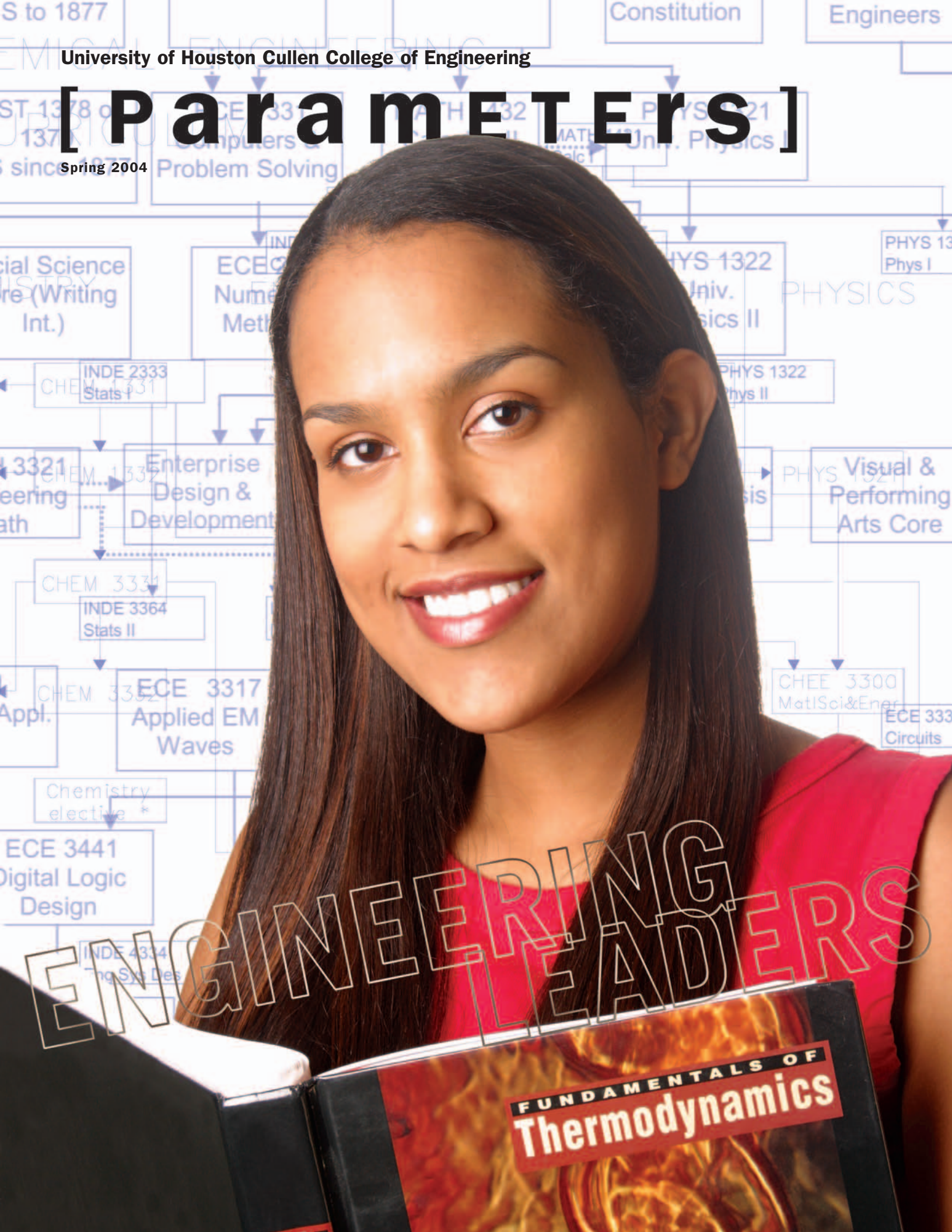
University of Houston Cullen College of Engineering

[ParamETErs]

Spring 2004



Dean's Message

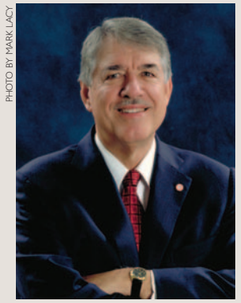


PHOTO BY MARK LACY

The last few months have been a particularly exciting time for our college as we have expanded our research efforts and strengthened our ties with our neighbors at the Texas Medical Center and NASA. But ever so subtly, and perhaps without as much fanfare, our educational programs are equally evolving, and we are poised to take an unprecedented leap to the next level.

Our unique assortment of educational programs has placed us in the vanguard of educational outreach and teaching innovation. The result is a better-prepared graduate who enters the working world with the tools necessary for a long and fruitful career. Our efforts involve team-based workshops, summer programs, certificate programs, research programs for high school teachers, and an elite new program that stresses leadership and entrepreneurial skills.

As this issue of *Parameters* illustrates, we are well down the road to reshaping the way engineering education is delivered. As engineers, we are inclined to address real-world problems with real solutions. One example is our response to the job "outsourcing" problem, which has received significant attention in the media recently. A huge number of high-tech jobs are shifting overseas, meaning the U.S. job market is becoming more and more competitive. We're actively addressing this problem and offering options to our students that we feel will enhance their marketability. Our Engineering Leadership and Entrepreneurism Program is one of many ways we uniquely prepare our graduates to gain the competitive edge in the market place. By preparing them to be innovators and leaders, we are differentiating our graduates from those of other engineering programs.

Another real-world problem is the shortage of young people in the country selecting engineering as a career. Our solution: We are launching nationally funded programs (e.g., the Infinity Program and others) to reach high school students across the Houston metropolitan area, all designed to spark greater interest in tomorrow's pool of student candidates.

