTIGATING GEOLOGIC CARBON SEQUESTRATION TO COMBAT CLIMATE CHANGE

MANAGING WATER RESOURCES WITH NASA'S SATELLITE DATA

MICHIGAN WATER CRISIS INSPIRES RESEARCH ON LEAD IN WATER LINES



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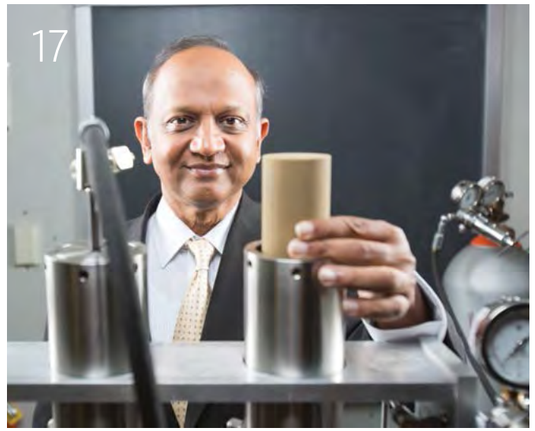


**Blueprint**

*Blueprint* is published by the University of Houston Cullen College of Engineering, Office of Communications.

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UNIVERSITY of HOUSTON
CULLEN COLLEGE of ENGINEERING

# CHAIR'S MESSAGE

As I write this letter, students and professors in the UH Department of Civil and Environmental Engineering (CEE) are commercializing nano-sized filters to increase global access to clean water, researching new methods of carbon sequestration and redesigning bridges across the state of Texas to lower maintenance costs and increase safety.

UH civil and environmental engineers continue to conduct research with direct, real-world impacts in the Houston region and around the world by providing the services and facilities on which modern life depends. The demand for highly-skilled civil and environmental engineers will increase significantly in coming decades, especially in the city of Houston, the Energy Capital of the World.

Your support has allowed the UH Civil and Environmental Engineering Department to both expand and enhance its academic and research offerings, earning recognition as one of the Best Engineering Programs of 2017 by *U.S. News and World Report*. By 2025, the UH Cullen College of Engineering will double its enrollment to more than 8,000 students and will be ranked among the Top 50 engineering schools in the country.

In preparation for the increased demand for UH civil and environmental engineering graduates, the CEE department will continue to grow its student enrollment, faculty members and research portfolios. In the meantime, I invite you to learn more about how the Civil and Environmental Engineering Department at UH is making a positive and lasting impact in the Greater Houston region and beyond in this issue of *Blueprint Magazine*.

And please consider becoming an integral part of our growth and continued success by making a gift to the UH Department of Civil and Environmental Engineering today at *https://giving.uh.edu/eng*. To stay in touch with updates from the CEE Department and the UH Cullen College of Engineering, please subscribe to our e-newsletters by filling out the web form at *https://ssl.uh.edu/subscribe/index.php* and selecting "Engineering e-News."

**Roberto Ballarini**
Thomas and Laura Hsu Professor and Department Chair
Civil and Environmental Engineering
Cullen College of Engineering
University of Houston



## CIVIL ENGINEERING BY THE NUMBERS

BEST GRAD SCHOOLS U.S.News ENGINEERING 2017

**BEST ENGINEERING PROGRAM OF 2017**

**SOURCE** // *U.S. NEWS & WORLD REPORT*

**#62** BEST GRADUATE PROGRAM IN THE COUNTRY

**SOURCE** // *U.S. NEWS & WORLD REPORT*

**$61,734**
AVERAGE ANNUAL STARTING SALARY WITH B.S. IN CIVIL ENGINEERING

**$60,375**
AVERAGE ANNUAL STARTING SALARY WITH B.S. IN ENVIRONMENTAL ENGINEERING

**$67,962**
AVERAGE ANNUAL STARTING SALARY WITH M.S. IN CIVIL ENGINEERING

**$65,857**
AVERAGE ANNUAL STARTING SALARY WITH M.S. IN ENVIRONMENTAL ENGINEERING

**SOURCE** // NATIONAL ASSOCIATION OF COLLEGES AND EMPLOYERS SALARY SURVEY, 2016

## UH CULLEN COLLEGE OF ENGINEERING BY THE NUMBERS

BEST GRAD SCHOOLS U.S.News ENGINEERING 2017

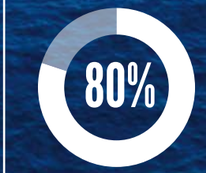
**BEST ENGINEERING SCHOOL OF 2017**

**SOURCE** // *U.S. NEWS & WORLD REPORT*

**22:1** UNIVERSITY-WIDE STUDENT TO FACULTY RATIO

**$103,390**
AVERAGE ANNUAL SALARY OF ENGINEERING PROFESSIONALS IN HOUSTON, TEXAS

**SOURCE** // *U.S. BUREAU OF LABOR STATISTICS, 2015*




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

**$26 MILLION**
IN RESEARCH EXPENDITURES

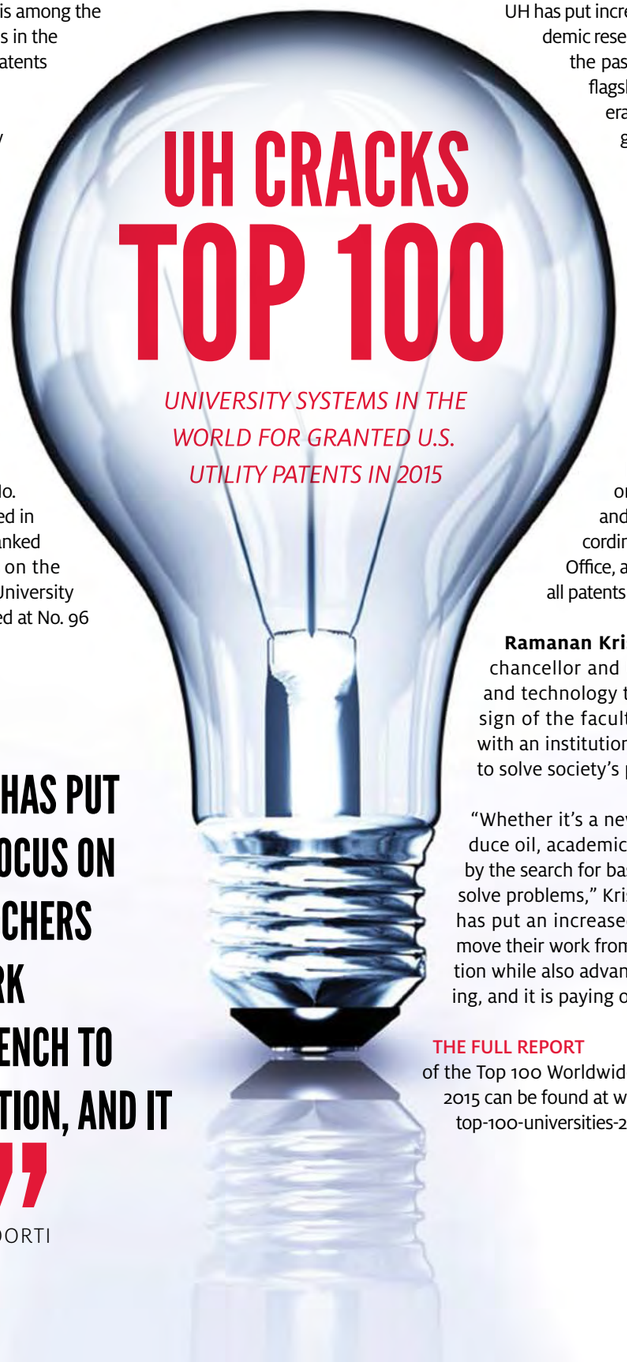
# UH MOVES UP IN GLOBAL RANKINGS FOR ISSUED PATENTS

By Jeannie Kever

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

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

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




> THE UNIVERSITY HAS PUT AN INCREASED FOCUS ON HELPING RESEARCHERS MOVE THEIR WORK FROM THE LAB BENCH TO COMMERCIALIZATION, AND IT IS PAYING OFF.
>
> RAMANAN KRISHNAMOORTI

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

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

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

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

**THE FULL REPORT**

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


By Shawn Lindsey

The *Princeton Review* is highlighting why more students are choosing Houston. The education services company 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.

In its profile, the *Princeton Review* praises UH for being "a world-class research institution and a fixture in Texas education" and "attracting many more bright students to the university." The book quotes extensively from UH students who were surveyed. Among their comments, the school "provides some of the greatest opportunities in the world." Students attributed UH's ideal location in Houston as a strength for both academics and student life – noting UH's ties to business and industries, as well as UH's proximity to "fun places to eat, party, hang out and exercise." "If you feel there's nothing you could do here... you, my friend, are wrong," said one UH student.

"Outstanding academics are the chief reason we chose UH for this book, and we strongly recommend it to applicants," says Robert Franek, *Princeton Review*'s editor-in-chief and author of "The Best 381 Colleges." "We make our selections primarily based on data we collect through our annual surveys of administrators at several hundred four-year colleges. Additionally, we give considerable weight to observations from our school visits, opinions of our staff and our 24-member National College Counselor Advisory Board, and an unparalleled amount of feedback we get from our surveys of students attending these schools. We also keep a wide representation of colleges in the book by region, size, selectivity and character."

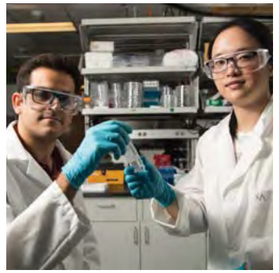
The *Princeton Review* surveyed 143,000 students (about 375 per campus on average) attending the colleges. The 80-question survey asked students to rate their schools on several topics and report on their campus experiences. Topics range from their assessments of their professors as teachers to opinions about their school's library, career services and student body's political leanings. UH received high marks for the diversity and "dedicated spirit" of the student body, pointing out that students routinely wear red and cheer on the athletic programs.

