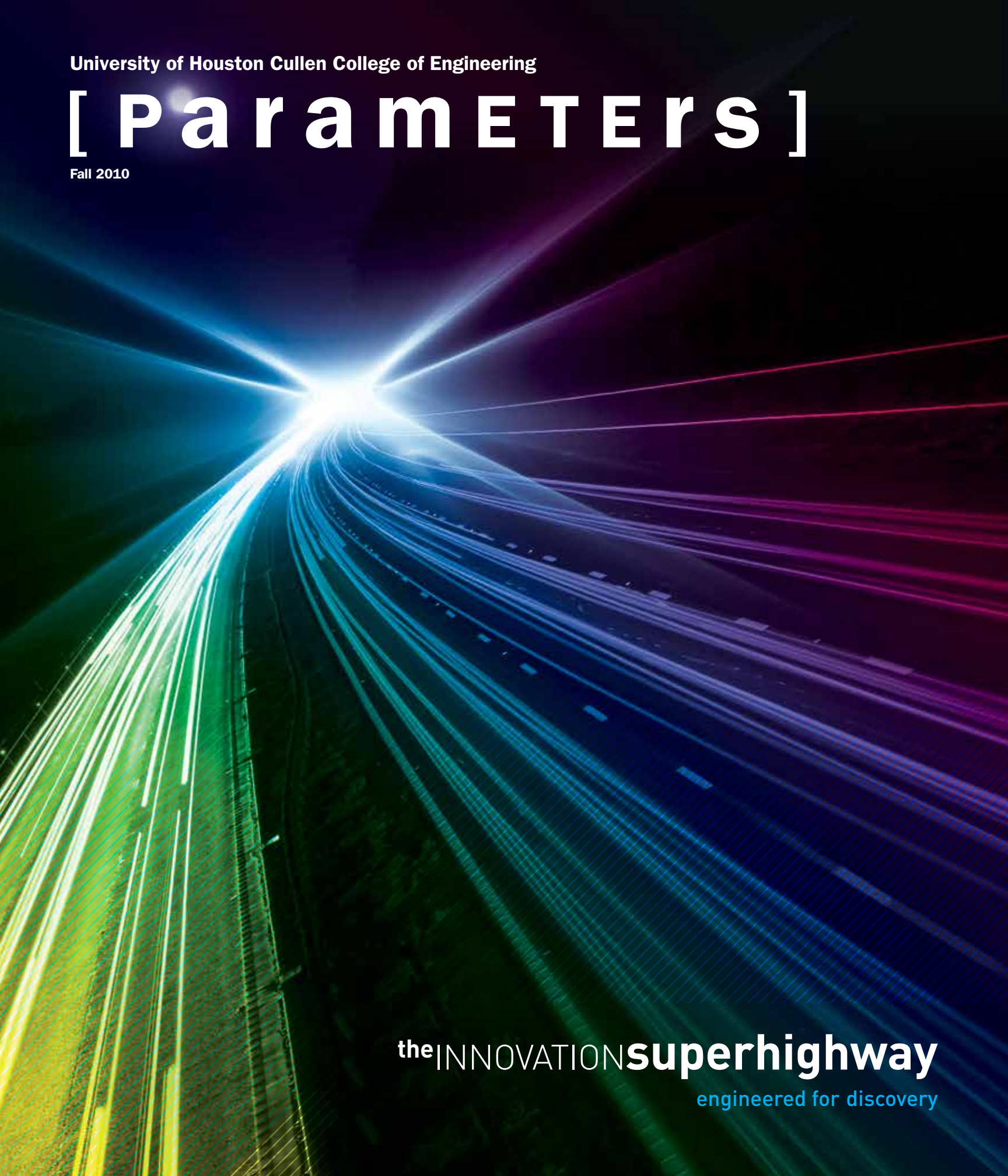
University of Houston Cullen College of Engineering

# [ ParamETErs ]

Fall 2010



## the INNOVATION superhighway

engineered for discovery

A major focus for the University of Houston Cullen College of Engineering is growing our research enterprise. A critical component of our strategic plan calls for a 30 percent growth in our faculty numbers as well as a doubling of our research expenditures. To be a competitive, nationally ranked engineering program, we must attain these benchmarks by recruiting more prolific faculty members to UH, which not only strengthens our research and academic programs but also provides Houston with more intellectual capital for its growing medical and energy communities.

We are pleased to announce that we are making incredible progress toward these goals. This year, we have added three National Academy of Engineering members to our faculty roster. Professors Surendra Shah and Kaspar Willam along with Adjunct Professor Anestis Veletsos joined our Department of Civil and Environmental Engineering. With the addition of the National Center for Airborne Laser Mapping and new department chair, Professor Abdeldjelil Belarbi, we are strengthening our core research expertise in the areas of urban infrastructure and the environment. In addition, Badrinath "Badri" Roysam recently joined us from Rensselaer Polytechnic Institute as the new chair of our Department of Electrical and Computer Engineering. Bringing a wealth of neuroscience and biomedical engineering expertise to the college, Roysam will be charged with boosting our already prolific area of nanomaterials research as well as growing biomedical-related research within our largest department.

Moreover, this issue of *Parameters* features several of our junior faculty members who are quickly becoming leaders in the fields of nanoengineering, materials, renewable energy, wireless communication, bioengineering and health. These faculty members have won National Science Foundation CAREER Awards, received major grants from government agencies such as the NSF, the National Institutes of Health and the Defense Advanced Research Projects Agency, and are publishing in high profile journals such as *Science*.

We are incredibly proud of our research excellence and are equally as proud of our ongoing student success. In this issue, we also feature our local and regional student competition wins—four first place trophies were earned by UH Cullen College of Engineering students in robotics, Chem-E Car and concrete canoe competitions! With the growing community of strong engineering students and educators at the University of Houston, we are definitely poised to help UH become a Tier One institution.

Warm regards,

Joseph W. Tedesco

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



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FEATURES

**PARAMETERS - FALL 2010**

ON THE COVER

**The Innovation Superhighway**

Though the road to discovery is long for all scientific researchers, UH Cullen College of Engineering faculty are traveling great distances at great velocities. Many of our young researchers are making tremendous headway in every area along the spectrum of engineering research, including nanotechnology, materials, energy, telecommunications, biomedicine and the environment.

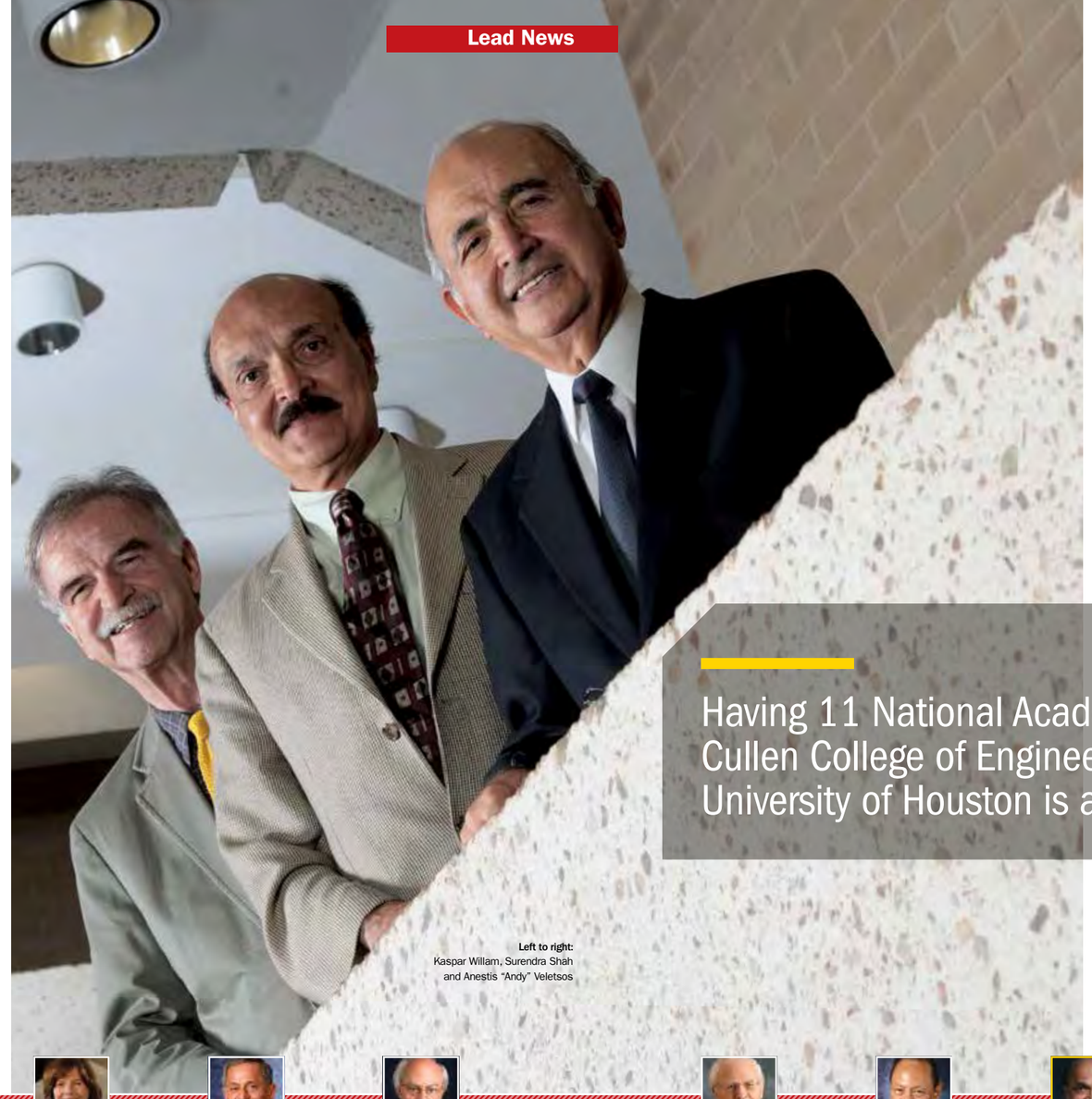
# 3

## *National Academy Members Join*
## College of Engineering

Drawing top researchers to its already outstanding faculty roster is an ongoing effort at the University of Houston Cullen College of Engineering. These professors help grow the university's overall research expenditures and improve the success rates of its undergraduate and graduate students—both essential to UH's drive to earn recognition as a Tier One research university.