Our new Science and Engineering Research Building will enhance our research efforts across several key areas. BioNano research, in particular, will benefit tremendously. With the recent addition of our new undergraduate program in biomedical engineering, combined with recent strides in the nano-engineering area, our college is poised to become one of the premier players in this important area. As we do this, our bonds with neighboring institutions in the Texas Medical Center grow stronger and more productive.

Although we are making positive strides in all our programs, the challenges that our students face continue to grow, not only after college but during college as well. Because of the necessity of recent state budget cuts, our students face much tougher financial hurdles on the way to graduation, making the importance of scholarships greater than ever before. Our donors, who are recognized in this issue of *Parameters*, play a vitally important role in protecting the access to education that has been the hallmark of our college since its inception.

Our students, faculty, donors and friends are all working together, not only to push the college forward but also to aim for tomorrow's breakthroughs in innovation, technology and business leadership. Let's keep it rolling!

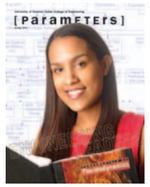
Sincerely,

Raymond W. Flumerfelt, *Dean*
Elizabeth D. Rockwell Endowed Chair

pa·ram·e·ter
Pronunciation: pə-'ram-ə-tər
Function: noun
Etymology: New Latin, from para- + Greek metron measure
Date: 1656

1: a. an arbitrary constant whose value characterizes a member of a system (as a family of curves); also: a quantity (as a mean or variance) that describes a statistical population
b. an independent variable used to express the coordinates of a variable point and functions of them—compare PARAMETRIC EQUATION
2: any of a set of physical properties whose values determine the characteristics or behavior of something
<parameters of the atmosphere such as temperature, pressure and density>
3: something represented by a parameter: a characteristic element; broadly: CHARACTERISTIC, ELEMENT, FACTOR
<political dissent as a parameter of modern life>
4: LIMIT, BOUNDARY—usually used in plural
<the parameters of science fiction>

Contents



Engineering Leaders
Eda Braña-Soto is a junior honors student in mechanical engineering, and she is one of many UH engineering undergraduates benefiting from UH Cullen College of Engineering's exceptional educational programs and innovations in teaching, retention and training that make UH graduates unique, and prepare them to be leaders among the next generation of engineers.

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

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SHOW YOUR PRIDE

Affix the enclosed UH Cullen College of Engineering decal to the back window of your vehicle. Send us a photo of you and your car showing the decal to the e-mail or address on the left and we'll post it to www.egr.uh.edu/pride. Make sure to include your name, class year and why you're proud to be a Cougar Engineer!

Key Research Areas Converge in $81 Million Complex at UH

The University of Houston commemorated a "groundbreaking" step toward the future of collaborative research and high-tech classroom instruction with a formal ceremony Dec. 5.

The $51 million Science and Engineering Research and Classroom Complex (SERCC), which also will require approximately $30 million to furnish and equip its 40 labs and "clean room," will be the only academic facility of its kind in Houston. Here, the pursuit of crucial cross-disciplinary research in a state-of-the-art structure will ultimately lead to breakthrough innovations.

According to Steven Pei, associate dean for research in the Cullen College of Engineering, such an integrated facility will lead to powerful innovation that will continue to push limits. Nano-lithography, for instance, is a key area, Pei says, where the combination of the powerful optoelectronic and magnetic technology with novel nano- and bio-materials will yield new functionalities and capabilities that far exceed the current microelectronics technology, which has been driving the high-tech industry and the economic growth of the world since the creation of Silicon Valley.

"There is so much going on in both science and engineering right now with research that holds countless opportunities for the future," said Pei. "The proximity and complimentary capabilities offered by SERCC will change dynamics completely to create a stimulating environment, and it's in that creation of an intelligent spark where creativity is born."

Pei also stressed that this type of intellectual property is the key to maintaining a competitive edge in both research and economic impact, calling it "the engine to drive the economy for the region."

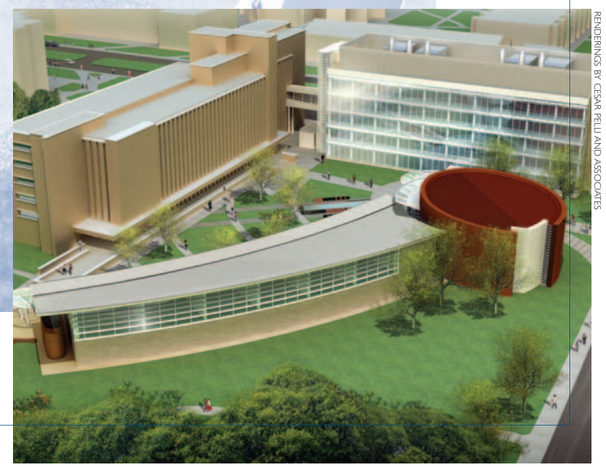
"It is our job not only to disseminate, but also to create knowledge," Pei said. "UH is stepping up to the plate to strengthen the region's infrastructure and will ultimately play a major role in carrying American innovation to the next level."

In addition to the research marvel this building will become, high-capacity classrooms and a spacious oval teaching theater will advance the overall academic objectives of UH even beyond the research to be conducted in SERCC.

"These classrooms will enable UH faculty to provide growing numbers of students from every discipline with technology-enhanced instruction. The auditorium and 11 classrooms, together accommodating more than 1,700 students during each teaching hour, will address the desire of faculty and students to teach and learn within engaging, innovative space," said Elaine Charlson, associate vice president for Academic and Faculty Affairs and professor of electrical and computer engineering.

For more information, visit www.uh.edu/media/serc.