The University has not only caught the attention of the *Princeton Review* as being a university "on the rise in recent years," but also has potential students taking notice. Applications and enrollment were up 3 percent this fall compared to last year.

Overall, the University of Houston continues its evolution and growth on all fronts – from the physical landscape to its academic offerings. There are several new schools, degree programs and academic opportunities debuting this fall.

The *Princeton Review*'s recent recognition of UH complements previous acknowledgements in books "Colleges that Pay You Back: Schools that Give you the Biggest Bang for Your Tuition Buck" (Feb. 2016) and "Colleges That Create Futures" (Sept. 2015). UH also earned the No. 2 spot in *Princeton Review*'s "2015 Top Entrepreneurial Programs" for the Cyvia and Melvyn Wolff Center for Entrepreneurship in the C.T. Bauer College of Business.

The *Princeton Review* is an education services company known for its test-prep courses, tutoring, books and other student resources. The company is not affiliated with Princeton University. ■

# ON THE MOVE

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

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

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

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

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

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

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

Nearly 5,000 students are enrolled in engineering courses – 3,722 undergraduates as well as 1,247 master's and doctoral students in biomedical, chemical, civil, computer, electrical, environmental, geosensing systems, industrial, mechanical and petroleum engineering. The college also offers interdisciplinary graduate programs in subsea, aerospace, materials, and computer and systems engineering.

The Cullen College is home to some of the country's highest ranked engineering programs, including chemical engineering (33rd), industrial engineering (53rd), civil engineering (62nd), environmental engineering (64th) and mechanical engineering (78th).

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

**FOR THE FULL LIST OF RANKINGS**

from *U.S. News* & *World Report*, please visit *http://grad-schools.usnews.rankingsandreviews.com/best-graduate-schools/top-engineering-schools* ■

THE CULLEN COLLEGE IS HOME TO SOME OF THE COUNTRY'S HIGHEST RANKED ENGINEERING PROGRAMS

**53rd**
INDUSTRIAL ENGINEERING
BEST GRADUATE PROGRAM

**33rd**
CHEMICAL ENGINEERING
BEST GRADUATE PROGRAM

**62nd**
CIVIL ENGINEERING
BEST GRADUATE PROGRAM

**78th**
MECHANICAL ENGINEERING
BEST GRADUATE PROGRAM

**64th**
ENVIRONMENTAL ENGINEERING
BEST GRADUATE PROGRAM

CULLEN COLLEGE CLIMBED FROM #76 TO
**#73**
FOR GRADUATE-LEVEL ENGINEERING PROGRAMS

SOURCE //
*U.S. NEWS & WORLD REPORT*
NATIONAL RANKINGS

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

DEAN JOSEPH W. TEDESCO

# CULLEN COLLEGE LAUNCHES INDUSTRY-RELEVANT ONLINE ENGINEERING PROGRAMS

The University of Houston Cullen College of Engineering has launched flexible, online master's programs in civil, mechanical, subsea and industrial power systems engineering. Tailored for working professionals, the innovative digital programs include live videos of lectures, interactive web-based discussions and opportunities for one-on-one learning experiences.

All four of the online programs in engineering can be completed in as little as two-to-three years. The UH Engineering degrees earned online are exactly the same degrees earned by students who choose to attend classes on campus.

Students enrolled in UH Engineering's online programs take the same classes as on-campus students, but in a digital environment, said JR Rao, director of online programs and extension services at the UH Cullen College of Engineering.

"The online and face-to-face classes have the exact same rigor, expectations and admissions processes," Rao said. "In fact, the online and in-person courses are taught by the same professors in many cases."

Many of the in-person classes are filmed and posted online for all students to view. Instructors post the materials, lectures, tests and assignments online for students to access at any time. Typically, all courses are available for download and viewing two hours after the live lecture has been captured.

The initial online course offerings were hand-picked to counteract critical shortages in engineering workforce talent in the city of Houston and across the nation, said Joseph W. Tedesco, Elizabeth D. Rockwell Dean of the UH Cullen College of Engineering.

"It is critical that the Houston region and the U.S. have the engineering talent required to address the grand challenges in energy, infrastructure and the environment facing our society," said Tedesco. "UH Engineering's online master's programs are a flexible and cost-effective option for working engineers to help fill those workforce gaps by acquiring specialized skills and earning advanced degrees."

Plans to launch additional online graduate programs in petroleum and industrial engineering are currently underway, Tedesco said.

UH Engineering also offers two fully-online certificate programs in subsea engineering, with more online certificate programs in development.

The University of Houston's Cullen College of Engineering, located in the Energy Capital of the World, is one of the nation's premiere destinations for engineering research and education. Ranked among the Top 100 best engineering colleges in the country by *U.S. News & World Report*, the Cullen College is home to some of the world's most prominent engineering researchers, centers, laboratories and cutting-edge research collaborations.

**FOR MORE INFORMATION**
on the UH Cullen College of Engineering's online learning programs, visit *onlinelearning.egr.uh.edu* ■





# SCHOLARSHIP HONORS A MAN DEDICATED TO CIVIL ENGINEERING AND CULLEN COLLEGE

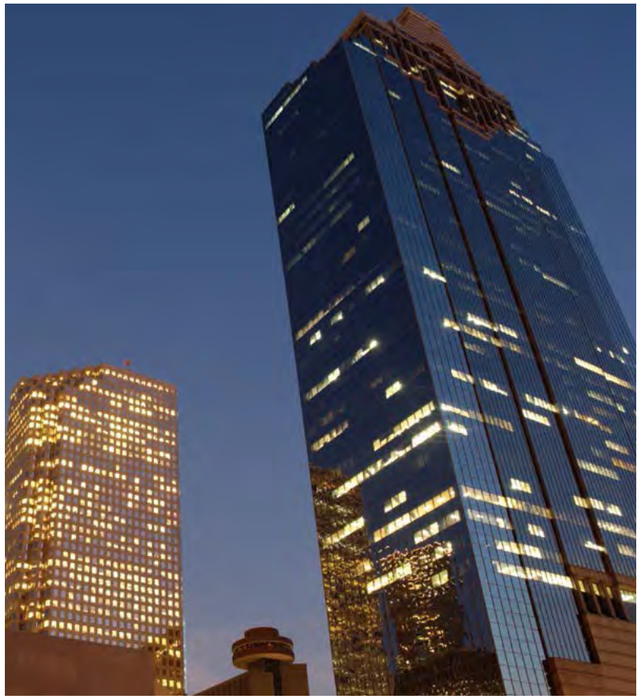
BY LAURIE FICKMAN

When proud UH Cullen College alumnus Charles Beyer passed away in May, his family shared one of Beyer's favorite mottos, which they said he imparted to anyone who met him: "The world is run by those who show up."

When it came to the UH Cullen College of Engineering, Beyer did much more than show up. Named one of the University of Houston's Distinguished Engineering Alumni in 2001, Beyer's name has been distinguished again – now with an endowed scholarship. The Charles A. Beyer Houston Contractors Association Civil Engineering Endowed Scholarship was established in honor of Beyer and his many contributions to the Cullen College thanks to the generous donations from the Houston Contractors Association as well as Beyer's family, friends and colleagues.

"We have received significant support from friends and family of Charles, which has allowed us the ability to create a permanent endowed scholarship in his name," said UH chief development officer Russell Dunlavy. "This is a true testament to his character and the number of family and friends that he meant so much to. Future engineering students who earn this scholarship will carry with them the legacy that Charles created and I hope they go out in the world and make an impact as big as Charles did."

The income distributed annually from the endowment will be used to provide scholarships in the Cullen College of Engineering to eligible juniors or seniors pursuing degrees in civil engineering. ■



# DEMAND FOR CIVIL ENGINEERS ON THE RISE

BY NATALIE THAYER

In the 2016 article "Demand for Biomedical, Civil Engineers Continues to Rise," the *Houston Chronicle* spotlighted the increasing need for skilled engineers in both disciplines across the nation.

Biomedical engineers work to improve the quality and effectiveness of patient care, exploring healthcare technology, management and delivery, and civil engineers contribute to environmental, structural and infrastructural projects, such as road repair and water management systems.

"Civil engineering is a very exciting field with lots of opportunities," said Fritz Claydon, director of the division of undergraduate programs and student success for the Cullen College of Engineering.

As the demand for improved healthcare and infrastructure support increases, employment opportunities for skilled biomedical and civil engineering professionals will continue to grow in response. According to the U.S. Bureau of Labor Statistics, employment of both biomedical and civil engineers is projected to grow much faster than the average for all other occupations from 2012 to 2022.

**VIEW THE FULL ARTICLE AT**
*www.chron.com/jobs/article/Demand-for-biomedical-civil-engineers-continues-6736291.php* ■

# HYONGKI LEE'S PLAN TO MONITOR WATER IS OUT OF THIS WORLD

By Laurie Fickman

If it has to do with water, you can bet Assistant Civil and Environmental Engineering Professor **Hyongki Lee** has an appetite whet for it. Fresh off the success of helping Pakistani officials manage water resources, he's at it again, selected by NASA to manage water for Indochina.

For Lee, it's an issue of fairness.

"Although essential for life, water resources are not fairly distributed among countries according to needs," Lee said. Especially, he added, in the Lower Mekong region where several countries share water resources. "We need to help them build a sustainable system for water management."

So to shore up water down below, Lee and company take data from high above, gathered by NASA. They then analyze and interpret it to see what impact it has on water systems. With NASA research funds behind him, he will build the toolbox to generate satellite-based water management products and applications that can routinely map, warn and enable decisionmaking on water-related vulnerability issues in low-lying deltas of Indochina.