This effort recently resulted in the successful recruitment of three faculty members who belong to the elite National Academy of Engineering, clearly marking them as among the very best in their fields. With these additions, the college now has 11 professors who belong to the NAE. In rankings of national research universities, some institutions in the top 50 have as few as five faculty members university-wide that belong to the National Academies.

"Having 11 National Academy members in the Cullen College of Engineering alone shows that the University of Houston is already a top-tier research institution," said Joseph W. Tedesco, Elizabeth D. Rockwell Endowed Chair and Dean. "It also demonstrates the essential role that the college plays in UH's drive to earn the Tier One designation. These new faculty members will help us draw more research funding to the university and continue providing our students with an outstanding education."



**Left to right:**
Kaspar Willam, Surendra Shah and Anestis "Andy" Veletsos

Kaspar Willam, professor of civil and environmental engineering, joined the college this fall from the University of Colorado at Boulder. Inducted into the NAE in 2004, he has authored more than 160 publications and served as an invited speaker on more than 140 occasions. Willam, who earned his Ph.D. from the University of California, Berkeley, is also a fellow of the American Society of Civil Engineers, the American Society of Mechanical Engineers and the United States Association for Computational Mechanics. He is recognized as a leading authority on structural mechanics and materials.

NAE member Anestis "Andy" Veletsos joined the college as an adjunct professor of civil and environmental engineering. He is also the Brown & Root Professor in the Department of Civil Engineering at Rice University. Veletsos is a two-time winner of the Norman Medal, the highest award given by the American Society of Civil Engineers for papers published in its journals. He headed the group that formulated the Applied Technology Council's first design provisions for soil structure and then incorporated those provisions into the federal government's National Earthquake Hazards Reduction Program. Veletsos' areas of expertise include structural and foundation dynamics, earthquake engineering and the dynamics of offshore platforms.

The Cullen College's third new NAE member is Surendra Shah. Shah joined the college as a visiting professor in the Department of Civil and Environmental Engineering in January 2010, and is slated to become a full professor at the beginning of 2011. In addition to his NAE membership, he is an honorary fellow of the American Concrete Institute, a member of the Indian National Academy of Engineering and a foreign member of the Chinese Academy of Engineering. Shah is the Walter P. Murphy Professor in Northwestern University's Department of Civil Engineering, where he serves as director of the National Science Foundation's Center for Advanced Cement-Based Materials. His areas of expertise include the application of nanotechnology in civil engineering, fiber-reinforced concrete and nonlinear fracture mechanics.

> Having 11 National Academy members in the Cullen College of Engineering alone shows that the University of Houston is already a top-tier research institution.

## National Academy of Engineering Members

### Neal Amundson
***Chemical Engineering, 1970***

For pioneering contributions to the fundamental analysis of chemical processes and leadership in chemical engineering education.

### Benton F. Baugh
***Mechanical Engineering, 1999***

For implementation of concepts for subsea equipment used in offshore oil production.



### Bonnie J. Dunbar
***Biomedical Engineering, 2002***

For personal leadership and significant contributions to solutions to engineering design problems in human spaceflight and to on-orbit operations.



### Fazle Hussain
***Mechanical Engineering, 2001***

For fundamental experiments and concepts concerning important structures in turbulence, vortex dynamics and acoustics, and for new turbulence measurement techniques.



### John H. Lienhard
***Mechanical Engineering, 2003***

For creating the awareness of engineering in the development of cultures and civilizations, and for the development of basic burnout theories in boiling and condensation.



### Dan Luss
***Chemical Engineering, 1984***

For his scholarly insight into important industrial problems in chemical reactor engineering and for his ability to supply novel, inspired and useful solutions.



### Yih-Ho Michael Pao
***Mechanical Engineering, 2000***

For research, development and commercialization of water-jet technology for machining, trenchless boring and surface preparation.

### Surendra Shah
***Civil Engineering, 2006***

For work on advanced cement-based materials and for promoting interdisciplinary research and education on concrete materials.

### James Symons
***Civil Engineering, 1994***

For major research discoveries that significantly advanced the understanding and practice of improving drinking water safety.

### Anestis "Andy" Veletsos
***Civil Engineering, 1979***

For contributions to advancements in structural dynamics and earthquake engineering, especially in inelastic behavior and soil-structure interaction.

### Kaspar Willam
***Civil Engineering, 2004***

For contributions to constitutive modeling and computational failure analysis of concrete and quasi-brittle materials and structures.

## Biomedical Engineering

# Doctorate Program *Approved*

The University of Houston Health Initiative has received a major boost from the Texas Higher Education Coordinating Board, which recently approved the establishment of a doctoral program in biomedical engineering at the UH Cullen College of Engineering.

The new doctoral program will be launched alongside existing bachelor's and master's degree options in biomedical engineering, giving current and prospective students a greater opportunity to pursue a terminal degree while studying in Houston's prolific medical research community.

Research in the doctoral program will focus on three main areas—neural, cognitive and rehabilitation engineering; biomedical imaging; and genomics and proteomics. The overall goal of the research is to better understand what causes diseases so that accurate and affordable medications and therapies can be developed for treatment.

"Our program will discover, develop and deliver technological solutions aimed at reducing health care costs," said Metin Akay, founding chair of the UH Department of Biomedical Engineering. "That's the difference between our program and the more than 90 others in the United States."

Specifically, the program's neural and cognitive research area will explore everything from neural implants and neurochip development to the effect of neurogenesis on brain function. Biomedical imaging will focus on molecular, cellular and clinical imaging as it relates to cardiovascular and neurological therapeutics. Research in the genomics and proteomics area will be geared toward cancer studies and involves the investigation of gene regulatory systems and networks as well as intelligent drug delivery and design.

**Clockwise from left:** Carl Carlucci, VP for Administration and Finance; Joseph Tedesco, Dean of the UH Cullen College of Engineering; Venkat Selvamanickam, Professor of Mechanical Engineering and Director of the TcSUH Applied Research Hub; John Antel, Senior VP for Academic Affairs and Provost; Gerard van Spaendonck, Senior VP and CFO, Imaging Systems, Philips Healthcare; Art Kazanjian, General Manager of SuperPower Inc.; Allan Jacobson, Professor of Chemistry and Director of TcSUH.

## UH, SuperPower Sign License Agreements

UH executed two license agreements with SuperPower Inc., a wholly owned subsidiary of Royal Philips Electronics. One covers the intellectual property on second-generation high-temperature superconductor wire developed under the parties' existing Sponsored Research Agreement. The second covers a patent related to a high-temperature superconductor discovered at UH in 1987. UH and SuperPower are also partners in a $3.5 million award from the state of Texas to create the Applied Research Hub of the Texas Center for Superconductivity at UH, and the DOE-funded $10.6 million Smart Grid Fault Current Limiting Superconducting Transformer Demonstration program.

## UH, Partners Awarded $4.2 Million DOE Grant

The University of Houston and three other institutions have received a $4.2 million grant from the U.S. Department of Energy to develop a superconducting magnet energy storage system device that could revolutionize the nation's electrical power grid.

The collaboration consists of UH, ABB Inc. of Cary, N.C., SuperPower Inc. of Schenectady, N.Y., and the DOE's Brookhaven National Laboratory in Upton, N.Y. Venkat Selvamanickam, M.D. Anderson Chair Professor of Mechanical Engineering and Director of the Applied Research Hub of the Texas Center for Superconductivity at UH, will lead the university's effort.



## New Honors Engineering Program Launches

The UH Cullen College of Engineering has launched an innovative honors program for high-achieving students seeking a more extensive academic experience.

Designed to promote inventiveness and teamwork, the Honors Engineering Program (HEP) gives academically gifted students a larger selection of comprehensive engineering courses presented in small classroom environments.

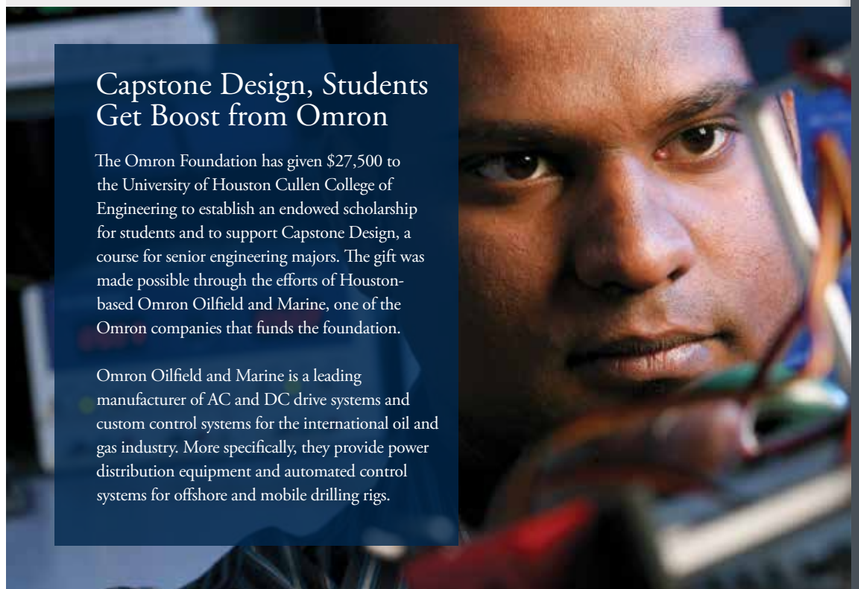
HEP was developed in partnership with the university's longstanding Honors College, providing students with upper-level honors engineering coursework that had previously not been widely available. Currently, six courses are on track to be included in the program's curriculum. However, the goal is to provide enough courses that students can take an honors class each semester while working toward their degrees. Honors versions of dynamics, statistics, fluid mechanics and senior design are all being explored for the future.