Ron Lohec (1955 BSME) and wife Bo, Dean Raymond Flumerfelt and faculty and staff from the college, including John Lienhard, Jack Wolfe, Angie Shortt, Vita Como, Steven Pei, Elaine Charleson, Michael Massey, Stuart Long and Dmitri Litvinov, were on hand for the groundbreaking of the new Science and Engineering Research and Classroom Complex.



RENDERINGS BY CESAR PELLI AND ASSOCIATES

Petroleum Engineering Program Expands To Sugar Land, Cinco Ranch

Earning a master's degree in petroleum engineering from UH got easier in January 2004 when the Cullen College of Engineering expanded its course offerings in this program to two teaching centers—UH System at Sugar Land and UH System at Cinco Ranch. The petroleum engineering master's degree program is based at UH.

"This expanded program in petroleum engineering provides people who live and work in the Energy Corridor convenient access to courses needed for a master's degree in this field," said Christine Ehlig-Economides, professor of chemical engineering and director of the program. "Students are able to attend classes toward the degree program on any of the three locations."

Information and applications are available at www.che.uh.edu/petroleum.

PHOTO BY JONATHAN COBB

Visteon brought a prototype of the test vehicle to UH last summer.

UH Partners with Visteon on Enhancing New Police Vehicles

UH engineers recently launched a research project with Visteon Corporation to enhance the next generation of police cars with new technology featuring voice command, touch screen and control pad that integrates command-and-control into a single system. Spun off from Ford in 2000, Visteon is one of the largest automotive suppliers in the world, and has 72,000 employees in 25 countries.

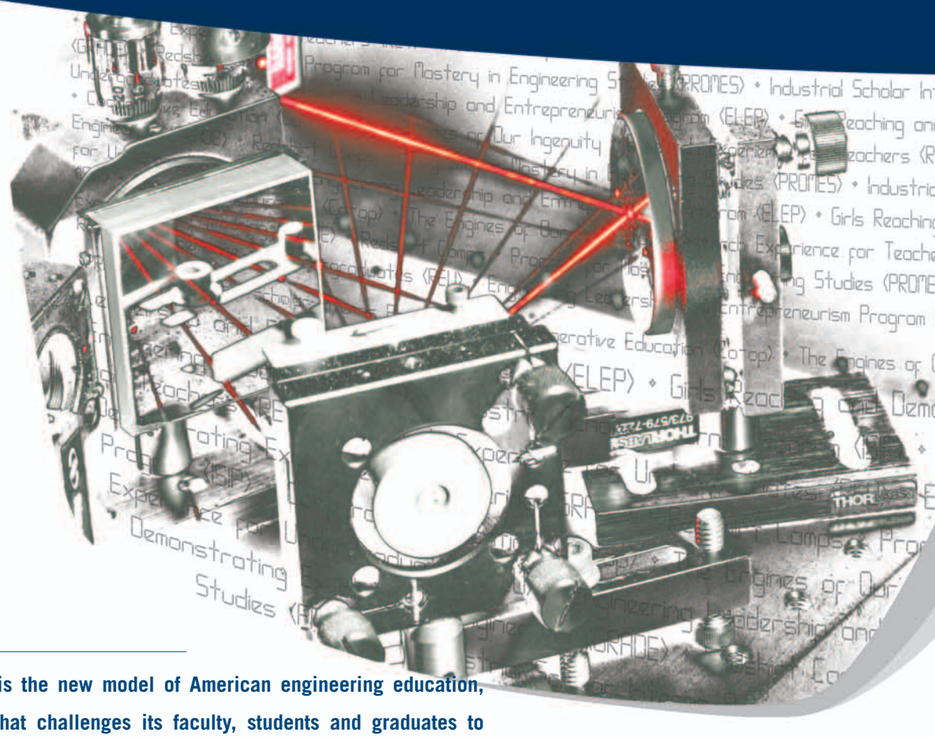
Steven Pei, associate dean for research in the Cullen College of Engineering and the lead researcher on the project said, "We are looking forward to a long-term partnership with the automotive industry and the law enforcement community to develop the next generation integrated mobile command-and-control capability. We plan to acquire two state-of-the-art law enforcement vehicles for the UH Police Department as the test bed from the TACNET division of Visteon." Developing ways to integrate systems so that they work well with each other and the rest of the vehicle will be a key focus of the research, Pei said.

Police departments typically add many devices to the police cars they acquire from manufacturers. Each piece of equipment, from sirens to radios to computers, requires its own controls and monitoring devices, which tend to overcrowd the driver cockpit. In addition, these systems often are not designed or installed to focus on usability for the driver and ergonomics inside the vehicle. TACNET was designed to eliminate those problems.

Visteon's system dramatically reduces the number of devices installed in a police car interior by integrating them into a single command-and-control unit that is accessed by voice command, touch screen or control pod.

RESHAPING ENGINEERING EDUCATION

FEATURES BY BRIAN ALLEN
PHOTOS BY JEFF SHAW



As millions of high-tech jobs are being lost to overseas competitors, the landscape of professional engineering in the United States is changing rapidly. Engineering colleges are under pressure to respond, but what exactly are they supposed to do? They cannot stem the tide of change itself, but they can prepare their graduates for greater success in tomorrow's leaner marketplace.

The UH Cullen College of Engineering is doing that and much more as it heralds the dawn of a new kind of engineering education designed for the challenges of the 21st century. UH engineers are launching nationally funded programs in teaching, recruiting and retention that address a multiplicity of needs: The need to recruit more girls into the field of engineering, the need to connect with high school teachers, bring engineering into high school classrooms and inspire students while they're still in the decision-making process about college studies.