Lee is the principal investigator (PI) on the project called "Building Lasting Capacity for Water Management in Vulnerable Deltas of Indochina." His co-investigator is Faisal Hossain of the University of Washington. The program is one of 16 selected by the NASA SERVIR program for funding and will receive $598,527 over the next three years. Derived from the Spanish word meaning "to serve," SERVIR "connects space to village" by helping developing countries use information provided by Earth-observing satellites and geospatial technologies to manage climate risks and land use, according to NASA.

> "WE USE THE SATELLITE DATA TO SOLVE SCIENTIFIC PROBLEMS."
>
> HYONGKI LEE

## WATER EVERYWHERE

Water might seem plentiful in the Mekong basin, since the Mekong itself is one of the world's longest rivers. But as the longest poem by English poet Samuel Taylor Coleridge will tell you, "Water, water, everywhere, nor any drop to drink."

Lee isn't the Ancient Mariner – but he'll tell you why Coleridge is right. He points to construction of dams higher upstream in countries in the Mekong Basin. While they build dams for more access to water, many of the downstream countries, like Vietnam, may get squeezed with not much rolling downhill.

It's no small problem considering the Mekong River flows through many countries. For example in Cambodia, residents mostly eat fish and depend on it as their main source of protein.

"But if the upstream country builds a dam, it's going to block the migration of fish," said Lee. "That means they have new problems related to their own food security." Lee said increasing capacity in the use of NASA's satellite data that can provide complementary hydrologic variables with unprecedented accuracy is urgently needed.

The low-lying deltas are also vulnerable to water availability due to dense population and extensive irrigation. That makes groundwater the go-to supply to supplement surface water stocks for irrigation and domestic use. But like a precarious house of cards, over-exploitation of groundwater has led to land subsidence and increased the risk of flood. When you throw in climate change and the inability of other riverside countries to manage water resources, you have the perfect storm.

## MAKING IT LAST

Lee is keen on institutionalizing the project, so that it is sustainable and can be utilized by end users after the project is completed. In fact, his biggest goal is to walk away.

"SERVIR has different application readiness levels. Our goal is to reach the highest level, which means our tools have been implemented by the stakeholder agencies for their decisionmaking, and they do not rely on us after the project ends," said Lee.

They may not rely on him after he has taught them how to interpret the data, but they will long remember his work in making information understandable and water accessible to those who need it most. ■

# UH ENGINEER DIVES IN TO DETERMINE HOW MUCH WATER EXISTS IN THE WORLD

By Laurie Fickman

**Hyongki Lee**, assistant professor of civil and environmental engineering at the Cullen College, is making quite a splash. Lee has accomplished so much in the field of water you could say he's all over the map, but soon his work will be high above the map. He's helped Pakistani officials manage water resources and was selected by NASA to do the same in Indochina. Now NASA has come calling again, making Lee part of the pre-launch team for their Surface Water & Ocean Topography (SWOT) satellite mission – set to go airborne in 2020 – to conduct the first global survey of Earth's surface water.

No satellite mission has ever been designed to specifically examine surface water – SWOT is the first of its kind. In 2007, the National Research Council Decadal Survey of Earth Science selected it as one of the missions that NASA should implement in the next decade.

According to NASA, the SWOT mission, which is a joint venture with CNES, the French space agency, "will provide the very first comprehensive view of Earth's freshwater bodies from space and will allow scientists to determine the height and area of fresh water across the globe at an unprecedented resolution."

**MAYBE IT'S TIME**

The truth is no one really knows how much water we have on Earth or understands much about its movement. "We don't have much clue," said Lee.

Come 2020, after the SWOT satellite mission gathers its data of freshwater storage changes in global lakes, he hopes to have more than just a clue – especially about the Mississippi Basin, which is the portion of the mission he is examining.

"How much water we have in the world is a fundamental question and mystery of science," said Lee. "We need to first have a holistic picture of where water is and how much there is. Those are the questions we need to answer to have proper resource management."

To help find the answers, NASA will give Lee $80,000 over the next four years. The principal investigator (PI) is Edward Beighley of Northeastern University and two other co-PIs come from Ohio State University and the Jet Propulsion Laboratory.

*Digital rendering of the Surface Water & Ocean Topography (SWOT) satellite.*
*Thales Alenia Space*

**BUT FIRST, MATH AND COMPUTER SCIENCE**

The very trajectory of the satellite, or orbital design, is something Lee has had a hand in developing. In 2010 he helped determine which way the SWOT satellite must travel to get that holistic look at the world's terrestrial surface waters.

Now Lee has switched his own trajectory, concentrating on developing the scientific algorithm that will determine water discharge amounts. The satellite will gather the data and then go through the formula being developed by Lee and his colleagues.

"The algorithm will make the information readily accessible and usable," said Lee.

To create the algorithm, Lee and his colleagues will use SWOT-like data, simulating and predicting the information SWOT will eventually deliver. To develop the SWOT-like data, the team will use existing satellite measurements including lake storage changes, river level elevation data, precipitation data and a hydrology model.

"Once we have all this we can think about what kind of algorithms to use to calculate the river discharge from the real SWOT data," said Lee.

**AN INTERNATIONAL MIX FROM ABOVE**

When the math is delivered, NASA will use it to continue planning the mission. Then, in 2020, high above our heads, SWOT's eyes in the sky will observe the details of our surface water and measure how all the bodies of water change with time.

Those details will be delivered to the mission alliance, comprised of U.S. and French oceanographers, hydrologists and other international partners who have been with the project since the concept was first developed in the early 2000s.

If measured in time, the project has taken a good bit, but in this water-thirsty world the need for basic information about this precious natural resource is incalculable.

"Using data from the SWOT satellite mission, our expectation is to have a more complete understanding of surface water distribution and volume changes," said Lee. ■

> "HOW MUCH WATER WE HAVE IN THE WORLD IS A FUNDAMENTAL QUESTION AND MYSTERY OF SCIENCE."

# MICHIGAN WATER CRISIS INSPIRES UH RESEARCH ON LEAD IN WATER LINES

By Natalie Thayer

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

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

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

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

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

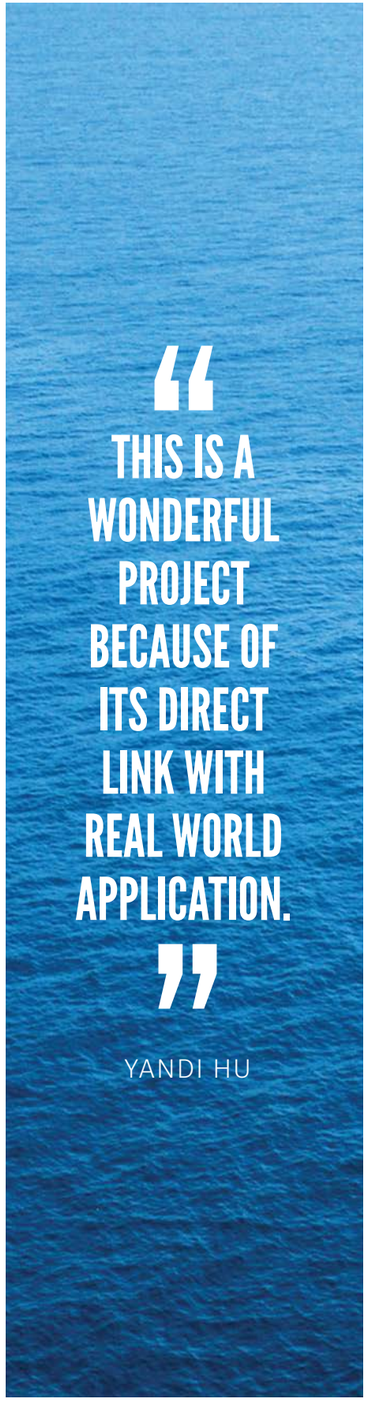
When the city of Flint changed water sources, a corrosion inhibitor was not added to the highly corrosive waters of the Flint River. Subsequently, the untreated water dissolved the pre-existing lead phosphate mineral scales inside the pipes, exposing the lead pipes directly to the corrosive water. As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

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

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

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

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




*Yandi Hu tackles one of the energy industry's biggest challenges*

# ENVIRONMENTAL ENGINEER BOOSTS OIL PRODUCTION EFFICIENCY WITH DEPARTMENT OF ENERGY GRANT

By Natalie Thayer

A researcher at the UH Cullen College of Engineering is collaborating with researchers from multiple universities and national labs on a major Department of Energy (DOE) project to tackle one of the biggest challenges in the energy industry – controlling mineral scaling to improve oil production efficiency.

Everyone with a water faucet knows the nuisance of limescale, the chalky deposits of minerals that tend to build up inside of water heaters, pipes and pots. If left untreated, limescale can obstruct the flow of water through pipes and cause serious damage to various components of water lines and water heating systems.

Similarly, mineral scaling inside of oil wells poses significant obstacles to efficiently extracting energy resources. Naturally-occurring minerals inside of oil wells can collect on the surface of rocks, equipment or pipes, forming a coating similar to limescale. The build up of mineral scale inside of oil wells can drastically hinder the flow of oil out of the well and compromise the effectiveness of oil production equipment.

**Yandi Hu**, assistant professor of civil and environmental engineering, was awarded a three-year, $204,000 research project to study the growth of barium sulfate, a scale-forming mineral commonly found inside of oil wells and reservoirs. Hu serves as a co-principal investigator (PI) on the project, which is led by PI Andrew Stack of Oak Ridge National Laboratory. The goal of Hu's research group is to reveal the fundamentals of barium sulfate scale formation to better control mineral scaling in oil production processes and sites.

"We're looking at the nucleation and growth – the initial stages – to understand how barium sulfate starts to form on the rocks' surfaces," she said.

Barium sulfate scaling occurs inside an oil well when the mineral precipitates. In severe cases, the scaling can form solid mineral deposits on the surface of production equipment and inside of production piping, rendering the equipment ineffective and sometimes plugging the piping completely.