## Chemical Engineering Shines in National Rankings

The Cullen College of Engineering boasts one of the nation's top doctoral programs in chemical engineering, according to the most recent evaluation of Ph.D. programs released by The National Academies' National Research Council (NRC).

Based on data from 2005, the program placed 18th in the country in the NRC's survey-based rating, which measures a program against standards set by members of its discipline. By this metric, the Department of Chemical and Biomolecular Engineering bested its counterparts at institutions such as Rice University, Texas A&M, Cornell, Penn State and Georgia Tech. The University of Texas at Austin was the only school in the region with a higher ranked program.

The department fared even better in the research activity evaluation, which factored in publications, citations, the percent of the faculty holding research grants and recognition of scholarship. In this category, the college's chemical engineering Ph.D. program ranked 13th in the country.



## Capstone Design, Students Get Boost from Omron

The Omron Foundation has given $27,500 to the University of Houston Cullen College of Engineering to establish an endowed scholarship for students and to support Capstone Design, a course for senior engineering majors. The gift was made possible through the efforts of Houston-based Omron Oilfield and Marine, one of the Omron companies that funds the foundation.

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

# ENGINEERING extras

### Chinese Academy of Engineering

» Surendra P. Shah, a visiting professor at the Cullen College slated to become a full professor in 2011, was recently inducted into the Chinese Academy of Engineering (CAE) as a foreign member. Shah is one of only four engineers in the world—and the only civil engineer—who is a member of the CAE, the U.S. National Academy of Engineering and the Indian National Academy of Engineering. Shah will join the faculty full time in January.

### Camo to Classroom to Career

» A new program has been established to help address the unique higher education needs of veterans and active military. The Camo to Classroom to Career Program is designed not only to guide them through college life, but also support them in finding a job upon completion of their engineering degree. By partnering with the Veterans' Services Office on campus, the program will be able to pair newcomers with graduate-level mentors of a similar background.

### National Wind Energy Center

» The National Wind Energy Center received a $2.3 million grant from the U.S. Department of Energy to develop and test composite materials and components for large offshore wind turbines. Located in the UH Energy Research Park, the center will focus on improving current thermoset epoxy-blade design while developing thermoplastic composites for blade applications.

### Texas ARP Funding

» UH was one of 24 institutions that received money from the Norman Hackerman Advanced Research Program in April. A competitive, peer-reviewed grant program funding science and engineering research projects of faculty members at Texas higher education institutions, ARP gave out more than $15 million this year. Of the 13 grants awarded to UH, the Cullen College of Engineering received five, totaling $678,050.

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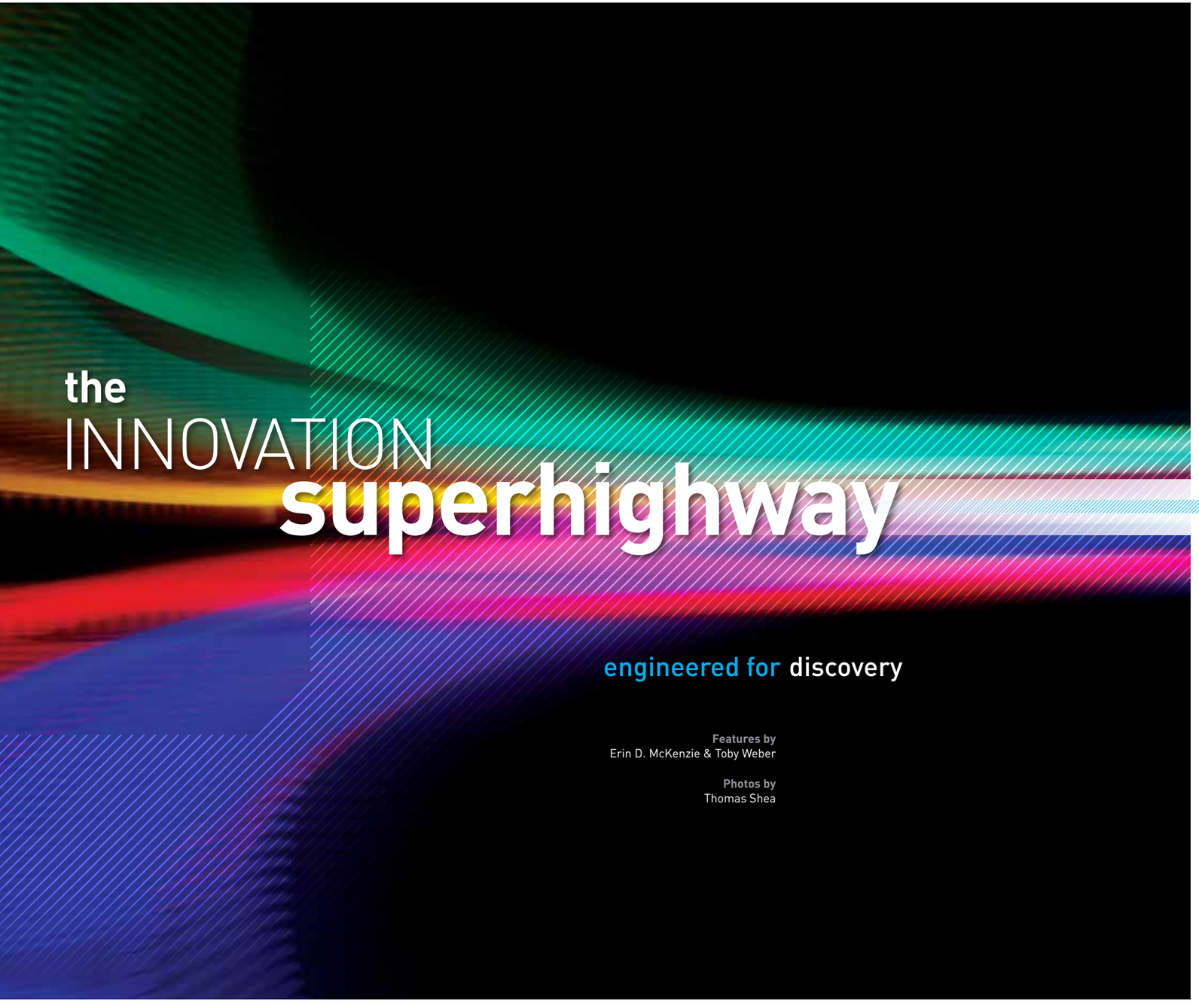


# the INNOVATION superhighway

## engineered for discovery

**Features by**
Erin D. McKenzie & Toby Weber

**Photos by**
Thomas Shea

No matter how innovative a new technology may seem, it didn't just appear out of nowhere. Practically all discoveries travel a long road – the innovation superhighway – before they reach a place where people can benefit from them.

Completing this journey can take decades. Often, multiple researchers take the wheel, with each starting farther along the road thanks to the work of those who came before them.

At the University of Houston Cullen College of Engineering, junior faculty members are taking their shift on the innovation superhighway. Though early in their careers, these faculty are advancing quickly down this road.

The six features in this issue of *Parameters* cover an incredible range of research topics, including the creation of antibacterial surfaces designed to stop the spread of infection to the development of technology that will allow wireless devices to more efficiently share valuable information on increasingly crowded airwaves.

This research has already earned these faculty patents for their discoveries, invitations to serve as guest lecturers at prestigious conferences and institutions, and major grants that will help them continue their research. Thanks to them, and all the faculty here, the Cullen College is poised to drive innovation for decades to come.

# ENERGY**efficient**

## Far more than just fossil fuels will be necessary to feed the country's future energy needs.

**Stanko Brankovic**

*Assistant Professor*
*Electrical and Computer Engineering*
*Ph.D., Arizona State University, '99*

This fact has led many to search for ways to make alternative energy options more practical sources of power.

Stanko Brankovic is among those leading efforts for fuel cells. His discovery, for which he holds a patent, has influenced the future of these electrochemical energy conversion devices.

An assistant professor of electrical and computer engineering at the University of Houston, Brankovic invented the first platinum monolayer fuel cell electrocatalyst. The component responsible for driving the anodic and cathodic reactions in fuel cells, this breakthrough not only made fuel cells more efficient, but also reduced their cost by using nearly 10 times less platinum than traditional nanoparticle-based catalysts.

Now, he is building on this work in the hopes of increasing the stability and catalytic activity in this extremely thin monolayer of atoms.

"It's not only important to get a monolayer, it's important to control that monolayer by understanding its morphology," said Brankovic, who holds two other patents for his work. "That knowledge is currently missing, and we need to find out what experimental conditions are important to control the monolayer catalyst morphology."

Comprehending the morphology, or how the structural features of the monolayer electrocatalyst are arranged, can impact the performance of a fuel cell's conversion of the chemicals hydrogen and oxygen into water, which allows the device to generate electricity.

"Understanding the morphology would enable people to design catalysts at the atomic scale," Brankovic said. "You would be able to get down to that fundamental level and control the properties of the monolayer—make a configuration where every atom counts."

This, he said, could improve the efficiency of fuel cells by up to 300 percent—making them an even more promising source of heat and electricity in buildings as well as an electrical power source for vehicles.

"Fossil fuels are a finite resource. This means oil will only be more expensive in the future," said Brankovic. "Fuel cells, in general, have a huge advantage for many applications. For fuel cell-driven cars using hydrogen as fuel, every kilowatt of energy you generate will be produced free of $CO_2$. That could turn us green overnight."