In addition, UH engineers are fostering new teaching techniques that stress team learning and problem-based learning, which are proven strategies that better prepare students for life after graduation. Programs such as the new Engineering Leadership and Entrepreneurism Program offer students a rare opportunity to combine the knowledge of business practices with the technical design skills they need to succeed as leaders of their own business or leaders within an existing company. With an emphasis on the often-overlooked softer skills, such as communications, presentations, marketing and finance, the new courses pave the way to success in business.

This is the new model of American engineering education, one that challenges its faculty, students and graduates to dream big, to invent tomorrow's breakthroughs in technology, and to produce the leaders who will give us answers where today only questions prevail. Questions like, where will we turn for energy when the world's supply of oil and natural gas runs out? How can we clean up toxins and ensure the purity of water, air and soil for future generations? What can we do to cure the sick, heal the injured, and protect our citizens from the threat of terrorist attacks? How can we accelerate the exploration of outer space?

At the University of Houston, some of the country's best and brightest engineers are formulating the right answers to those formidable questions. UH engineers are also molding tomorrow's leaders, the men and women who will invent new technologies, drive the new economy and give shape to our best dreams of the future.

Business-Focused Program

Teaches Highly Marketable Skill Set to Seniors

The program, one of only a handful of its kind in the country, represents a recent trend toward incorporating business concepts in engineering programs. It has a project-focused curriculum designed to simulate the realistic conditions surrounding technical-based companies. The program, which includes assigning each student a mentor in the business community, emphasizes problem-based learning, professional communications and the integration of business and engineering concepts.

Don Engelstad worked for 29 years as an engineer with Shell. Along the way, he picked up a good deal of business savvy. Today Engelstad is helping UH engineering students get a handle on the business aspects of engineering before they enter the workforce by teaching part of the curriculum for the college's Engineering Leadership and Entrepreneurism Program (ELEP), which was launched last year.

Engelstad developed the program with Professor William Sherrill, director for the Center for Entrepreneurship and Innovation at the UH Bauer College of Business, and Hamid Parsaei, chair of the UH Department of Industrial Engineering. The three lead a team of instructors and guest speakers as they guide the students through a two-course program designed to prepare graduates to be more successful when assuming leadership roles in their companies and facing real-world business challenges.

"I fumbled around with the business thing for five or 10 years after college before I got a handle on it," says Engelstad. "I learned on the fly, and probably not very well. Where as here, we have Professor Sherrill, who is a real expert. We try to bring in practical world experience. Sure we teach out of the textbook, but students can read that stuff. So we also try to show how we've lived the things that we've learned."

"This new program combines two of the university's traditional academic strengths—business and engineering—but in an innovative new way," says Raymond Flumerfelt, dean of the UH Cullen College of Engineering. "It prepares students for the real challenges of today's competitive global markets, and it grooms them for entrepreneurial and intrapreneurial success in a technical-type business."

During the classes, students are divided into enterprise teams, each selecting executive leadership positions and a product or service, form a board of directors, prepare a business plan and request capital—fictitious money—from an investment board. The teams have to deal with real-world challenges, such as technical, manufacturing, financial, environmental, legal and human resources issues.

"I believe this program will widen the perspective of the engineering students, especially when it comes to the total business process in which they're involved," said Sherrill, who assisted in developing the program's curriculum and helps teach the courses.

The program, the brainchild of Dean Flumerfelt, was conceived to address the needs of the students as well as their possible future employers.

"When the dean originally surveyed the engineering community, he found out that our students are great technically—they can solve a differential equation or design a chemical plant, or design some kind of fancy circuit—but their shortcomings were on the softer side—making presentations, working on teams," says Engelstad. "We're trying to differentiate our students from students from other universities, to give our students a competitive advantage in the marketplace."

Because technical jobs are moving overseas at a rapid rate, having an advantage may be more critical than ever. Graduate Teaching Assistant Arun K. Adat sees the program as a strong benefit for UH graduates. "China and Japan are producing more engineers, but the advantage which the West has is English is still the business language of the world. So if we can produce engineers who understand the business aspects in addition to being technically sound, then we can produce a more effective engineer."

The second course of the program addresses the more technical aspects of engineering design. Hamid Parsaei, one of the principal developers of the program, leads the students through the process: "They were asked to think about the material selection, the fabrication process, and building the components of the product. They were also asked to think about a new generation of the product. And they did a wonderful job."

Senior engineering student Shilpa Singh is in the second course of the program and serves as CEO for her team, which focused its project on creating a business plan and the creation of an electronic paging device to help people find lost items, such as car keys or remote controls. She says the program has been meaningful to her in many ways.

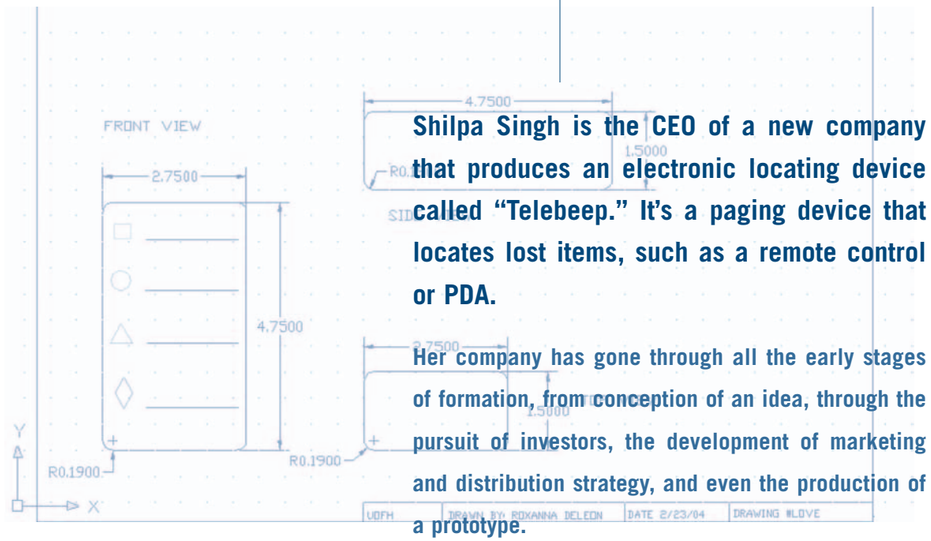
"It's an experience that is very unique," Singh says. "It doesn't just give you the experience to become an entrepreneur; it gives you many other things. It gave me training of business, of team building, of being a leader; it gave me the gift of having a mentor, more personal confidence, and helped with my personality development. And these are qualities that are very attractive to employers. They want someone who can work in a team, who knows how to resolve conflicts, and knows how to build relationships while working together." ■