Even in milder cases, the precipitation of barium sulfate causes massive headaches for oil producers. In the hydraulic fracturing process, where liquid is injected at high pressure into shale, a thin layer of oil-rich rock, scaling can restrict or block the flow of oil through the rock's tight pores and cracks. Although scale removal is common for oil well operation, current methods are costly and limited in effectiveness. Producers can add polymers, for instance, to inhibit the production of barium sulfate, but the method is expensive and difficult to control, sometimes even leading to a permanent decrease in oil production in a reservoir.

Hu will conduct laboratory experiments on synthetic organic coatings on rock surfaces to understand the fundamental growth mechanisms of barium sulfate mineral scale formations in oil and gas reservoirs at the molecular level. Her experiments will take into account various conditions, such as the presence of impurity ions like Strontium and Radium, as well as the presence of inhibitors and other organic materials inside of the well that could impact scale formation.

"Once we have such fundamental understanding, we can better predict and control what's happening in the subsurface environment," she said. "With this data we can give some useful suggestions about the selection of the operation conditions and how industry can design the appropriate inhibitors. We are providing the basis for further applications." ■

# WIRED MAGAZINE TALKS TO UH CIVIL ENGINEER ABOUT WORLD'S LARGEST INDOOR WATERFALL

By Natalie Thayer

Singapore's Changi Airport, voted the world's best airport for the fourth consecutive year, already offers travelers a wide array of top-notch amenities, including a rooftop pool, 24-hour cinema, butterfly garden and multiple spas. But in 2018, the airport will unveil its newest attraction – the world's tallest indoor waterfall called the Rain Vortex.

The nine-story waterfall, designed by architect Moshe Safdie, will be housed in a glass donut-shaped building and will use rain water collected from the airport's rooftop.

To learn more about the complex engineering required to realize this design, *WIRED Magazine* interviewed UH Cullen College of Engineering associate professor Arturo Leon, a civil and environmental engineer who specializes in hydraulic engineering. Leon spoke to *WIRED* about the structure and design of weirs – barriers that look like miniature waterfalls commonly used to alter the flow of rivers.

"The hydraulics are very simple, but the architecture is very, very impressive," said Leon. It's the conceptual leap from small weirs to the massive Rain Vortex that makes the whole project interesting, writes *WIRED*'s Sarah Zhang.

< *Scale model of the Rain Vortex.*

*Image credits: Changi Airport and Safdie Architects*

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*WIRED Magazine* explores the impact of emerging technologies on business, culture, design, products, science, security and transportation. The magazine boasts a monthly circulation of nearly 1 million. ■


**Published in *WIRED Magazine's* September 2016 issue**



# 'SMART' CEMENT COULD TALK TO ENGINEERS ABOUT WELL CONDITIONS

By Jeannie Kever

*Photo Credit: Jessica Villarreal*

With the rattle and hum of a giant drilling bit churning through clay, a new frontier in oil and gas exploration began at the University of Houston last spring.

A 40-foot well, designed to test "smart" cement developed by **Cumaraswamy Vipulanandan,** professor of civil and environmental engineering, was drilled on the outskirts of the University's Energy Research Park, a complex of research labs, technology incubation space and administrative offices just two miles from the main campus.

The results could be far-reaching. Knowing where to find oil or natural gas is the first step in drilling a successful well, but what happens next – and how those next steps are performed – is crucial.

Vipulanandan's smart cement is a new piezoresistive material that can be monitored from an offshore platform thousands of feet above the well or even from hundreds of miles away. He is also developing the monitoring system.

Cement slurry is pumped into a well to hold the casing to the natural geological formations, as well as to isolate the formations, even thousands of feet under the ocean floor.

"Currently, how do you know the cement is setting?" Vipulanandan asks. "You don't know. With smart cement, you can monitor it."

The cement has been tested in the lab, but the test well will allow the researcher and graduate students working with him to see how it works under more natural conditions.

Smart cement isn't regular concrete studded with sensing materials – Vipulanandan said embedding sensors in the cement mixture would result in weaker cement. Instead, the sensing materials – less than 0.1 percent by weight – are actually incorporated into the mixture, forming a "bulk sensor" with sensing properties several hundred times higher than current cements. The performance is further enhanced using nanotechnology and surfactant technology.

The modifications enhance the mechanical properties of the smart cement, without affecting the rheological properties.

The sensors measure changes within the material, allowing those who monitor the well to determine if it has set or is cracking, if pressure is increasing and other performance variables.

Cement's critical role in offshore wells came into sharp relief after the 2010 Deepwater Horizon explosion, which killed 11 people and spilled almost 5 million barrels of oil into the Gulf of Mexico. Regulators and government investigative panels found the accident was caused by deficient cementing.

Smart cement could help to avoid similar accidents.

Vipulanandan, director of the Center for Innovative Grouting Materials and Technology at the Cullen College of Engineering, as well as director of the Texas Hurricane Center for Innovative Technology, began working on the cement in 2012 with a $2.6 million grant from the Department of Energy. Oilfield services company Baker Hughes provided additional funding.

Vipulanandan compares the smart cement to the sensors in your skin. "When someone touches you, it will tell you when they do it, how much pressure they are applying," he said.

But the brain might be a better analogy, as the cement reports its status to engineers and other monitors: Is it curing? Has it set? Has there been fluid loss or circulation loss? Are cracks forming that could allow hydrocarbons to escape?

And that reporting doesn't stop once the well begins pumping oil or natural gas, Vipulanandan said.

"People can monitor the cement throughout its entire lifetime." ■

# NANO-SIZED TECHNOLOGY IMPROVES GLOBAL ACCESS TO CLEAN WATER

*The team with a thirst for healthy water (from left): Eric Beydoun, Ivette Rubio, Debora Rodrigues, Enrico Nadres, Maria Rodriguez-Moya*

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

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

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

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

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

Rodrigues serves as an advisor to the team, which also includes Enrico Nadres, a UH chemistry alumnus serving as lead scientist, and Maria Rodriguez-Moya, a Rice University alumna who serves as lead chemical engineer. For their efforts, the UH team was named to the 2015 list of 50 Young Entrepreneurs Aiming to Change the World by *Inc. Magazine*. WAVVE also won business plan competitions in Houston, Nassau, Bahamas and Paris, France. The UH RED Labs startup accelerator accepted the business in 2014, and the H2o Challenge, an aquatech startup accelerator based in Madrid, Spain, admitted the business in 2015.

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

Last year WAVVE received Stage I and II grants from VentureWell through its three-stage E-Team Program. VentureWell is a non-profit organization that strives to help an emerging generation of young scientists launch ventures that improve life for people and the planet. WAVVE received $5,000 to invest in their invention as Stage I recipients, and $20,000 for their Stage II prize. ■

# UH ENGINEER INVESTIGATES GEOLOGIC CARBON SEQUESTRATION TO COMBAT CLIMATE CHANGE

By Natalie Thayer

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

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

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

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

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

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

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

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



# UH ENGINEER FOCUSES ON IMPROVING QUALITY OF BRIDGES

By Jeannie Kever

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

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

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

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

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

That uneven spacing makes the cap more likely to crack, driving up maintenance costs.

Mo proposed a unique way to uniformly distribute the rebar throughout the entire skewed bent cap. He said that's never been tried and computer modeling suggests reduced costs for design, construction and maintenance will be about 30 times greater than the cost of the research.

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

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

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

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

## BY THE NUMBERS:

**10%**

OF U.S. BRIDGES WERE CONSIDERED STRUCTURALLY DEFICIENT LAST YEAR

SOURCE // American Road and Transportation Builders Association

# CIVIL AND ENVIRONMENTAL ENGINEERING CHAIR DELIVERS LECTURE IN VIENNA

By Audrey Grayson

**Roberto Ballarini**, Thomas and Laura Hsu Professor and Chairman of the department of civil and environmental engineering at the Cullen College, was invited to deliver a lecture at the Technical University of Vienna last May on strategies for cultivating a multidisciplinary environment in education and research.

Ballarini, who is well-known for bringing a cross-disciplinary flair to his academic and research pursuits, was invited to deliver the lecture as part of the Technical University of Vienna's "Vision 2025 Forum," which brings together experts from a variety of backgrounds to exchange ideas and reflect on ongoing questions in research, teaching and the social role of the university.

Although Ballarini's primary background lies in the mechanics of materials and structures, his research has been published in a wide variety of top journals, covering topics ranging from biophysics and dentistry to aeronautics and microelectromechanical systems.

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

In his talk, Ballarini used an example from his experience as a researcher to segue into the importance of nurturing multidisciplinary interactions within the education and research environments. Specifically, Ballarini studied seashells' resistance to catastrophic cracking and fracturing in order to apply these biological lessons to modern-day structures and infrastructures.

The talk concluded with some suggestions of mechanisms that can be created and sustained within an academic environment that will encourage, nurture and enable multidisciplinary pedagogy and research, Ballarini said. ■

# UH RESEARCHER RECOGNIZED FOR WORK IN CLEAN ENERGY

By Jeannie Kever

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

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

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

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

Most available water treatment technologies require several steps, which raise the cost. Reverse osmosis, for example, effectively removes contaminants but requires huge amounts of energy.

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

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

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

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

**"I LOVE RESEARCH," SHE SAID. "I LIKE TO BE WITH MY STUDENTS. I THINK I CAN MAKE A DIFFERENCE FROM HERE."**

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

# CENTER FOR INNOVATIVE GROUTING MATERIALS' ANNUAL CONFERENCE ADDRESSES CRUCIAL INFRASTUCTURE CHALLENGES

By Audrey Grayson

The Center for Innovative Grouting Materials & Technology (CIGMAT) held its annual conference at the UH Hilton this March. The theme of the conference was "Infrastructures, Energy, Geotechnical, Flooding and Sustainability Issues Related to Houston & Other Major Cities."