Brankovic's work is being funded with a five-year, $550,000 Faculty Early Career Development (CAREER) Award from the National Science Foundation and several other agencies. He is collaborating with researchers from Brookhaven National Laboratory, the University of Berlin and the University of New Mexico, Albuquerque.

Brankovic received a 2010 CAREER Award from the National Science Foundation.

# TRANSFORMING**technology**

## We live in a world highly dependent on products developed by the semiconductor industry.

**Gila Stein**

*Assistant Professor*
*Chemical and Biomolecular Engineering*
*Ph.D., University of California Santa Barbara, '06*

Higher-capacity memory chips and the microprocessors that make our computers faster and cheaper all use the miniature electronic circuits this industry has made paramount.

There is just one problem—going smaller while maintaining the high throughput needed to create the nanoscale devices used in memory chips and microprocessors is becoming a challenge. So researchers like Gila Stein are attempting to find ways to understand the limits of techniques such as optical lithography to keep pace with the industry's historic growth rates.

"Lithography is the technique used to actually pattern these devices," said Stein, an assistant professor of chemical and biomolecular engineering at the University of Houston. "However, recent experimental and theoretical reports suggest that the current lithographic materials are not appropriate for nanoscale patterning. Meaning, it will be harder to go smaller."

Stein believes closer study of the materials used to make these circuits—or more specifically chemically amplified photoresisists—may help the industry go smaller and enhance the imaging capability of lithographic systems used in the manufacturing of these circuits.

Photoresists are polymer coatings designed to change solubility upon exposure to light. In a typical lithographic process, silicon wafers are coated with thin films of chemically amplified photoresist. These photoresist films are exposed to a pattern of light, which activates a catalyst. Moderate heat promotes a chemical reaction that changes the polymer solubility. Washing away the soluble polymer develops an image, and then the photoresist pattern is transferred to the silicon substrate by plasma etching.

Stein is closely studying the chemical reaction in thin films of photoresists to better understand the fundamental limits for this material.

"Right now it is difficult to predict the resolution limits for chemically amplified photoresists," said Stein. "This is one of the first steps toward finding an answer. Our hope is that this will allow us to squeeze as much as possible from the current technology."

To do this, Stein is creating her own photoresists and measuring the images in these photoresists using x-ray diffraction.

"There are currently no experimental methods available to access this information. This project offers a unique strategy to identify the fundamental limitations of chemical amplification for next-generation lithography that will continue to help the semiconductor industry produce the nanoscale devices needed to improve the speed of things such as modern computers," she said.

Stein's work is being funded by a $175,000 grant from the National Science Foundation.

Stein is the winner of a 2009 BRIDGE Award from the National Science Foundation.

# MIRACLE**metals**

## Imagine how valuable the ability to create a stronger metal would be to the United States military.

**Yashashree Kulkarni**

*Assistant Professor*
*Mechanical Engineering*
*Ph.D. California Institute of Technology, '07*

Among other things, this metal could be used to coat military Humvees in stronger armor—ensuring more soldiers return from conflicts overseas.

For years, engineers have manipulated the structure of metals in hopes of creating such a metal. They've changed manufacturing processes and even modified their nanostructures. Yashashree Kulkarni included.

An assistant professor of mechanical engineering, Kulkarni is using computational modeling to better understand a special kind of material, known as nanotwinned metal, that has the potential to make all this a reality.

"While many approaches have been successful in creating high-strength materials, the ductility is usually severely compromised," said Kulkarni. "This is critical because high-strength materials are useless for several applications if they are brittle or not sufficiently ductile."

Using funding attached to a 2010 Young Faculty Award from the Defense Advanced Research Projects Agency (DARPA), the research arm of the U.S. Department of Defense, Kulkarni is modifying the atomistic structure of metals to see how exactly these changes impact their strength and stability. Her findings could help engineer a metal ten times stronger and more ductile than anything in existence to date.

Traditionally, the grain boundaries created due to the mismatch of orientation between adjacent grains have been sources of defects in metals. This can lead to a loss of stability and strength.

"Nanotwinned metals contain a very special class of grain boundaries known as twin boundaries," she said. "They have unique properties owing to the fact that the grains on either side of a twin boundary are 'twins,' or mirror images of each other."

These twin boundaries help absorb defects in the crystal structure, making the material stronger and more ductile. Kulkarni's study will dissect this phenomenon to create other high-strength materials by incorporating nanoscale crystalline grains into their microstructure. She is testing how different types of metals hold their stability under conditions such as intense strain and higher temperatures when twin boundaries are present.

"I make a sample of the metal with the desired nanostructure on the computer and follow the dynamics of each and every atom, in the millions, that make up the specimen," she said. "By performing simulations of tests such as nanoindentation, compression or crack propagation, I can observe the deformation mechanisms that govern the mechanical behavior of nanotwinned structures and analyze the critical spacing between twin boundaries for maximum performance."

What she learns during the two-year study could provide scientists with a guide for the optimal design of such a metal.

Kulkarni received a 2010 Young Faculty Award from the Defense Advanced Research Projects Agency (DARPA).



# WORRY-FREE**wireless**

## As wireless technologies advance, more of us experience the adverse effects of an increasingly crowded radio spectrum.

**Zhu Han**

*Assistant Professor*
*Electrical and Computer Engineering*
*Ph.D., University of Maryland, College Park, '03*

That's because our cell phones, laptops and even the sensor networks that help keep the temperature of our office buildings constant are all competing for bandwidth. This vie for space is responsible for everything from dropped calls to poor Wi-Fi connections.

Zhu Han believes he can change this with one emerging technology—cognitive radio networks.

"To secure the future wireless world, we need radio technologies that can help better utilize spectrum bands," said Han, assistant professor of electrical and computer engineering at the University of Houston. "Cognitive radio networks may be the answer because they actively monitor the external wireless environment and route transmissions of signals from occupied frequency bands to idle frequency bands."

The Federal Communications Commission (FCC) allocates portions of the radio spectrum, in varying frequencies. In recent years, they have found that although a growing number of devices compete for use of the spectrum, far more than half of the frequencies go unused.

Han is using $400,000 in funding from the National Science Foundation's Faculty Early Career Development (CAREER) Program to explore the technology's ability to more efficiently use the spectrum. The CAREER Award is NSF's most prestigious and competitive grant for junior researchers in science and engineering fields.

A new class of intelligent radio devices, Han's technology would not only enhance communication between new devices and systems, it would identify available radio waves, detect interference and reconfigure to best match conditions.

The device would use computer processors to run software allowing it to perform signal processing. An RF sensor—consisting of an electronic circuit and antenna—would be responsible for monitoring the spectrum.

Driving the system, however, is a series of decision-making algorithms Han will develop in the Wireless Networking, Signal Processing, and Security Lab at UH during the course of the five-year grant. These algorithms run on the processors and change the RF frequencies so that transmitters can utilize portions of the spectrum which legitimate primary users are not occupying.

"Cognitive radio is a new communication paradigm that will significantly change the way the communication network works," said Han, who is the co-author of the recent book, *Dynamic Spectrum Access in Cognitive Radio Networks.* "The resulting future wireless networks will be more efficient and robust to provide heterogeneous services anywhere and anytime."

Han received a 2010 CAREER Award from the National Science Foundation.

# SURFACE**science**

## A trip to the hospital to cure what is ailing you, these days, can often make you sicker.

**Jacinta Conrad**

*Assistant Professor*
*Chemical and Biomolecular Engineering*
*Ph.D., Harvard University, '05*

In fact, the Centers for Disease Control and Prevention estimate some 1.7 million patients contract infections annually at U.S. hospitals, resulting in 99,000 deaths. A significant portion of these numbers result from bacteria growing on devices implanted in the body.

"It's been observed that bacteria like to attach to very rough surfaces," said Jacinta Conrad, assistant professor of chemical and biomolecular engineering at the University of Houston. "On devices such as catheters and dental implants, improper machining can lead to rough edges. These places can be a breeding ground for bacteria."

Fighting infections associated with medical devices is far more complex than just taking an antibiotic. These nasty bugs attach together to form larger masses of bacteria, known as biofilms, which can be as much as 10,000 times more resistant to antibiotics.

So Conrad is studying ways to cheaply engineer surfaces to be resistant to some of the more common strains causing problems in health care facilities.

Using soft lithography, a rapid-prototyping technique that has been widely applied to engineer polymer-based microdevices, Conrad is working to create an antibacterial coating that can be applied to the surface of a device.

By exposing liquid polymer coatings to light she can control the texture and elasticity of the surface, thus finding just how smooth and hard a surface needs to be to ward off these bacteria.

In her laboratory, Conrad will introduce cultured bacteria to surfaces she has engineered and will monitor how they move and attach over the course of a few hours using bright field microscopy. By using the software to automatically track bacteria, she will be able to relate characteristics of their motion to specific surface properties.

"We are interested in that very first stage when you start to see bacteria grow," she said. "We are looking at how they initially move on and attach to the surface and how they sense different surface properties. This is crucial in understanding how bacteria form biofilms."

She is hopeful to find just the right combination of surface properties to help deter these bacteria from attaching to medical devices before they find strength in numbers.

Conrad's research on bacteria motility was published in the October 8 issue of *Science*.

# CHARACTERIZING**crystals**

## Inside every one of us are tiny crystals—the building blocks for painful kidney stones.



**Jeff Rimer**

*Assistant Professor*
*Chemical and Biomolecular Engineering*
*Ph.D. University of Delaware, '06*

Though the National Institutes of Health estimate one in 10 people will experience a kidney stone in their lifetime, these crystals only ever develop into larger stones if the right combination of factors allows them to assemble.

How exactly this happens has been the focus of Jeff Rimer's research for some four years.

In his laboratory on the UH campus, this assistant professor of chemical and biomolecular engineering is using colloidal and interfacial techniques to characterize the formation of these crystals and design synthetic methods to selectively tailor their properties. What he learns could aid in the development of a preventative treatment for kidney stones.