Engineering students Nimit Shah, Roxanna Mezquiti, Morolake Kuteyi, Kelechi Agim, and Shilpa Singh wear their new Engineering Leadership and Entrepreneurism Program jackets.

Engineering + Business + Communication
Leadership + Professionalism
Education Experience + Future Challenges

Team Learns How To Launch

A SUCCESSFUL NEW BUSINESS



Shilpa Singh is the CEO of a new company that produces an electronic locating device called "Telebeep." It's a paging device that locates lost items, such as a remote control or PDA.

Her company has gone through all the early stages of formation, from conception of an idea, through the pursuit of investors, the development of marketing and distribution strategy, and even the production of a prototype.

But there is something unique about this company: It doesn't actually exist. Singh and her team of corporate executives are students in the Engineering Leadership and Entrepreneurism Program at the UH Cullen College of Engineering, and their company is the result of a realistically detailed experience designed to cultivate the business skills of the students to a mature level before they even enter the real business world.

The program, which was launched last year, begins by grouping a select cluster of students into teams of five, and those teams become the corporate leadership of new companies charged with the task of successfully launching their business.

"The first semester, you come up with your product idea, formulate the business plan, go in front of investors for money and write an annual report," says Singh. "At that point it's like swimming with sharks because up to this point we had never really studied business. We were told, 'Part of the program is learning; you have to go out and find examples of business plans on the Internet. You're seniors, and as a good engineer you should be able to solve a lot of problems.'"

The team had to find a real manufacturer and get an estimate on costs, although for the class they produced a plastic prototype using 3-D printing technology.

Next the team contacted a company for shipping, and they went with U.S. Ocean and Air, who offered an estimate of how much shipping would cost. The team pulled together what it believed was an optimal business plan, and then made a presentation to potential investors (the program brings in real financial professionals).

Students Morolake Kuteyi, Roxanna Mezquiti, Nimit Shah, Shilpa Singh (also pictured on opposite page) and Kelechi Agim worked together to launch their own mock company and product.

"We didn't really know at that point that we hadn't looked at all the aspects of the business—insurance for the cargo, salaries for the company officers, salaries of other employees, office space," says Singh. "Since it was all very fictional, we didn't add everything that was supposed to be there. The investors asked many questions that we really never had thought about but were very important."

The team then set out to revise its plan, and one of the key changes was raising the amount of capital they were seeking to meet realistic expectations. "We were asking for $200,000 and they said, 'This is just not going to work out for you. You're going to shut down in the very beginning. You need enough capital.' They gave us quite a few tips on how to properly formulate the business plan."

Next, the team prepared an annual report, including financials, details about the design, an estimate of when they could have a prototype ready, and a detailed description of future plans for the company. "It was a lot of work," Singh says. "In between all that, we had lots of fun activities too. We had a retreat in the Hill Country; we were given iPAQs; we had a Jacket Investiture ceremony."

Each team was also required to make five presentations because the program places a strong emphasis on developing public speaking and leadership skills.

"A lot of class time was spent on the podium," Singh says. "They are trying to teach us to be confident public speakers. I've seen a lot of the students change from being shy to outspoken. This class has not just given us an experience, it has given us the gift of personal achievement."

The second course is focused more on technical design aspects. The team had to build a plastic prototype using a rapid prototyping machine, which is housed in the Department of Industrial Engineering. By the end of the second course, each team is expected to deliver a final report with a final business plan and a working model.

The program enables graduates to enter the working world with the business skills and knowledge that other graduates might need years to develop. ■

INNOVATIVE EDUCATIONAL PROGRAMS HELP MOLD NEXT GENERATION OF ENGINEERS

By Portia-Elaine Gant and Amanda Strassner

Equipped with an exceptionally trained staff and an assortment of innovations in teaching, recruitment, retention and outreach, the Cullen College of Engineering at the University of Houston has become a leader in the national effort to reshape engineering education. Funded primarily by the National Science Foundation (NSF), some pioneering and highly successful programs are expanding rapidly in size and scope.

A total of 44 high school girls encountered electrical engineering at two GRADE Camps last summer. The first week's participants are pictured above.

In an attempt to encourage such programs, NSF recently awarded the college a $1.5 million grant over five years to expand programs that began in the Department of Electrical and Computer Engineering (ECE). The grant will fund a multifaceted initiative called "STEP-AHEAD: Access to Higher Education through Academic Retention and Development," and will be used to expand the programs to include all five of the college's departments.

The initiative focuses on the expansion of two programs: The highly successful "Girls Reaching and Demonstrating Excellence in Engineering" (GRADE) Camp, which introduces girls in grades 9–12 to the engineering field, and "Redshirt" Camps, which are designed to offer guidance to UH engineering students tackling some of the most difficult courses in the curriculum. The ECE camp and workshops are funded by the Texas Engineering and Technical Consortium, a statewide program created to compensate for a dramatic drop in engineering graduates over the past decade.