Over 250 leading industry professionals, researchers and government policymakers from across the country came together at the conference to discuss the most pressing current challenges facing the construction, maintenance and sustainability of various civil infrastructures in the Houston region and beyond. Energy production and related issues were also discussed.

The one-day conference also included presentations on current projects and proposed projects that specifically address challenges for the region's infrastructure and energy production needs.

Conference speakers included Dale Rudick, director of the City of Houston's Public Works and Engineering Department; Bill Brudnick, director of planning at TxDOT; John Tyler, deputy director of the Harris County Toll Road Authority; Kenneth Tand, CEO of Kenneth Tand & Associates; and Jason Pettrey, department head for ExxonMobil's Beaumont refinery, among many others.

**Cumaraswamy Vipulanandan,** professor of civil engineering at the Cullen College, is the director of CIGMAT and a leading expert in the field of smart materials. Over the past four years, Vipulanandan and his colleagues at CIGMAT have received more than $3 million in funding from the non-profit Research Partnership to Secure Energy for America, (RPSEA), the U.S. Department of Energy (DOE), and oil field services firm Baker Hughes to develop new types of cementing and drilling materials for use in oil rig operations. Such materials could also be used to increase the resilience and sustainability of aging infrastructures.

**FOR MORE INFORMATION ABOUT**
CIGMAT conferences, please visit
*cigmat.cive.uh.edu* ■

# CIVIL AND ENVIRONMENTAL DEPARTMENT WELCOMES FOUR NEW FACULTY MEMBERS

**Egor Donstov, *Assistant Professor***

Donstov joined the Cullen College faculty after a postdoctoral fellowship in the math department at the University of British Columbia in Canada. He has published multiple papers and delivered numerous presentations relating to his areas of research, including hydraulic fracturing, gradient elasticity, nonlinear ultrasound and acoustic radiation force. He earned his doctoral degree in civil engineering from the University of Minnesota in Minneapolis.

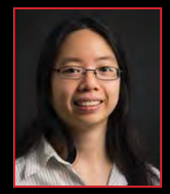
**Konrad Krakowiak, *Assistant Professor***

Krakowiak comes to UH from the Massachusetts Institute of Technology where he served as a research assistant in the Concrete Sustainability Hub, an industry-university partnership dedicated to advancing the technology transfer from concrete nanoscience into engineering practice. He is particularly interested in improving civil infrastructure through synthesis, mechanics and durability of construction materials to address critical issues of our built-in environment. He received his Ph.D. in civil engineering from the University of Minho in Portugal and his M.S. in theory and computer analysis of structures at Warsaw University of Technology.

**Arturo Leon, *Associate Professor***

Leon's research interests include areas tailor-made for Houston: resilient approaches to flood control, optimal reservoir operation under uncertainty, sustainable storm water management, hydraulic systems and modeling. Before joining the Cullen College, he served as assistant professor in the school of civil and construction engineering at Oregon State University. He holds a 2000 M.S. degree in hydraulic engineering from National University of Engineering in Peru and a 2007 Ph.D. in civil and environmental engineering from the University of Illinois at Urbana-Champaign.

**Stacey Louie, *Assistant Professor***



Louie earned her 2014 doctorate from Carnegie Mellon University in Pittsburgh, Pennsylvania, where she wrote a thesis entitled "Characterization and modeling of macromolecules on nanoparticles and their effects on nanoparticle aggregation." She received an NRC Postdoctoral Fellowship at the National Institute of Standards and Technology and served as Highlights Editor of the Royal Society of Chemistry journal, *Environmental Science: Nano*. She also holds memberships in the Association of Environmental Engineering and Science Professors (AEESP) and the American Chemical Society (ACS). ■

# A 'BARREL' OF FUN AND SCIENCE

## FOR CULLEN COLLEGE STUDENTS LAUNCHING PAYLOADS

By Laurie Fickman

**It actually does take a rocket scientist to be a rocket scientist.**

Case in point: Professor of physics and electrical engineering at the UH Cullen College of Engineering **Edgar Bering**, whose business card really does say he's a rocket scientist – and for good reason. He's been working with NASA on sending things airborne for decades. Now he's traveled to Sweden where he and his students watched their payload launch in NASA's fourth BARREL balloon campaign mission. Bering was joined on this quest by three colleagues, associate professors Jinghong Chen, electrical and computer engineering, and **Craig Glennie** and **Debora Rodrigues**, both civil and environmental engineering.

BARREL stands for Balloon Array for Radiation-belt Relativistic Electron Losses and its purpose is to study the Van Allen belts, two huge radiation bands circling the globe. The radiation belts do most of their damage to spacecraft flying through them, which is why the space station's orbit is selected to minimize its exposure to the radiation belts, but some of their particles are flung out into space.

"The particles in the radiation belts don't stay there forever. They're eventually lost to the atmosphere," said Bering. That process of loss is called precipitation, like a rain of radiation from the upper atmosphere. To understand their atmospheric impact, NASA and company measure X-rays produced by electrons from the Van Allen belts.

"What we're trying to do is understand how the radiation belts are created and filled and how and why the particles are lost," said Bering. Lost particles can wreak havoc on satellite systems, knocking them out instantly.

*Credit: NASA/Dartmouth/Alexa Halford*

"These killer electrons kill satellites," said Bering. Getting a handle on the activity of the belts and precipitation will help predict whether satellites will be lost during a certain atmospheric event. "If you know that, you can turn the satellites off to prevent it," he said.

### PUTTING UNDERGRADS TO WORK

And who better to work on such a heady project than the next generation of rocket scientists: Cullen College undergraduates taking part in NASA's Undergraduate Student Instrument Project (USIP), which provides real-life earth or space science flight project experience.

Samar Mathur, a junior in mechanical engineering, and Michael Greer, a senior in mechanical engineering, joined Bering's very low frequency (VLF) team. "Our goal was to create the proper instrumentation, a VLF circuit, to gather the data, to read and process the waves," Mathur said. They also built a complicated timecode circuit, called the IRIG-B, which keeps track of the exact time when data is actually gathered.

The work was intense, beginning in May for an August launch.

"Michael and I are mechanical engineers," said Mathur. "We knew nothing about electricity coming into this, except basics, but nothing about circuitry."

Greer agreed. "It was a lot of us sitting in the lab, changing out resistors, researching filters ourselves, banging our head against the wall – that's when we would go talk to Dr. Bering," he said.

That's very much Dr. Bering's style, said Mathur. "He's taught us to learn trial by fire and then come to him when we're stuck."

"I lit fires with these students," said Bering proudly. "But they did it and I'm incredibly proud."

Christian Behrend, also a senior in mechanical engineering, worked on building the receiver that would actually listen to the VLF hiss in the atmosphere, made up of the electron precipitation.

"We repaired a VLF receiver that already existed and redesigned the antenna," said Behrend.

### BLASTOFF

The balloons, carrying the Cullen College payloads, were launched at the Esrange Space Center near Kiruna, Sweden, nearest to the Northern Lights, or Aurora Borealis. Since the aurora is the result of electrons colliding with the upper atmosphere it's the best place to measure electron movement.

Takeoff launched the students into a world of excitement. Said Behrend, "It's really satisfying to make and put something on a payload and then watch it leave while you're thinking, 'That's the thing that I did!'"

The entire group shared that sense of accomplishment.

Mathur said, "Honestly, when we were going to Sweden, we were in the airport and I was like, 'Wait, what are we doing here?'"

Equally elated, Greer said he also felt a bit uneasy. "It is a little bit scary watching everything we've worked on just float away, but it's really a great feeling."

### THE FINAL ANALYSIS

Uncovering the results of the data collection comes next. Soon Bering and his students will open up the files to interpret the data collected. But one thing is already certain, according to Bering, and that's the success of USIP.

"I am extremely proud of the entire USIP project. My colleagues and I have put together a program of instruction in science and engineering that is unmatched," said Bering.

Interestingly, he actually radiates with excitement when he speaks of it. ■

*Photo Credit: NASA/University of Houston/Edgar Bering*

# CIVIL ENGINEERING STUDENT EARNS COVETED MELOSH MEDAL

By Natalie Thayer

Former civil and environmental engineering student **Maruti Kumar Mudunuru** was awarded the Robert J. Melosh Medal for his doctoral dissertation in the area of finite element methods and computational mechanics.

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

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

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

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

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

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

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

# A RARE BREED: UH STUDENT CHOSEN FOR PRESTIGIOUS COMPUTER TRAINING PROGRAM

By Audrey Grayson

A doctoral student at the UH Cullen College of Engineering was one of only 65 participants selected to attend the 2015 Argonne Training Program on Extreme-Scale Computing (ATPESC) funded by the U.S. Department of Energy's (DOE) Office of Science.

Civil engineering student **Justin Chang** traveled to St. Charles, Illinois for the intensive two-week training program, which provided hands-on training on the key skills, approaches and tools to design, implement and execute computational science and engineering applications on current supercomputers and the high-performance computing (HPC) systems of the future.

"I was delighted to have found that I was chosen considering how selective this training program is," Chang said. "This program will let me stay up-to-date with the latest technologies, trends and innovative ideas within the high performance computing community."

Chang's advisor, Kalyana Nakshatrala, a civil and environmental engineering assistant professor, said that although civil and environmental engineering and high performance computing may not seem so compatible, the fields often go hand in hand. "Highly sophisticated computer modeling is necessary for many civil and environmental engineering projects," Nakshatrala said.

Take Chang's research, for example: as a doctoral student at UH, Chang developed sophisticated computer models and numerical methods for subsurface flow and transport modeling. Satish Karra, a staff scientist in the Earth and Environmental Sciences Division of the Los Alamos National Laboratory (LANL) who worked with Chang last summer, said that Chang's "state-of-the-art algorithms are vital for our group's research in modeling aspects of carbon sequestration, groundwater contamination, hydraulic fracturing and nuclear waste disposal."