"We are designing molecules that bind to the surface of crystals and could serve as synthetic drugs that could be taken just like a daily vitamin. Basically, we want to design molecules that inhibit crystal formation," said Rimer, who first studied kidney stones extensively as a postdoctoral researcher at New York University's Molecular Design Institute.

His work there related to L-cystine stones, a rare disease affecting roughly 20,000 in the United States, revealed two effective growth inhibitors that could be viable drugs. These results are now filed as a preliminary patent and were recently featured in the popular journal *Science*.

Through continuing collaborations with researchers at New York University and now Rensselaer Polytechnic Institute, Rimer is looking at the factors that influence the rate of crystal growth and how they affect the formation not only of L-cystine stones, but also the more common calcium oxalate stone.

"If we understand the growth rate of these materials, and ways in which we can slow the growth, we can suppress or lessen crystal formation," said Rimer. "Then the likelihood of crystal aggregation is reduced, and also the chance of passing single crystals before they form a stone will increase."

The formation of kidney stones happens, in part, when the body does not properly absorb excess minerals such as calcium or amino acids. High levels of these constituents cause crystal nucleation, growth, retention on cellular surfaces, and eventually crystal aggregation into hard stones.

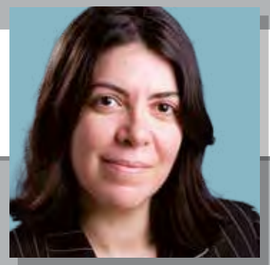
To better understand this, Rimer is characterizing real-time crystal growth in his lab. He is then exploring how small, tailored protein segments, called peptides, bind to mineral surfaces and influence crystal formation.

"We are trying to design peptides by breaking down urinary proteins into smaller segments to determine if their association with crystal surfaces accelerates or inhibits growth," Rimer said. "We are looking for specific sequences of amino acids that yield a molecular recognition for binding to the crystal surface. Once we identify these segments, they will serve as building blocks for the rational design of therapeutic drugs."

Rimer's research on crystal growth inhibitors was featured on the cover of the October 15 issue of *Science*.

# New Faculty

With the strategic goal of expanding the college's tenured-track faculty from 90 to roughly 130 by 2013, the University of Houston Cullen College of Engineering has been aggressively recruiting junior and senior faculty who are leaders in energy, materials, biomedical engineering and sustainability research. Eight faculty joined the college this fall and will be part of the college's efforts to become a top-ranked engineering program.



## Haleh Ardebili

Assistant Professor of Mechanical Engineering

Haleh Ardebili joins the college from Rice University, where she was a postdoctoral research fellow in the department of mechanical engineering and materials science. She received a Ph.D. in mechanical engineering from the University of Maryland, College Park in 2001, M.S. in mechanical engineering from Johns Hopkins University in 1996 and B.S. in engineering science and mechanics from Penn State University in 1994. She served as a lecturer for the UH Department of Mechanical Engineering since 2004 and served as a research scientist for General Electric Global Research Center prior to moving to Houston. Her research is in the areas of polymer nanocomposite electrolytes, lithium ion conduction, materials for energy storage, lithium ion batteries and electronic materials.

## Craig Glennie

Assistant Professor of Civil and Environmental Engineering

Craig Glennie joins the college from TerraPoint USA Inc., a LiDAR remote sensing company, where he was vice president of engineering. He received a Ph.D. and B.Sc. in geomatics engineering from the University of Calgary, Alberta in 1999 and 1996, respectively, and is a registered professional engineer. Prior to his role as vice president at TerraPoint, he served as senior geodetic engineer and manager of U.S. operations. He has also worked as a geomatic engineer for Aerotec LLC, and the Focus Corporation. At UH, he will work as part of the National Center of Airborne Laser Mapping and the proposed graduate program in geosensing systems engineering.

## Reagan Herman

Instructional Associate Professor, Research Associate Professor

Reagan Herman joins the college from the department of civil engineering at Johns Hopkins University, where she served as senior lecturer and assistant research professor. Prior to her appointment at John's Hopkins, she was an assistant professor of civil engineering at UH. She received her Ph.D. and M.S. in structural engineering from The University of Texas at Austin in 2001 and 1995, respectively. She received a B.S. in civil engineering from North Carolina State University in 1993. Her research interests focus on the design and behavior of steel structures, with an emphasis on steel bridge design. Her research work has included studies of various aspects of steel trapezoidal box girder bridge design and behavior, including projects focusing on box girder compression flanges and box girder bridges with skewed supports.

## Megan Robertson

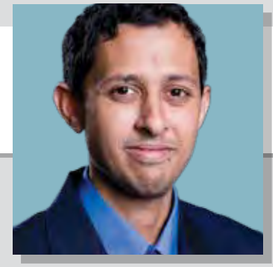
Assistant Professor of Chemical and Biomolecular Engineering

Megan Robertson joins the college from the University of Minnesota, where she was a postdoctoral research associate in the department of chemistry. She received her Ph.D. in chemical engineering from the University of California, Berkeley in 2006 and her B.S. in chemical engineering from Washington University in St. Louis in 2001. Her graduate research focused on the design of block copolymer surfactants for the preparation of nanostructured materials from immiscible polymers. Following graduation, she worked as a senior scientist at Rohm and Haas (now part of Dow Chemical). Her research at UH will focus on the interface between polymer chemistry and physics to produce nanostructured polymeric materials for a variety of applications.

## Debora Rodrigues

Assistant Professor of Civil and Environmental Engineering

Debora Rodrigues joins the college from Yale University, where she was a postdoctoral researcher in the environmental engineering program within the department of chemical engineering. She received a Ph.D. in microbiology and molecular genetics from Michigan State University in 2007, and her M.S. in sciences and microbiology and B.S. in biology and biology education from the University of São Paulo, Brazil in 2002 and 1999, respectively. Her research focuses on microbiological processes of biofilms in the environment. She is currently investigating the toxic effects of nanomaterials on biofilm communities from aquatic systems and the role of biofilms in corrosion.



## Navin Varadarajan

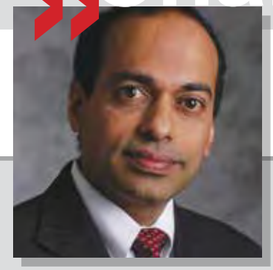
Assistant Professor of Chemical and Biomolecular Engineering

Navin Varadarajan joins the college from the Massachusetts Institute of Technology Chemical Engineering Department, where he worked as a postdoctoral researcher. He received a Ph.D. in chemistry from The University of Texas at Austin in 2006, M.S. in organic chemistry from the India Institute of Science in 2001 and a B.S. in chemistry from the University of Madras in 1998. His research interests include the development of high-throughput screens designed to characterize a wide range of functions ranging from the properties of proteins in single cells to antigen mediated cellular cytotoxicity.

**"We are thrilled to have so many new prolific faculty members to help grow our research enterprise."**

**- Dean Tedesco**

# New Department Chair



## Kaspar Willam

Hugh Roy & Lillie Cranz Cullen Distinguished University Professor

Kaspar Willam joins the college from the University of Colorado at Boulder, where he served as professor of civil engineering. He received a Dr.-Ing. Habil. Degree from the University of Stuttgart, Germany in 1980, a Ph.D. from the University of California, Berkeley in 1969, M.S. from California State University in 1966 and a Dipl. Ing from the Technical University in Vienna, Austria in 1964. He is a fellow of the American Society of Civil Engineers, the American Society of Mechanical Engineers and the U.S. Association of Computational Mechanics. In 2004, he was inducted into the National Academy of Engineering. His research interests include computational failure mechanics, finite element analysis, interface modeling, mechanics of materials, plasticity, elastic damage, high temperature effects on porous materials, localization analysis of cohesive-frictional materials, hygrothermal spalling of concrete materials and seismic response of masonry infill walls.



## Badrinath Roysam

Hugh Roy & Lillie Cranz Cullen University Professor and Chair, Department of Electrical and Computer Engineering

Badrinath "Badri" Roysam joins the college from Rensselaer Polytechnic Institute, where he served as professor of electrical, computer and systems engineering and professor of biomedical engineering. He also served as associate director of the Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems, a National Science Foundation Engineering Research Center, and co-director of the Rensselaer Center for Open Source Software. Roysam received a D.Sc. and M.S. in electrical engineering from Washington University in St. Louis in 1989 and 1987, respectively, and a B.Tech. in electronics engineering from the Indian Institute of Technology in 1984. His research interests include the study of algorithms and high-speed computing for imaging and image analysis with applications in biomedicine and biotechnology. He is working on the computational synthesis of molecular imaging systems, mapping of gene transcription activity, automated neuron and vessel tracing, biological image change analysis, laser retinal surgery and assay automation.

## Engineering Professor Receives
# Top University Award

For the second consecutive year, a Cullen College of Engineering professor has received the **Esther Farfel Award**, the highest faculty honor given by the University of Houston. A symbol of overall career excellence, it recognizes a professor who is a superior teacher, researcher and community member.

**Stuart Long,** professor of electrical and computer engineering, is the seventh professor from the college to be given the prestigious honor in the 32-year history of the award.

Since beginning his career at UH in 1974, Long has held leadership roles that include 15 years as a department chair, 12 years as associate dean of the college and, most recently, interim dean for The Honors College at UH. He presently serves as the university-wide associate dean for undergraduate research and The Honors College as well as the university's interim vice president for research.

In addition to teaching at least one course every semester, Long devotes time to students in the Electromagnetic Undergraduates Program, one of the longstanding programs that offers research opportunities to talented undergraduates in the department.

As a researcher, Long's work in applied electromagnetics has produced two new classes of antennas. Developed in the 1970s alongside UH Professor Emeritus Liang Shen, the compact, rugged circular microstrip antenna was first used by the military on artillery shells. Since then, the antenna's design equations have been adapted for use in a wide range of technology, including cell phones and other wireless communication devices.