"We thought the Redshirt Camps were very successful in electrical and computer engineering. They were well received by the students," says Stuart Long, associate dean for educational activities. "We want to give that same kind of assistance to people in the other departments. We think it will have the same kind of impact. If students are more successful, they're more likely to stay and complete their degree in engineering."

While recruitment and retention programs are beneficial in increasing the college's enrollment, Long says that due to the projected decrease in engineering graduates, he was interested in sparking an interest in engineering in students, regardless of what university they plan to attend.

"We are trying to let students know that engineering is a good career and a viable option to look towards," Long says. "They watch television, and they see the show *Law and Order* and want to be a lawyer. They see *ER* and want to be a doctor. They don't have any role models out there to make them want to be an engineer." »

Industrial Engineering Student Unites *Academic Excellence, Community Involvement, Leadership Skills*

By Portia-Elaine Gant

All education doesn't take place in the classroom, and industrial engineering major Lorenzo X. Cano is well aware of that fact. Like many students in the Cullen College of Engineering, Cano maintains exceptional grades and still immerses himself in extra-curricular activities to hone his leadership skills and obtain a better education.

"I think it's important to have other interests because going to school for four years and focusing on one major you learn a lot, but when you increase the scope of the things you do, it makes you a more well-rounded person," Cano said. "It allows you to meet different people, have different experiences, and by the time you graduate, you will not only have a strong sense of your major but other things in life."

Cano, a senior, has not only participated in engineering activities but is also the president of the Hispanic Students Association (HSA) and active in the community. From his fraternity involvement to his recognition as the 2003 Homecoming King, Cano's desire for leadership and community outreach is evident.

"I enjoy participating in community service events," Cano said. "Each experience has affected me in some way. You begin a project with the goal of making a difference in someone else's life, but I've learned that you are touched also. You are exposed to other realities you never might have faced."

During the holiday season, HSA sponsors an annual Thanksgiving event for the less fortunate. Those are the experiences that Cano said not only touch him but inspire him to achieve greater things.

"Because we deliver food to their houses, I see how some people live. Some people live in houses that are falling apart, they may have rats or a family of 15 living in one bedroom," Cano said. "It makes you appreciate what you do have, and you see how other people manage to make it despite unfortunate conditions."

Cano touts accolades and recognition for his work in the community and from his fraternity, Sigma Lambda Beta, but his leadership skills merged with his engineering background during his summer internship with Frito-Lay.

"As an intern for Frito-Lay, I was an assistant to the warehouse manager, and one of the main things I did was implement the new packaging scanners in the packaging room center. It involved me learning how to use their program and finding ways to teach the program to the workers effectively. I had to see how the workers were doing after the scanners were installed, what mistakes were being made, and find out ways to improve any problems," Cano said.

The outcome of his work ended with increased efficiency and savings for Frito-Lay, and Cano reaped benefits of his own from the program.

"I learned a lot about the different functions in a business and about working in a warehouse. I learned a lot about logistics, transportation, distribution, supply chains, management, production, technology, warehouse efficiency, and most importantly, living on my own for the first time," Cano said.

At the beginning of the Fall semester, Cano joined the multitudes in search of financial aid and scholarship funds. After going through multiple applications, he captured the 2003 John Lienhard "Engines of our Ingenuity" Scholarship Endowment.

"I think that the function of a scholarship is as much to bestow confidence as it is to see people through hardship. This is a fairly generous scholarship, but that's only help for someone who is already motivated," said John Lienhard, M.D. Anderson Professor Emeritus of Mechanical Engineering and History.

Motivation was not a problem for the once music major who claims to have learned his life lessons through his music interests, community service and travel, and coupled with a fondness for engineering. While Cano is not sure whether he will continue with a master's degree in engineering or business, his involvement in engineering and extra curricular activities has made him certain that he wants a career that deals closely with leadership.

"While in college, I've learned to enjoy leadership and structure within organizations, so I'd like to apply that to something with engineering," Cano said.

GRADE Camp is a weeklong summer endeavor geared toward girls who are entering grades 9–12. Instead of including potential engineering majors only, the program is designed to expose young females to the field.

"We have created GRADE Camp to support a 'theory into practice' model," program director Jenny Ruchhoeft says. "Each morning the girls learn about underlying theory, such as voltage and current, motors and generators, and feedback control, for example, and then they apply that knowledge in their Robotics Lab during that same afternoon."

As an added bonus to the already fruitful experience, if participants enroll at UH as engineering, natural sciences or mathematics majors they receive a $1,000 scholarship. Four one-week camps are offered during the summer for $200, and scholarship opportunities are available to cover that cost. The fee covers lunch, snacks, materials and a newfound sense of confidence in the young participant.

Ash Nguyen, who attended the 2003 camp, says, "I saw Chidiogo (Madubike) and Diana (De la Rosa) up at the front of the room teaching us and I thought, 'I could do that too!' Now I know that there are women in engineering and there are organizations like the Society of Women Engineers (SWE) to support them."

Graduate student Ben Fasenfest (2002 BSEE) advises Stephen Arkenbruck during a Redshirt Camp, which uses collaborative learning to increase student retention.

The Promise of 'PROMES'

Though events such as GRADE Camp kindle a potential student's interest in the college, PROMES (pronounced 'promise') works in all facets of a student's educational experience, including academic advising, team-learning and study skills, scholarships and job-search assistance.

The program, developed by Engineering Professor Gerhard Paskusz, began more than 25 years ago and provided the foundation for many of the teaching innovations now being implemented in the new programs. Paskusz says he was inspired to create PROMES by General Electric CEO Reginald H. Jones, who delivered a speech that named engineering as the vehicle for elevating the economic future of minorities.