"It feels incredible to have come from a civil engineering background and still be selected for this two-week crash course on important topics in extreme-scale computing," Chang said.

Prior to the course, Chang received the U.S. DOE's Office of Science Graduate Student Research (SCGSR) Award. The SCGSR program provides supplemental awards to support part of a graduate student's thesis research to be conducted at a DOE laboratory. After completing the ATPESC program, Chang travelled to LANL in New Mexico for five months to write scientific code and study the computational efficiency of these numerical methods on state-of-the-art HPC systems.

Chang said that completing the ATPESC program just in time to travel to LANL to complete his graduate student research was a huge boost to his education and his research.

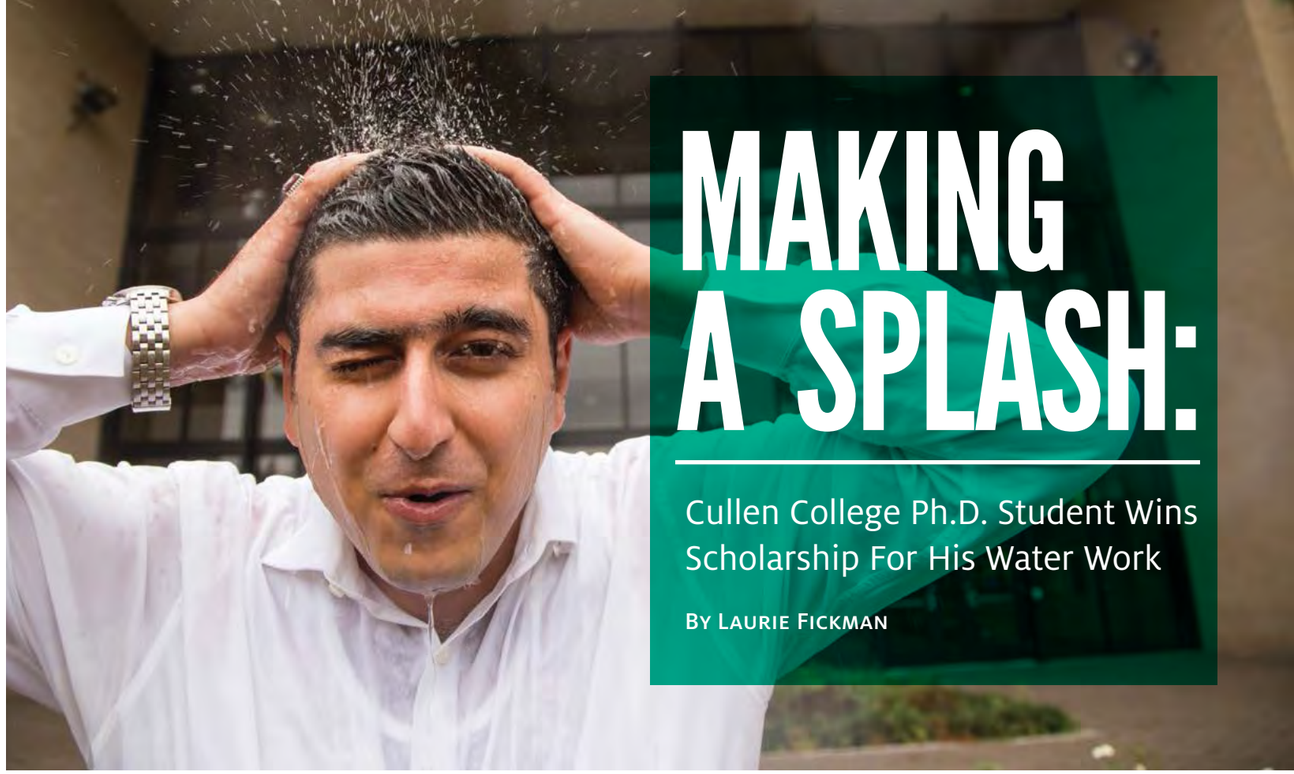
"ATPESC gave me excellent exposure to how the technologies are moving towards extreme-scale computing and how my codes can be adapted to this change," he said. "I believe that this training program gave me the essential knowledge and the required skill set, thereby boosting my background in HPC needed for my research."

Another huge benefit of the training program, Chang said, was meeting the 64 other participants, who included scientists, postdocs and doctoral students, as well as the leading experts who guided the ATPESC training sessions.

"It is a rare opportunity to learn from and network with top computational scientists from around the world," he said. ■

> "HIGHLY SOPHISTICATED COMPUTER MODELING IS NECESSARY FOR MANY CIVIL AND ENVIRONMENTAL ENGINEERING PROJECTS."
>
> KALYANA NAKSHATRALA





# MAKING A SPLASH:

## Cullen College Ph.D. Student Wins Scholarship For His Water Work

By Laurie Fickman

As a Ph.D. student in environmental engineering, **Amin Kiaghadi** already has a patent under his belt and won awards for his idea of how to treat "produced water," the dirty, non-usable water created during hydraulic fracturing. Now Kiaghadi can add scholarship recipient from Texas American Water Works Association Southeast Chapter to his burgeoning list of credits.

Kiaghadi, from Iran, studies the climate intensely to develop his concepts and chose Houston for his graduate work, also with the climate in mind.

"I hate cold weather," Kiaghadi said with a big grin. So he narrowed his graduate choices to warmer American cities and Professor Hanadi Rifai, director of the environmental engineering graduate program and associate dean of research and facilities at the college, won him over.

"She's was a perfect match for my research interests and she is so supportive and generous, even allowing me to file my own patent," he said.

**IT SEEMS THE SENTIMENT RUNS BOTH WAYS.**

"Amin is one of the top students in the environmental engineering program," said Rifai. "He has boundless energy and passion for research and for teaching. I foresee a great academic career in his future."

Kiaghadi models water quality, using either developed software or programs and codes he writes himself.

**DIRTY WATER, A SOLUTION AND PATENT**

In 2015, the challenge Kiaghadi met was creating a way to utilize the unusable water produced as a byproduct of oil and gas wells and exploration.

"It's super dirty, super salty – seven times saltier than sea water," said Kiaghadi. Current practices call for disposal of such water into deep injection wells below the ground. Kiaghadi says that process may just cause more problems and treating that water is too expensive.

So Kiaghadi had a better idea: to use the heat from the earth (geothermal energy) from existing oil and gas wells to treat the water. He and his colleagues developed a process to harness that energy to distill the water.

"Then that water can be used for agriculture or industrial use, and that's what the patent is about. No one ever thought before about using existing or abandoned oil and gas wells to harness geothermal energy for treating water," he said.

That could be why Kiaghadi continues to win awards, like this $1,500 scholarship.

He's got other ideas, too, just waiting to be tested. He explains the inequality of water distribution in the world and predicts water to be a major crisis in the next 10 years.

"My research emphasis is on water but also the nexus of water and energy, the relationship between the two," he said. "You cannot separate them nowadays. You need energy to treat that water and you need water to produce energy. You always need both. I'm trying to expand the horizons and come up with new ideas to – I think – save the world."

He may need another scholarship for that. ■


# UH TEAM WINS THE TEXAS ENERGY INNOVATION CHALLENGE

By Jeannie Kever

*Photo Credit: Justin Cross/The Daily Cougar*

Graduate students from the University of Houston won top honors in the 2015 Texas Energy Innovation Challenge with a plan to harness geothermal energy to treat water produced during hydraulic fracturing.

The competition featured five teams of graduate and professional students from across the state, tasked with researching and developing the most creative and cost-effective use for water produced from the hydraulic fracturing of wells.

As the first-place winner, the UH team won $10,000 in scholarship funding. Each team was made up of graduate students from engineering, business and law; the other teams were from Texas A&M University, the University of Texas at Austin, UT-El Paso and Texas Tech University.

Hydraulic fracturing uses sand, water and chemicals, pumped at high pressure into a well, to fracture the dense rock formations and release oil and natural gas, with millions of gallons of water returning to the surface along with the oil or gas. There is a growing desire to recycle or reuse that water, although the cost has kept many companies from doing so. Most inject the water into disposal wells.

But concern about disposal wells – studies have linked wastewater disposal to small earthquakes, and many shale plays are in water-scarce regions – has spurred a search for new ideas.

The competition was sponsored by Power Across Texas, an organization seeking solutions to critical energy concerns, with a panel of judges from the energy industry.

UH team members, using the name GeoTherm$H_2O$, proposed to harness geothermal energy from decommissioned wells to reduce the cost of water treatment.

Team members include **Amin Kiaghadi** and **Rose Sobel,** both Ph.D. candidates in environmental engineering, Shanisha Smith, a lawyer who just completed a Master of Law degree, and Varun Sreenivas, an MBA student specializing in energy finance and the energy supply chain.

Faculty advisors included Hanadi Rifai, professor of civil and environmental engineering; Zachary Bray, assistant professor of law; Radha Radhakrishnan, clinical assistant professor in decision and information sciences, and Konstantinos Kostarelos, associate professor of chemical and biomolecular engineering. Executives from Houston-based Rockwater Energy Solutions served as industry mentors.

The team's research found that while membrane and distillation technologies provide the highest quality water treatment, both require huge amounts of energy, making treatment more expensive than disposal.

Under their plan, a closed loop system using a small volume of freshwater would be recirculated in the decommissioned well to power a desalination unit, capable of cleaning and recovering about 70 percent of the water. That treated water could become an inexpensive, drought-resistant source of water for agricultural and nonpotable municipal use.