Even more widely known is Long's work to develop the first dielectric resonator antenna. Unlike the earlier microstrip antenna, these antennas are useful for their efficiency at higher frequencies and were first used in the 1980s in communications systems for the military.

Over the course of his career, he has received more than 80 grants and contracts that have surpassed $17 million to support his research. Much of these funds have been focused recently on increasing students' interest in pursuing Science, Technology, Engineering and Math (STEM) majors.

Long received a Ph.D. in applied physics from Harvard University in 1974 and a B.S. and M.S. in electrical engineering from Rice University in 1967 and 1968, respectively.



## Faculty Accolades

### BIOMEDICAL ENGINEERING

**Metin Akay** received the Romania Diploma of Honor from Iasi University at the E-Health and Bioengineering Conference.

**Kirill Larin** received the Junior Faculty Research Award from the college.

### CHEMICAL AND BIOMOLECULAR ENGINEERING

**Vemuri Balakotaiah** has been named a Hugh Roy and Lillie Cranz Cullen Distinguished University Chair.

**Vincent Donnelly** received an Excellence in Research and Scholarship Award from the university.

**Demetre Economou** has been named a Hugh Roy and Lillie Cranz Cullen Distinguished University Chair.

**Mickey Fleisher** received a Teaching Excellence Award from the university.

**Michael Harold** received the Fluor Daniel Faculty Excellence Award, the highest award given by the college, as well as an Outstanding Teaching Award.

**Michael Nikolau** received the Senior Faculty Research Award from the college.

**Peter Vekilov** was elected vice president of the International Organization for Biological Crystallization.

**Richard Willson** was named a John and Rebecca Moores Professor.

### CIVIL AND ENVIRONMENTAL ENGINEERING

**Abdeldjelil Belarbi** was named an honorary member of Chi Epsilon, the honor society for civil engineering.

**Surendra Shah** was inducted into the Chinese Academy of Engineering as a foreign member.

**Kyle Strom** received an Outstanding Teaching Award from the college.

### ELECTRICAL AND COMPUTER ENGINEERING

**Stanko Brankovic** received a National Science Foundation Faculty Early Career Development Award. He also received an Excellence in Research and Scholarship Award from the university.

**Ovidiu Crisan** received the 2010 Institute of Electronics and Electrical Engineers' Student Branch Counselor Award for Region 5.

**John Glover** received the W.T. Kittinger Teaching Excellence Award from the college.

**Zhu Han** received a National Science Foundation Faculty Early Career Development Award.

**David Jackson** received an Outstanding Teaching Award from the college.

**Stuart Long** was named interim vice president for research for the university.

**Len Trombetta** received the Career Teaching Award from the college.

**John C. "Jack" Wolfe** has been named a Hugh Roy and Lillie Cranz Cullen Distinguished University Professor.

### INDUSTRIAL ENGINEERING

**May Feng** was named a Brij and Sunita Agrawal Faculty Fellow.

**Gino Lim** received an Outstanding Teaching Award from the college. He was also promoted to associate professor with tenure.

### MECHANICAL ENGINEERING

**Charles Dalton** received an Outstanding Teaching Award from the college.

**Venkat Selvamanickam** and collaborators at Oak Ridge National Laboratory and SuperPower Inc. received a 2010 R&D 100 award for their high-performance superconducting wires.

## Professor Receives International Award for Chemical Reaction Engineering

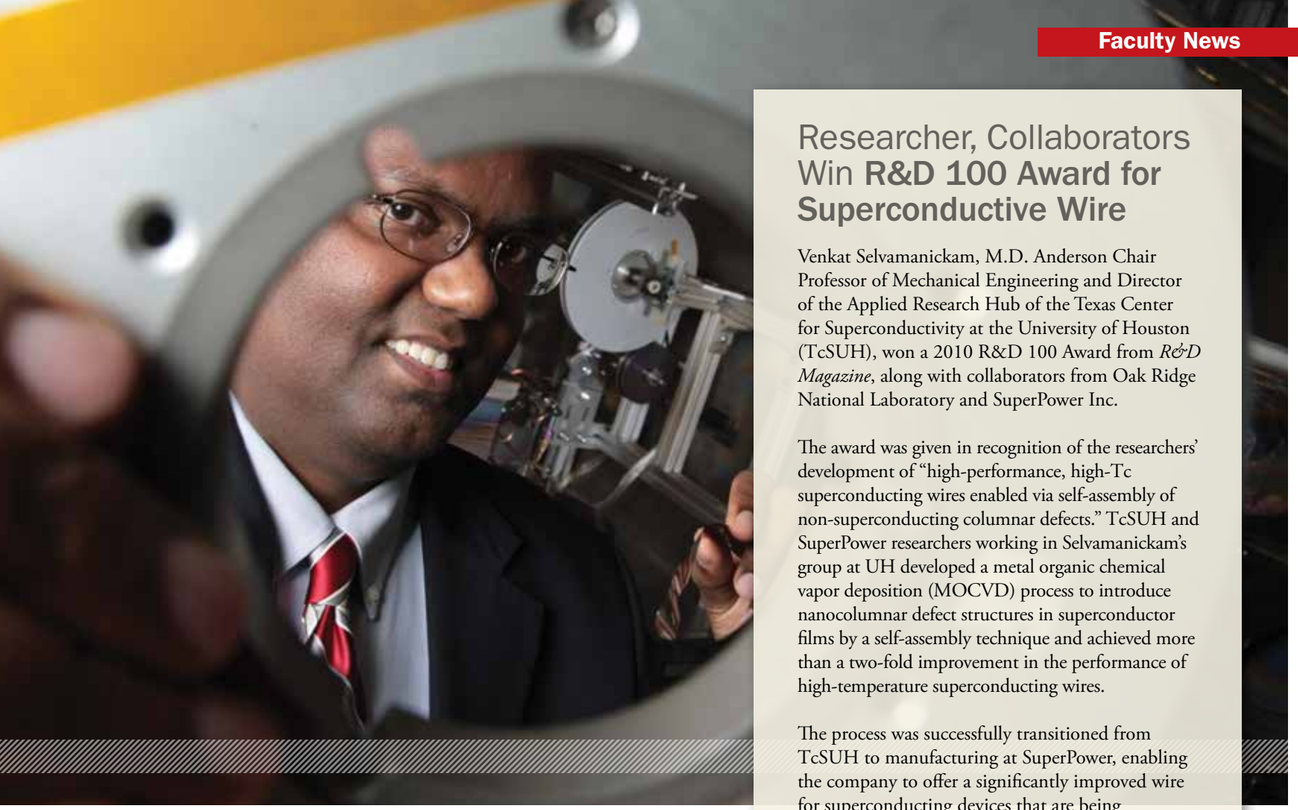
The International Symposium for Chemical Reaction Engineering (ISCRE) has named UH Professor Dan Luss as the 2010 recipient of the Neal R. Amundson Award for Excellence in Chemical Reaction Engineering. One of the highest honors in the field, the Amundson Award is bestowed every three years to recognize a pioneer in the field.

"Dan has been a leader in reaction engineering for many years," said Michael Harold, professor of chemical and biomolecular engineering, who co-nominated Luss for the award. "He is, in part, responsible for bringing advanced analysis methods to the field and developed advanced tools to solve problems of practical importance."

For more than four decades, much of Luss' research has focused on the safe operation of potentially unstable chemical reactors. Through advanced study of steady-state multiplicity and dynamics, he has been able to pinpoint what mode of operation or start-up leads to dangerous scenarios and map out how to avoid these potential hazards. In fact, many of his findings have been implemented as common operating standards and have even been a factor in the design and control of various chemical reactors.

The award itself is named after one of the most well known chemical engineering educators in the country, Neal Amundson, Cullen Professor Emeritus of Chemical and Biomolecular Engineering and professor emeritus of mathematics at UH. Amundson was the first winner of the award, which was later named in his honor. Luss, also a Cullen Professor, studied under Amundson at the University of Minnesota while pursuing his doctorate and was instrumental in recruiting him to UH in the late 1970s.

In addition to earning his Ph.D. from the University of Minnesota in 1966, Luss holds both a M.S. and B.S. in chemical engineering from Technion - Israel Institute of Technology in 1963 and 1960 respectively.



## Researcher, Collaborators Win **R&D 100 Award for Superconductive Wire**

Venkat Selvamanickam, M.D. Anderson Chair Professor of Mechanical Engineering and Director of the Applied Research Hub of the Texas Center for Superconductivity at the University of Houston (TcSUH), won a 2010 R&D 100 Award from *R&D Magazine*, along with collaborators from Oak Ridge National Laboratory and SuperPower Inc.

The award was given in recognition of the researchers' development of "high-performance, high-Tc superconducting wires enabled via self-assembly of non-superconducting columnar defects." TcSUH and SuperPower researchers working in Selvamanickam's group at UH developed a metal organic chemical vapor deposition (MOCVD) process to introduce nanocolumnar defect structures in superconductor films by a self-assembly technique and achieved more than a two-fold improvement in the performance of high-temperature superconducting wires.

The process was successfully transitioned from TcSUH to manufacturing at SuperPower, enabling the company to offer a significantly improved wire for superconducting devices that are being developed for energy, medical, transportation, industrial and military applications.

The advanced superconducting wire was developed at TcSUH under a contract with the U.S. Department of Energy through SuperPower. SuperPower is the first industrial partner in the TcSUH Applied Research Hub, which was created through a $3.5 million Emerging Technology Fund award to UH by the state of Texas earlier this year.


## Tool to Help Houston's First Responders **Avoid Flood Waters**

A computer-based system being developed by UH engineering researchers is expected to help Houston's emergency responders better navigate roads during times of flooding.