"That's what the impetus was," says Paskusz of Jones' speech. Paskusz then utilized a $5,000 grant from DuPont to start the program.

"PROMES is a backbone to a lot of engineering students," said industrial engineering student Morolake Kuteyi. "Some students say that if they were not involved in PROMES they don't think they would be engineering majors."

Since its inception, the program has evolved from an eight student, minority-only membership to a diverse group of more than 500 students. It offers special courses and workshops, and directs students to the Cooperative Education programs, where a semester of on-campus study is juxtaposed with a semester of work in industry.

PROMES offers a two-week summer venture for students entering grades 8–11, which is free of cost, courtesy of the Chemical Industry for Minorities in Engineering, the American Society of Civil Engineers and a variety of other corporations.

One of the main concerns for engineering colleges nationwide is student retention, and ECE spoke directly to that concern with the development of its Redshirt Camp. The foundation of the program is to assist students in the essential engineering courses. The highly interactive and collaborative experience is led by engineering faculty and was created by ECE Chair Fritz Claydon and Associate Professor David Shattuck, who helped bring in state and private funding.

"Here's the premise: I learn things best not when I do them but when I teach them to somebody else," Shattuck said. "Now that's a paradox; that's a bizarre notion. How do I teach it to somebody unless I've learned it already? But in fact you learn it better when you try to teach it to somebody else."

Shattuck says that the pass rates for both courses traditionally lingered around 50 to 60 percent, but the program participants passed at a rate of 73 to 91 percent, a dramatic increase that Shattuck in part attributes to PROMES.

Job Opportunities Key to Student Work Experience

Established four years ago by Dean Raymond Flumerfelt, the Industrial Scholar Interns Program (ISIP) is another tool offered to engineering students who are interested in obtaining scholarship funds, extra money and valuable work experience during their junior and senior year.

ISIP has taken advantage of the university's urban location and formed alliances with local industry. A 2.75 grade point average is required to participate, and students in the program receive $2,500 in scholarship funds each year for four years in addition to their internships. During an internship, students work part time and must maintain a minimum of 12 hours of coursework. Through the internship, students have the opportunity to earn up to $30,000 during their junior and senior year. ▸▸

ISIP students Jeswin Manakalathil and Yassaman Ebrahimi rack a high voltage circuit breaker with D.C. "Frog" Smith (wearing an arc protection suit) in a substation at Valero.

While ISIP speaks to students who have the time to work and go to school, Cooperative Education (Co-op) enables college students to receive paid training that is documented on a student's official transcript. There is a registration fee, much like with regular courses, and the student is assigned a grade based upon a work report that must be submitted.

The GPA requirement for interested students is a 2.25, but most companies prefer a higher GPA. Not only does the program provide hands on experience, it serves as a link into the business world, with most companies hiring graduates from their own programs.

Junior Honors Student Off To Fast Start in *Mechanical Engineering*

When Eda Braña-Soto arrived at the University of Houston two years ago, many things were new to her—dormitory life, college classes and new friends. But one thing was not new: the college-level academic work. Braña-Soto entered UH with nearly 50 hours of college credit earned as a high-achieving student at Westside High School in Houston.

In her fourth semester, the mechanical engineering major always gravitated toward the advanced placement courses, and had a particularly liking for math and science. Not coincidentally, Braña-Soto's parents both have college degrees in engineering. Her father, who taught engineering at the University of Illinois at Chicago, earned his bachelor's in chemical engineering at the University of Puerto Rico and his Ph.D. at the University of Wisconsin. Her mother also holds a bachelor's in chemical engineering from the University of Puerto Rico.

Yet even with all that engineering in her background, her decision to pursue engineering emerged only near the end of her high school days. "I really wasn't thinking all the time about engineering," she says. "I was more interested in astronomy, astrophysics, but I also knew that it was a very limited field, not very many career options. I remember reading about mechanical engineering, and I realized it was one of the broadest fields and that you can branch out into different things. You can go into biomedical, aerospace or even patent law."

Braña-Soto is on scholarship through the college's Industrial Scholar Interns Program, which provides ongoing financial support for four years and part-time job training in the student's junior and senior years. The university honors student, who is 5-foot-10, has an interest in pursuing modeling and acting, and also loves to draw and write fiction. Upon completing her bachelor's degree, she plans to go on to graduate school, although she remains undecided about which particular aspect of engineering she will ultimately focus on.

Reaching Out to Mexico and Beyond

In their effort to reach out beyond the university, the college began offering master's programs in Petroleum Engineering and Industrial Engineering in Mexico to employees of Petróleos Mexicanos, the only oil company in the Mexican oil market.

This partnership established with Universidad La Salle in Mexico City consists of courses traditionally offered at UH but are condensed into five-week sessions. Professors travel to Mexico and spend one week lecturing students for 40 hours. Students use the remaining four weeks to complete homework assignments and projects. In December 2002, the first class of these students participated in the commencement ceremony with the U.S. students.

The professors use an Internet interface program that allows students and professors to maintain communication throughout the independent study. Hamid R. Parsaei, chair for the Department of Industrial Engineering, believes that this program builds a bridge between his department and their counterparts in Mexico.

"These outreach opportunities can create financial independence for the department," Parsaei said. "We plan to use part of the proceeds to create scholarships for graduate and undergraduate students."

One of the most prestigious and popular outreach programs at the college is the radio show *The Engines of Our Ingenuity* by John Lienhard, M.D. Anderson Professor Emeritus of Mechanical Engineering and History at UH. The program, which tells the story of how our culture is formed by human creativity, uses history to depict how art, technology and ideas have shaped people.