The team also called for tax credits for water recycling and increasing the cost of disposal as a way to spur the use of the new technology. ■



# CIVIL ENGINEERING STUDENT WINS PRESTIGIOUS NASA EARTH AND SPACE SCIENCE FELLOWSHIP

By Audrey Grayson

**Ting Yuan**, a civil engineering Ph.D. student at the UH Cullen College of Engineering, won NASA's Earth and Space Science Fellowship (NESSF) for the 2015-2016 academic year. The award provides a maximum of $30,000 in funding each year for up to three years. Out of 391 earth science proposals submitted to the NESSF program, only 64 were chosen to receive the prestigious fellowship.

According to NASA, the purpose of NESSF is to ensure continued training of a highly qualified workforce in disciplines needed to achieve NASA's scientific goals.

The fellowship provided funding for Yuan's research investigating surface water fluxes over the Congo River Basin using one-dimensional and two-dimensional linear diffusion models combined with satellite remote sensing data. Yuan began working on this research with her faculty advisor, assistant professor Hyongki Lee, in 2012.

With a surface area of approximately 3.7 million square kilometers, the Congo River Basin is the second largest river basin in the world, surpassed only by the Amazon. Compared to the Amazon, though, the Congo Basin is still a mystery. Its remote location combined with political instability in the region has prevented researchers from gathering even the most basic information about the hydrology and hydrodynamics of the Congo's waters and their connections to global climate change.

Until now, many researchers hypothesized that the hydrology and hydrodynamics of the Congo floodplains were similar to those of the Amazon, Lee said. However, by combining synthetic aperture radar images, satellite altimetry data and multispectral images collected from NASA, the Japan Aerospace Exploration Agency (JAXA) and the European Space Agency (ESA), Yuan was able to show that these wetlands are very different from the Amazon Basin.

"What we see is that most of the water stored in the floodplains in the Congo River Basin are from upland runoff or direct rainfall," Yuan said. "In the Amazon, the floodplains are filled mostly from the river itself rather than from runoff. So, the Congo Basin is quite opposite from the Amazon Basin."

By integrating the different satellite data sets with the hydrology and hydrodynamics model that she developed, Yuan was able to produce 2D, high-resolution water level maps illustrating the water levels throughout the Congo floodplains. After rendering of the 2D models is complete, Yuan will be able to quantify the fine-scale hydrologic fluxes in the floodplains and investigate their seasonal and annual variations.

"By completing this research we will have a better understanding of global hydrology by understanding the Congo River Basin," said Lee. "The hydrology of the Congo Basin has an impact on climate change as well as the global water cycle, and we will have answers to many of those questions by the end of this research."

Moreover, because the floodplains of the Congo Basin receive most of its water from upland runoff rather than the river itself, damming projects along the Congo River may not have as much as an environmental impact in the wetlands as it would in the Amazon Basin.

This insight is particularly significant considering hydropower generation projects proposed in the Congo Basin, such as the Inga dam. The Grand Inga project has the potential to provide power to almost the entire African continent, generating twice the power of the Three Gorges Dam in China. The proposed dam would be located about 30 miles from the mouth of the Congo River, where powerful waterfalls and rapids are located.

"This work can help regulators make important decisions about hydropower generation projects in vital basins such as the Congo," Yuan added.

Yuan said she hopes to continue her research in her career after graduation from the Cullen College, but remains open to job prospects in industry as well. "I received a lot of guidance from Dr. Lee. He is very supportive and I learn a lot from working with him," Yuan said. "I feel well prepared for what might be next [after completing my Ph.D.], so I am quite open to career options." ■

# UH COMMUNITY MOURNS PASSING OF RESPECTED ENGINEERING ALUMNUS AND SUPPORTER

By Audrey Grayson

The University of Houston community mourns the loss of **Charles Beyer** (BSCE '72, MSCE '77), a distinguished alumnus and dedicated supporter of the UH Cullen College of Engineering. Beyer passed away on April 27, 2016, surrounded by his family. He was 67 years old.

A native Houstonian, Beyer received his bachelor's degree and master's degree in civil engineering from the University of Houston in 1972 and 1977, respectively. He went on to become the founder and president of Beyer Construction in 1983, a leader in the Houston area for commercial concrete, street and road paving.

During his successful career in the construction industry, Beyer remained an active supporter of the Cullen College of Engineering's students and programs since his graduation. Beyer participated as a player in the Engineering Golf Tournament each year and served as a member of the UH Civil and Environmental Engineering Advisory Board as well as the UH Engineering Leadership Board.

In an effort to bring together alumni and friends of the Cullen College's civil and environmental engineering department, Beyer founded the annual Civil Engineering Alumni Luncheon in 2002. Since then, the event has raised thousands of dollars for scholarships for civil and environmental engineering students at UH.

"Charles had a way of making everyone around him feel as if anything was possible. He never saw obstacles, only adventures and opportunity. He was dedicated and loyal to his family and friends and always made anyone who came into contact with him feel welcomed," said Russell Dunlavy, chief development officer at the UH Cullen College of Engineering.

In 2003, Beyer began mentoring UH Engineering students through the Engineering Leadership and Entrepreneurism (ELEP) program, which matched current industry leaders with students to help prepare them for successful careers after college.

In addition to donating his time to the Cullen College and its students, Beyer personally funded initiatives with enormous impacts at UH Engineering. As an early investor in the Multidisciplinary Research and Engineering Building (MREB) at UH, Beyer was instrumental in securing additional funding to construct the four-story, state-of-the-art engineering research building.

Joseph Tedesco, Elizabeth D. Rockwell Dean of the Cullen College, said Beyer will be remembered as more than a dedicated supporter of the college, its students and its programs.

"Charles wasn't just a selfless and unwavering supporter of the Cullen College – he was a wonderful person and a great friend. He made a significant mark on our college and our community that will never be forgotten," said Dean Tedesco.

Beyer began his construction career in the Texas Air National Guard where he was assigned to airfield construction projects. In 1968, he began his private-sector career with a local road and bridge contractor on various city of Houston, Harris County and Texas Department of Transportation projects.

Beyer held a variety of positions for local contractors including project manager, estimator, safety director, vice president, chief operating officer and president, before creating his own company in 1983 to provide concrete paving services to the Houston metropolitan area. Since founding Beyer Construction, he completed well over 1,000 miles of pavement projects – equal to the distance from Houston to Chicago.

He served as president for both the Houston Contractors Association, the HESS Club and the Houston Engineering and Scientific Society. He was also an active member of the Greater Houston Builders Association and the Associated General Contractors. In 2001, Beyer received the Distinguished Engineering Alumni Award at the Engineering Alumni Association Gala.

Beyer is survived by his wife, Nancy, to whom he was married for over 45 years, and his three children – Meredith, Bubba and Scott – and three grandchildren. ■



# SECRET LIVES OF ENGINEERS:

## CIVIL ENGINEERING ALUMNUS ALFRED CASTILLO JR., P.E.

By Natalie Thayer

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

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

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

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

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

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

"YOU DEFINE YOU."

ALFRED CASTILLO, JR.

# EAA HONORS THREE CIVIL AND ENVIRONMENTAL ENGINEERS AT


By Natalie Thayer

The Engineering Alumni Association (EAA) honored three civil and environmental engineering alumni at its EAA Alumni Awards Gala. The annual event, held last June at the Hilton Americas Houston, celebrated the professional achievements and contributions of college alumni and faculty.

**LIFETIME ACHIEVEMENT AWARD**
**ODIS COBB**

**John Odis Cobb**, P.E., (BSCE '71, MSCE '79) earned his B.S. and M.S. in civil engineering from the University of Houston in 1971 and in 1979, respectively. While earning his undergraduate degree, he participated in the Co-Operative Education Program at the Texas Department of Transportation.

Several years after graduating, Cobb became registered in the state of Texas as a licensed professional engineer and licensed as a registered professional land surveyor. In 1980, he and fellow UH alumnus, Bill Fendley, established the Houston-based civil engineering and land surveying firm Cobb, Fendley & Associates, Inc. Cobb retired from the company in 2013.

Cobb has been active in a number of professional engineering organizations. He served as president of the Houston Engineering & Scientific Society and director of the board for the Houston Council of Engineering Companies. In 2010, he was appointed to the board of directors of the Coastal Water Authority by Houston Mayor Annise D. Parker.

Cobb has been involved with the University of Houston as a committee member for the Cullen College's annual golf tournament, a member of the department of civil and environmental engineering advisory board, chairman for the telecommunications engineering advisory board and a member of the Dean's Engineering Leadership Board. In 1999, he was honored with the UH Engineering Alumni Association's Distinguished Engineering Alumnus Award and in 2012 he was elected to the Academy of Distinguished Civil and Environmental Engineers.

Over a 10-year period, Cobb and Fendley established various endowments at the University of Houston, including the Cobb Fendley Scholarship Endowment in Civil and Environmental Engineering, the Cobb Fendley Scholarship Endowment in Electrical and Computer Engineering, the Cobb Fendley Excellence Endowment Fund and the Cobb Fendley Engineering Building Endowment Fund. Cobb and Fendley were also instrumental in the establishment of the Charles J. Tamborello Memorial Scholarship Endowment in honor of their close friend, Mr. C.J. Tamborello, P.E.

Cobb and his wife, Barbara, who met during their freshman English class at UH, were married in 1969. They have two sons, Jonathan and Nicholas, and four grandchildren.

**DISTINGUISHED ALUMNI AWARD**
**DALE RUDICK**

**Dale A. Rudick**, P.E., (BSCE '91) was appointed as the director of public works and engineering for the city of Houston in 2014. According to the city, the director is responsible for overseeing services to Houston citizens through the planning, operation, maintenance, construction management and technical engineering of the city's public infrastructure. The department's responsibilities include operation and maintenance of the city's streets and drainage, production and distribution of water, collection and treatment of wastewater, and permitting and regulation of public and private construction. The department is staffed with a trained workforce of over 3,700 employees and operates with an annual budget of nearly $2 billion.