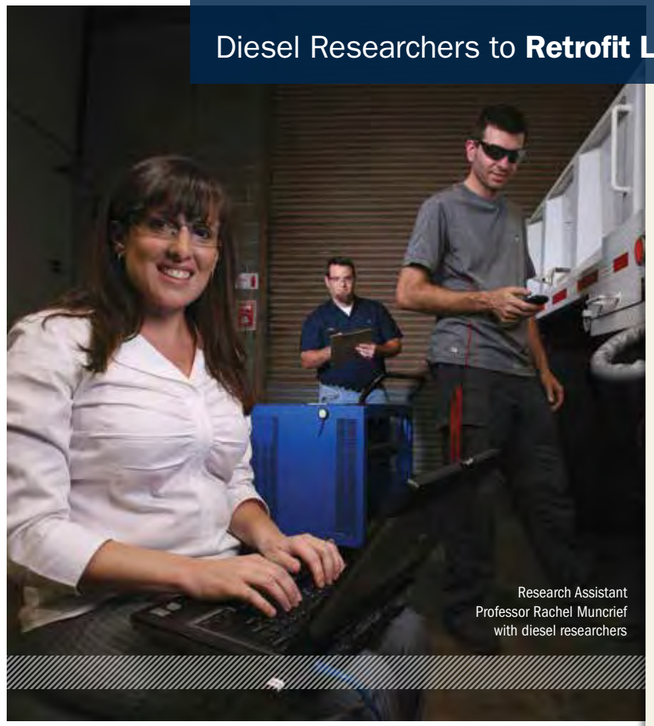
Designed to work similarly to Houston TranStar's online traffic map, the Real-Time Houston Flood Mapping System will use colors to instantaneously classify the amount of flooding present on roads near major highways within the borders of Houston's outer loop.

"This tool will substantially improve first responders' decision-making and their responding time," said Gino Lim, Hari and Anjali Agrawal Faculty Fellow and assistant professor of industrial engineering. "Information like that is priceless and could mean the difference between life and death."

To do this, Lim plans to merge city and county flood databases into one comprehensive resource that will be hosted on TranStar's website. The computer program will utilize existing cameras and rain gauges—which already feed data on water levels wirelessly to these databases—to aid in determining flood levels. Algorithms devised by Lim will turn this data into color-coded, visual representations of flooding on a map that can be accessed by emergency responders using the Internet on their laptop computers.

To ensure responders a fail-safe way of accessing maps, Lim will partner with Houston PBS to transmit a static image of the flood map via television signal, allowing responders to download the most up-to-date image to their laptop.

Using a $400,700 grant from the city of Houston to construct the flood map, Lim will work with researchers in the UH Systems Optimization and Computing Laboratory and the Southwest Public Safety Technology Center.



Research Assistant Professor Rachel Muncrief with diesel researchers

## Diesel Researchers to **Retrofit Local School Buses**

Using a $1 million grant from the U.S. Environmental Protection Agency, the Texas Diesel Testing and Research Center at the University of Houston will retrofit school buses with a system that attempts to diminish the negative impact their diesel emissions can have on the environment.

UH researchers will supervise the installation of Nett Technologies' BlueMAX Selective Catalytic Reduction System on 10 area buses. Over the course of the next two years, they will analyze the system's ability to reduce smog-causing Nitrogen Oxides (NOx) and sooty particles being released through emissions using a series of real-world tests.

"Retrofits are a cheaper alternative to completely replacing dirty diesel engines that contribute to non-attainment areas, such as Houston, being unable to meet air quality requirements," said Rachel Muncrief, the lead investigator on the grant and a research assistant professor of chemical and biomolecular engineering at the Cullen College. "The EPA is responsible for verifying the efficiency of retrofits before giving their approval for them to be utilized to get emissions credits. In-use testing projects such as these are an important part of the EPA's decision-making process when evaluating whether a technology should be verified."

The system is designed to convert NOx not only into water, but nitrogen gas by adding a reductant—in this case urea—to the exhaust stream. Sensors measure the amount of NOx present in the exhaust stream and determine the quantity of urea needed to produce a chemical reaction that reduces the NOx as it passes over a catalyst, thus releasing a smaller amount of toxins into the environment.

At least twice during the study, diesel researchers will conduct on-road tests using their portable emission measurement system as well as hook the buses up to a chassis dynamometer, which works like a treadmill for vehicles. Both tests will help them determine just how close the system can come to effectively reducing NOx as well as particulate matter and other pollutants produced by the buses.

"Houston has a high population density, poor air quality and is in an ozone non-attainment area due, in large part, to the significant amount of NOx emitted by diesel-powered vehicles and equipment," Muncrief said. "Retrofits have the potential to significantly reduce the total annual NOx emissions in the area."

Muncrief will work with diesel researchers Michael Harold, professor of chemical and biomolecular engineering, and Charles Rooks, director of the diesel center, on the project.

# 4

Four UH Cullen College of Engineering student teams captured first place in local and regional competitions this spring. Whether developing a small fuel-cell powered vehicle or crafting a canoe out of concrete, UH students clearly demonstrated how their teamwork and inventiveness can generate innovative solutions to engineering design.

## Chem-E Car Team
### Set to Compete at Nationals

It may not have been as sleek as other entries, but the Cougalac stole the show at the Chem-E Car Competition held at the American Institute of Chemical Engineers (AIChE) Southwest Regional Conference March 27.

Named after its bulky, gas-guzzling relative—the Cadillac—the 26-lb. car earned a team of eight chemical engineering students from the University of Houston a first-place win and a ticket to the national competition.

AIChE's Chem-E Car Competition, which began in 1999, allows students to apply their engineering knowledge to build an alternatively fueled car. Though each team must follow a set of rules governing what their car can and cannot do, in the end the design of the vehicle is something all their own. For the UH team—consisting of chemical engineering majors Richard Ma, Vinh Nguygen, Tola Ouk, Kennan Stuhr, Allen Lo, Abel Morales, Jorge Cubas and Walter Barta—it was the result of an entire semester's worth of brainstorming and a little trial and error.

With the help of Shell, the students were able to purchase supplies to build their car—designed to work on a pressure system. It relies on the decomposition of hydrogen peroxide using a catalyst (ferric chloride) that builds pressure in two tanks of the car. This pressure feeds oxygen to a pneumatic drill, which—much like a normal car—helps turn a gear that spins the front axle and moves the wheels of the Cougalac.

To capture first, the team's vehicle had to travel 50 feet carrying a water payload of 500 milliliters before coming to a complete stop as close to the finish line as possible. This, Cubas said, was the difficult part.

"Brakes were not allowed," he said. "The stopping mechanism had to be triggered by a chemical reaction."

The Cougalac beat its competitors on both runs—first with 44 feet and later with 51.5 feet—to represent the region at the national competition in Salt Lake City, Utah in November.

## UH Team Wins
### Texas VEX Robotics Championship

Calculated maneuvers and solid design earned a team of University of Houston engineering students a first-place win at the Texas VEX Robotics Championship this spring. The UH group beat teams from Rice University and The University of Texas at Austin for the top spot in the event's College Challenge.

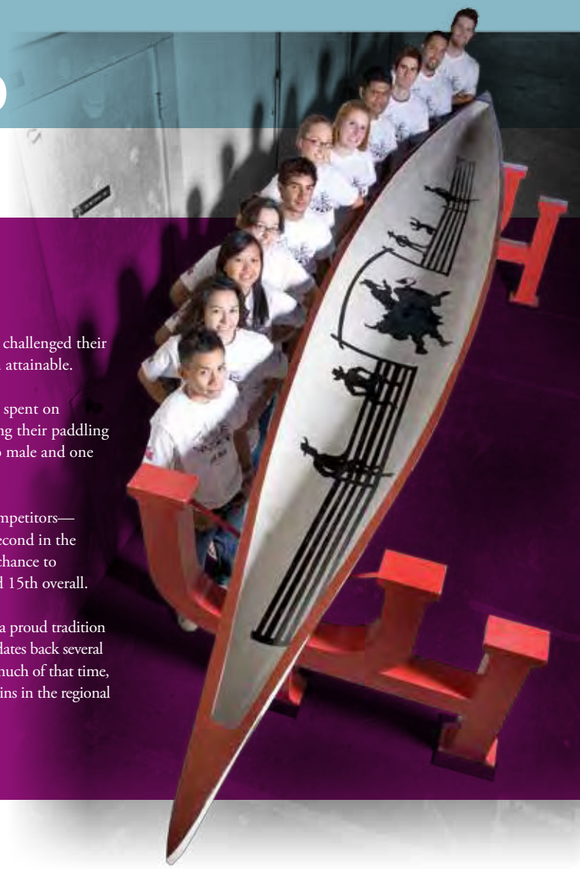
At the challenge, two robot pairs were placed on either side of a 12-foot by 12-foot square, walled competition field. Separated down the center with a low barrier, each robot team was tasked with locating and throwing different sized balls–ranging in point value–onto its opponents' side during a 60-second autonomous period. In the second part of the match, the robots were tasked with the same mission, only this time for 80 seconds, while being remotely controlled by an operator.

UH engineering students Hilario Torres, An Nguyen, Ryan Lee, Khary J. Bentick, Chris Lin, Pedro Cervantes, Gabriel Lugo, Ronald Barahona and Pablo Zamarripa Pesquera were the first UH students to ever compete in the event. All are members of the UH Robotics Team, a group that only became an official university student organization this spring.



# UH Teams Capture
# Consecutive Titles in 2010

## Concrete *Canoe*



A team of University of Houston civil engineering students worked for months to concoct the perfect recipe: a dash of fly ash, some silica fume, foam, shredded tires, PVA fibers, water, ceramic beads, glass bubbles and most importantly, a little cement. What they ended up with was a concrete mixture light enough to be buoyant.

It's what they used to pour their concrete canoe, Steer Clear, which took first place in this year's American Society of Civil Engineers (ASCE) Texas/Mexico Regional Concrete Canoe Competition. The students competed against 13 teams in early April for the title.