Rudick has an extensive background in municipal government. He worked for the city of Sugar Land for more than 18 years while the population nearly tripled. He served as city engineer until 2006. Then, from 2006 to 2011, he formed and built an intergovernmental relations department where he worked directly with local, state and federal elected officials on regional issues. His efforts in Austin and Washington D.C. included securing additional capital funding, gaining representation on a local water authority and – for the first time in Texas history – closing a state prison. He was hired by Mayor Annise D. Parker in September 2011 as the ReBuild Houston executive and served as deputy director of Public Works and Engineering. Prior to his public sector service, he worked for a road and bridge contractor in Houston.

Rudick came to Houston in 1987 and is a proud University of Houston graduate with a degree in civil engineering from the Cullen College. He also has a degree in business administration from the University of Louisiana at Lafayette. He resides in Houston and is a licensed professional engineer in Texas.

**DISTINGUISHED YOUNG ALUMNI AWARD**
**MORENA G. ARREDONDO**

**Morena G. Arredondo**, P.E., (BSCE '07) is a native Houstonian and a proud first-generation college graduate.

She enrolled at the University of Houston after graduating from the Houston Community College System with an associate degree in science. Upon earning her bachelor's degree in civil engineering from the Cullen College, she began her career with RPS Klotz Associates, a leading provider of civil engineering consultant services in Texas.

During her time at RPS Klotz Associates, Arredondo took on various roles, earned several promotions and received three Star Awards for outstanding performance in the workplace. Most recently, she was promoted to the role of project manager. She was also recently named as an associate, a title awarded to employees who add value to the company through exceptional performance and are instrumental to the long-term success of the firm.

Arredondo is personally committed to giving back to the local community and volunteers with organizations that provide educational outreach to future and current engineers. As a member of the Society of Hispanic Professional Engineers (SHPE) Houston Professional Chapter, she has served on the chapter's executive board as treasurer, community outreach coordinator and communications director for the SHPE Region 5 Leadership Team. She has also coordinated various events at local elementary, middle and high schools to promote STEM education.

At the Cullen College, Arredondo has shared her experience as a female engineer with female middle school students at the G.R.A.D.E. (Girls Reaching and Demonstrating Excellence) Camp luncheon. She has also recruited UH graduates for RPS Klotz Associates at on-campus career fairs and helped sponsor scholarships during the annual UH Engineering Alumni Association Engineers Week (E-Week) program for students from various engineering disciplines.

In 2015, Arredondo received the Emerging Leaders in Energy Award from the Houston Hispanic Chamber of Commerce and *LATINA Style Magazine*. In 2014, she was recognized by SHPE as the Young Engineer of the Year and was selected by the Greater HHCC Foundation for the Emerging Leaders Institute in 2013, where she was honored as one of Houston's Young Professional Future Leaders. She is a licensed professional engineer in Texas and a graduate of the National Hispanic Professional Organization Leadership Institute, an organization that identifies, develops and empowers emerging leaders. ■

# Q&A

## with GARY GOODHEART

**(BSCE '74)**

*Vice President of Water Resources at Patrick Engineering and 2016 Civil Engineer of the Year in Illinois*

By Natalie Thayer

Over the course of his extensive career, UH civil engineering alumnus Gary Goodheart has traveled near and far to tackle tough infrastructure questions and challenges. Goodheart began his career while he was still a student at the Cullen College. He now serves as vice president of water resources at Patrick Engineering in Lisle, Illinois and was recently named the American Society of Civil Engineers (ASCE) Illinois Section's Civil Engineer of the Year.

### *Q: Why did you want to become an engineer?*

**A**: I was very fortunate in that I figured out at an early age I wanted to be an engineer. I grew up on the south side of Houston and my father, a life-long civil servant, worked as an administrator at NASA for 18 years. He frequently took me along when he had things to do on weekends, and introduced me to a number of the scientists and engineers who were working on the Gemini program.

He and a friend also had a ranching partnership, where they raised cattle and grew hay. As the oldest of five children, I spent a lot of time in the fields helping out, particularly when it was time to bale and haul the hay. Those experiences taught me that I wanted to earn a living with my brain and not my hands.

### *Q: How did you know that civil engineering was the right field for you?*

**A:** At first, I thought I wanted to be a mechanical engineer, but two years into college I started working at Houston Lighting & Power Co. as a draftsman and, later, an engineering technician. At HL&P I realized I liked civil engineering, particularly soil mechanics. I liked the idea of designing and constructing "big things you could see" – like power plants and earth dams. For me now, the most rewarding thing about being a civil engineer is seeing a large, complex design and construction project through to completion.

### *Q: You were recently named the ASCE Illinois Section's Civil Engineer of the Year. What does this honor mean to you?*

**A:** Winning this award is certainly the biggest honor of my professional career. I am honored, grateful and humbled to be selected as the Illinois Section Civil Engineer of the Year, and have my name alongside so many great and distinguished engineers who have previously won this award. I couldn't have achieved this honor without the help and support of my family and my many friends and colleagues in the civil engineering profession.

### *Q: How did your experience at the UH Cullen College of Engineering prepare you for your career as a civil engineer?*

**A:** I have always believed that the most important thing you learn in engineering school is how to think. UH Engineering did an excellent job of preparing me for the real world. It was clear to me that I didn't have all the answers coming out of school, but I did have a pretty good idea where to go, how to start and who to talk to. My experience at UH and early in my career gave me great confidence that has served me well in my career.

### *Q: What advice can you share with current UH Engineering students?*

**A:** Getting a college education is just the beginning of your career. Remember that as an engineer, you never stop learning. You come out of college with ideals and aspirations, but you don't have all the answers yet. I would encourage young engineers to ask questions, challenge the status quo and strive to improve their skills every day. ■

> "I HAVE ALWAYS BELIEVED THAT THE MOST IMPORTANT THING YOU LEARN IN ENGINEERING SCHOOL IS HOW TO THINK. UH ENGINEERING DID AN EXCELLENT JOB OF PREPARING ME FOR THE REAL WORLD."
>
> GARY GOODHEART





*Cullen College of Engineering Dean Joseph W. Tedesco, far left, honors TIRR Foundation*

*Cullen College of Engineering Dean Joseph W. Tedesco, far right, honors Crawfish Boil Committee*

# DEAN HONORS TWO ORGANIZATIONS WITH INDUCTION INTO THE BRIDGEBUILDER SOCIETY

By Natalie Thayer

Two organizations were recently honored with inductions into the Bridgebuilder Society for the Cullen College of Engineering.

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

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

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

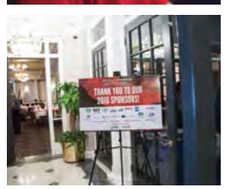
Led by executive director Cynthia Adkins, the TIRR Foundation has provided significant support to Jose Luis "Pepe" Contreras-Vidal, Hugh Roy and Lillie Cranz Cullen University Professor of electrical and computer engineering, and his Non-Invasive Brain Machine Interface Systems Laboratory at the UH Cullen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

The Offshore Industry Crawfish Boil Committee has organized, managed and led efforts to host the annual offshore industry, pre-OTC crawfish boil for 27 years. The popular on-campus event draws several thousand individuals to the University each year, including industry partners, alumni and community members. The tireless efforts of the committee members have resulted in more than $1 million in financial support for programs and student scholarships in the Cullen College of Engineering. ■

## 2016 CIVIL AND ENVIRONMENTAL ENGINEERING ALUMNI LUNCHEON



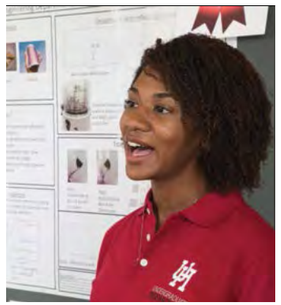





MORE THAN 150 UH CIVIL ENGINEERING ALUMNI, FACULTY AND STUDENTS GATHERED AT THE HESS CLUB ON WESTHEIMER TO RECONNECT AND HONOR THE MEMORY OF CHARLES BEYER AT THE 14TH ANNUAL CIVIL AND ENVIRONMENTAL ENGINEERING ALUMNI LUNCHEON HELD ON OCTOBER 18.

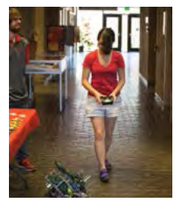
## 2016 UNDERGRADUATE RESEARCH DAY

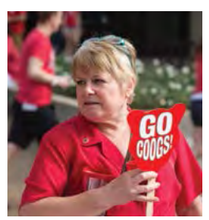



MORE THAN 200 UH UNDERGRADUATES PRESENTED THEIR RESEARCH AT THE 2016 UNDERGRADUATE RESEARCH DAY HELD AT THE ELIZABETH D. ROCKWELL PAVILION IN OCTOBER. A TOTAL OF 40 UH ENGINEERING STUDENTS PARTICIPATED IN THE CAMPUS-WIDE EVENT, PRESENTING RESEARCH ON A WIDE ARRAY OF TOPICS RANGING FROM MEDICINE AND HEALTH TO ENERGY AND MATERIALS.

## 2016 ENGINEERING HOMECOMING & 75TH ANNIVERSARY PARTY



FRIENDS OF THE UH CULLEN COLLEGE OF ENGINEERING GATHERED FOR BARBEQUE, DRINKS AND GAMES TO CELEBRATE THE COLLEGE'S 75TH ANNIVERSARY AND GEAR UP FOR THE 2016 UH FOOTBALL HOMECOMING GAME.

## FALL 2016 BOS PARTY

UH ENGINEERING STUDENTS TOOK A BREAK FROM THEIR STUDIES TO KICK OFF THE FALL SEMESTER AT THE ANNUAL BOS (BEGINNING OF SEMESTER) PARTY.

View more photos from the Cullen College of Engineering at www.egr.uh.edu/news/photo-gallery



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UH Cullen College of Engineering
Department of Civil & Environmental Engineering
Engineering Building 1
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