High rankings in each of the four portions of the competition—an oral presentation, design paper, physical display and five canoe races—earned them their spot. But it was their concrete mixture—poured to make the 215-pound canoe—that challenged their engineering minds and made the win attainable.

Many afternoons and weekends were spent on surrounding lakes and bayous bringing their paddling skills up to speed for two female, two male and one co-ed race in the boat.

At regionals, they breezed by their competitors—taking first in three of the races and second in the others. The win provided the team a chance to compete nationally, where they placed 15th overall.

Building and racing concrete canoes is a proud tradition among civil engineering students that dates back several decades. UH has been competing for much of that time, even earning back-to-back first place wins in the regional competition in 2007 and 2008.

## Robotics

A few sleepless nights and some creative thinking paid off big for one University of Houston robotics team at the 2010 Institute of Electrical and Electronics Engineers (IEEE) Region 5 Technical, Professional and Student Conference this spring.

The team—led by electrical engineering senior Osaid Shamsi (pictured), and comprised of electrical engineering seniors Carlos Moran, James Beamer and computer engineering senior John Hemmick—beat out more than 26 teams from 10 states to win first place.

Hosted by IEEE, the nation's largest electrical engineering professional organization, it was the second time in two years UH has taken the top spot for the region. In 2009, a group of students made history when they became the first UH team ever to win it.

Two UH teams were pitted against groups from Arkansas, Colorado, Kansas, Louisiana, Missouri, New Mexico, Oklahoma, South Dakota, Texas and Wyoming.

The autonomous robots competed on a square track equipped with an LED light in each of the track's four corners. Each of these lights emitted frequencies representing the resistance value of one of four eight-inch copper containers placed in the middle of the track.

At the start of each run, judges randomly set the resistance frequencies in each of the corners. Robots were programmed to measure the resistance values of the containers and take them to the corresponding corner. Though time was a factor—participants had a four-minute time limit—the run was based on the number of points earned for successful deliveries of the containers.

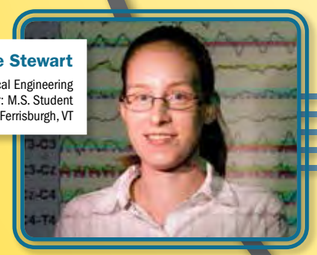
Both UH teams made it through the qualifying round, and went on to compete against 10 other teams in the first round of finals, where the UH team led by Shamsi captured the victory.

# Cullen*Connections*

At the University of Houston Cullen College of Engineering, students are connected through an active community of student organizations and college programs aimed at enriching the academic experience. Through these activities, a few of which are mapped below, Cullen College students develop interdisciplinary networks that serve as a support system for their success.

**Eduardo Valdez**
Major: Industrial Engineering
Year: Senior
Hometown: Houston, TX

**Ward Jablonski**
Major: Electrical Engineering
Year: Senior
Hometown: Friendswood, TX



**Nicole Stewart**
Major: Electrical Engineering
Year: M.S. Student
Hometown: Ferrisburgh, VT

## Undergraduate Research

Many students pursue undergraduate research opportunities independently throughout the academic year with professors or participate in the college's Research Experience for Undergraduates (REU) program during the summer. Undergraduate research is an important component for students who wish to pursue advanced degrees or research-based careers.

## AIChE

American Institute of Chemical Engineers

## NSBE

The National Society of Black Engineers at UH is actively involved in the college as the co-host for the Engineering Career Fair as well as in the community through a variety of programs such as A Walk for Education, which raises awareness about STEM education.

## Robotics

The UH Robotics team educates students about design and programming through local and regional robotics competitions. UH hosts a design competition for its members every year and students participating in senior design compete at the IEEE Region 5 Technical, Professional and Student Conference and the Texas VEX and World VEX competitions.

## Triangle

Triangle is a national fraternity for engineers, architects and scientists. UH has a very active student chapter.

## SHPE

The Society of Hispanic Professional Engineers at UH is involved in the national scene, with more than 40 students attending the national conference every year. Last year, several UH SHPE students won the Extreme Engineering Challenge, a round-the-clock exercise to test students' engineering skills.

## IIE

Institute for Industrial Engineers

## WIE

The Women-in-Engineering program provides workshops, mentoring programs and a strong network for female engineering students at UH.

## IEEE

Institute for Electrical and Electronics Engineers

## G.R.A.D.E. CAMP

Girls Reaching and Demonstrating Excellence (G.R.A.D.E.) CAMP is a week-long summer day camp designed specifically for entering 8th to 12th grade girls who want to find out what Science, Technology, Engineering and Mathematics (STEM) fields are all about through hands-on experience. Female UH engineering students mentor the campers while engineering faculty and graduate students lead interactive labs and activities during the week of camp.

## ASME

American Society of Mechanical Engineers

## PROMES

For more than 35 years, the Program for Mastery in Engineering Studies (PROMES) has provided a positive learning environment for underrepresented groups and first-generation college students. The program provides advising, workshops, scholarships and job opportunities for participating students. Many of the upperclassmen serve as teaching assistants for PROMES courses, creating peer-to-peer mentoring and tutoring opportunities for freshmen.

## EWB

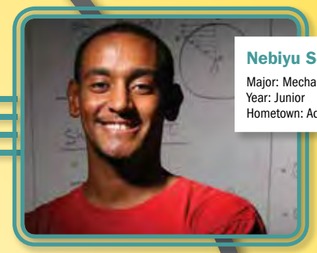
Engineers Without Borders is a recently launched organization at UH that provides developing international communities with support for sustainable engineering projects, such as sanitation systems to improve water quality.

## Engineering Workshops

The college hosts a variety of engineering workshops that serve as supplemental problem-solving sessions each week. Workshops are led by peer facilitators—students who have successfully completed the courses.

## GK-12

The GK-12 program allows graduate students to work with local schoolteachers to infuse their research topics into typical STEM classroom subjects. Students often promote traditional science and technology concepts through analogies to Harry Potter and current "hot topic" research areas such as nanotechnology.



**Nebiyu Sermollo**
Major: Mechanical Engineering
Year: Junior
Hometown: Addis Ababa, Ethiopia

**Lara Nguyen**
Major: Chemical Engineering
Year: Junior
Hometown: Honolulu, HI

**Folake Jeyifous**
Major: Biomedical Engineering
Year: Junior
Hometown: Houston, TX

**Nathan Howell**
Major: Environmental Engineering
Year: Ph.D. Student
Hometown: Frisco, TX

*For a complete listing of the college's student clubs and organizations, visit www.egr.uh.edu/people/?e=studentorgs*

# Engineering Education

Taken from *The Engines of Our Ingenuity*, Episode #1107

*Dr. John Lienhard*

How long have engineers been around? Well, it depends on what you mean by engineer. Whoever organized construction of the Great Pyramid, 5,000 years ago, richly deserves to be called an engineer. But the term has only been in general use for 200 years—since universities began training people to build things.

Before that, the great inventors and builders did their work without formal education. But by the mid-1600s, artillery and fortifications had grown so complex that armies began training officers in math and mechanics. That gradually turned into civil engineering. In 1775, King Louis XV of France authorized Jean Perronet to set up a School of Bridges and Highways with a three-year program.

After the chaos of the French Revolution, Napoleon decided he needed to start over. In 1794 he replaced Perronet's school with the Ecole Polytechnique and the game changed. The Ecole Polytechnique hosted the greatest mathematicians and theoretical mechanics of that age.

Lawrence Grayson's history of engineering education shows how that tradition exploded into America. As early as 1795, a crude form of military engineering was being taught in the town of West Point—even before the military academy was set up there.

In 1819, West Point began modeling itself on the Ecole Polytechnique. Rensselaer Polytechnic Institute offered civil engineering by 1828 and the University of Virginia by 1833. Norwich University was probably in the game even earlier. They all looked to France for guidance.

As I trace the old photos in Grayson's book, I see something I like. It's formality—of dress, of behavior. I'm probably the last dinosaur who still wears a necktie to teach classes. I do it to honor the process—like going to church. That necktie doesn't make me a better teacher or a more devout worshiper. It merely says I'm doing something I value.

One photo jumps off the page—a man and a boy at a blackboard, both friends of mine from long, long ago, both serious at their complex work. The man died young, from cancer. The boy went on to become a research director. The man lives on in the boy.

And I realize that I've now been in engineering schools for a fourth of the time the field has existed. I suppose it's no wonder I feel such love for these stiff images of students and teachers, once so serious and intent—on building America.

**The Engines of Our Ingenuity** *is a nationally recognized radio program authored and voiced by* ***John Lienhard****, professor emeritus of mechanical engineering and history at the University of Houston and a member of the National Academy of Engineering. The program first aired in 1988, and since then more than 2,600 episodes have been broadcast. For more information about the program, visit www.uh.edu/engines.*



# The Magic of Science

## Innovations in Nanotechnology and Nanosciences

With a $3 million grant from the National Science Foundation, UH Cullen College of Engineering Professors Pradeep Sharma, Fritz Claydon, Hanadi Rifai and Stuart Long are using the science behind Harry Potter and notions like invisibility and teleportation to teach children the basics of quantum mechanics and electromagnetism.

As part of the University of Houston's GK-12 Program, participating graduate students are working with local schoolteachers to promote Science, Technology, Engineering and Mathematics (STEM) fields. The program's interactive modules are designed to spark the interest of children in science while simultaneously allowing UH graduate students to practice articulating complex scientific ideas to a layperson audience.

Mechanical engineering doctoral student Parnia Mohammadi gives a lecture at Galena Park High School in Houston as part of the GK-12 Program at the University of Houston.

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## UH Engineering Students Winning at Robotics… and More

Rising enrollment has brought an incredible energy to the Cullen College, with more students than ever taking advantage of the activities and organizations available to them. For proof, look to the college's performance in recent engineering contests. Since March, teams from the Cullen College have won four local and regional competitions, two of which are repeat wins from the previous year. For more on these stories, visit page 20.