The nationally broadcast series began at KUHF-FM Houston on Jan. 4, 1988, and is heard five days a week by more than 30 National Public Radio affiliates across the nation, and more than 1,900 episodes have been broadcast.

Working With High Schools, Teachers

While the college spends a great deal of time working with the students, the departments noted that great teachers produce great students. Research Experience for Teachers (RET) is a program designed to provide teachers with the opportunity to conduct a research project under the guidance of a faculty mentor, learn about the Infinity Project, a national program to foster increased interest in engineering at the high school level, and bring a project kit back to their classroom to use as a teaching tool.

The programs cover a variety of topics, including control systems, biomedical engineering and computer programming, and the college will conduct this summer research program for Houston's high school math and science teachers from June 4 to July 16, 2004. The 12 teachers selected will receive up to a total stipend of $6,000 for six weeks of full-time research and will be provided with a library, office and laboratory space.

Outside the scope of RET, the college is developing curriculum and preparing to be the primary university provider for the Infinity Project in the entire Houston area. A creation of Texas Instruments and the Southern Methodist University School of Engineering, the Infinity Project is a program designed to incite interest in engineering and technology through secondary schools by using computer-based, interactive learning modules.

The program, which has been implemented in more than 39 high schools and higher education institutes, touts more than 350 engineering and technology design programs.

Learning to Conduct Research

Students will also profit from a summer research program, Research Experience for Undergraduates, conducted by ECE and geared towards undergraduate students with an interest in graduate studies and a career in research. Up to 15 students will receive a stipend of $4,000 for 10 weeks of research, which will be cross-disciplinary to provide students with maximum flexibility for future studies.

Dean Raymond Flumerfelt says he realizes that student interest is most integral to the learning process.

"The NSF grants represent the latest step in our efforts to enhance our engineering curriculum and increase the pool of prospective students," Flumerfelt says. "Key to our success and our profession's future success will be our ability to excite students about engineering as a field of study and career." ■

ISIP students Amada Duran and Pei Lin with supervisor Bryan Kennedy (1996 BSCE) at Jones and Carter. Duran is an intern in land development and Lin is in municipal utility district.

DONOR ROLL CALL [SEPTEMBER 1, 2002 – AUGUST 31, 2003]

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(continued on page 20)

ENGINEERING ALUMNI

Build Flourishing Business, *Recognize* UH As Driving Factor

By Portia-Elaine Gant

Bill Fendley and Odis Cobb

UH Cullen College of Engineering alumni Bill Fendley (1971 BSCE) and Odis Cobb (1971 BSCE, 1979 MSCE) are the quintessential alumni according to Vita Como, director of the Engineering Career Services Center. The commendation is well founded, though modestly received, by the partners of Cobb, Fendley & Associates. The two men have served as past presidents of the Engineering Alumni Association and served on the Dean's Engineering Leadership Board.

"All of our alumni should be like Bill and Odis," says Como. "Of course, we have other good alumni, but from the support of the dean, the support of the departments, the support of the students, on down the line, they punch the ticket all the way."

The pair have shown unwavering support by setting up student scholarships and an endowment for discretionary funds for the dean, a gift that Como says every dean dreams.

"This year, we awarded their scholarships to seven students, and the total amount awarded was $7,000," says Cumaraswamy Vipulanandan, chair of the Department of Civil and Environmental Engineering. "Also, they employ a lot of our graduates."

According to Vipulanandan, students are not the only beneficiaries of Cobb and Fendley's support of the college.

"Odis Cobb was our advisory board chair last year," Vipulanandan says. "In addition, not only do they participate in the functions, but they have their spouses come which is very encouraging for the faculty to see. That shows that their interest is not just business related but it's a family interest. They participate whole-heartedly."

As alumni, they also provide a different prospective on the commuter label that is placed on the University of Houston. Fendley and Cobb say that aspect of the university was integral to their education process.

"It's an advantage for Houston to have such a great university where you get such a quality education, full-time or part-time," Fendley says.

Both were married and working during their time as Cougars, but neither recognized the weightiness of their responsibilities. ▸▸

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"When you're in the middle of it, and you're married, you're going to school, and you're working and studying, you just do what you have to do," Fendley says. "You're young, and you do what you have to do to meet your goals."

Their success story has fueled their desire to help others, Como says.

"They're just really plugged into the college, and they bleed Cougar red," Como says. "They met while they were students here. Both of them were the first in their families to go to college, and they went to school nights and weekends. And that's why they are so committed to supporting students who are like them."

Being in business together for 24 years has been no different for the pair who met working at the Texas Highway Department and attending the university.

"It's like starting the business," Fendley says. "We made up our minds that we were going to do it, and we did. There's no difference in the commitment. If we have to be here 16 hours a day to keep this company going, then that's what we do. I don't even have to think about it."

That sound work ethic is what propelled Cobb, Fendley & Associates to become a well respected, successful civil engineering and land surveying firm. In particular, the company is recognized as a leader in telecommunications engineering design and utility coordination. The firm has a clientele that includes municipalities, private utilities, state and local agencies and private developers.

"We started on a shoestring," Fendley says. "We had to borrow some money and sometimes not pay ourselves. That's how we got started. Long hours and hard work have made us successful."

When they began, however, they could not purchase supplies in Houston but had to travel to Austin.

"A local company wouldn't give us an account to purchase survey equipment because we didn't have any credit," Cobb says. "We had personal credit but none as a company; we had to build that."

Since then, the firm has diversified its capabilities, now offering a variety of civil engineering services with offices in three Texas cities. The partners have served in organizations such as the Texas Society of Professional Engineers, the American Society of Civil Engineers, the Houston Council of Engineering Companies and the Houston Engineering and Scientific Society. The firm's success did not come easily for the pair, which is why they value their accomplishment.

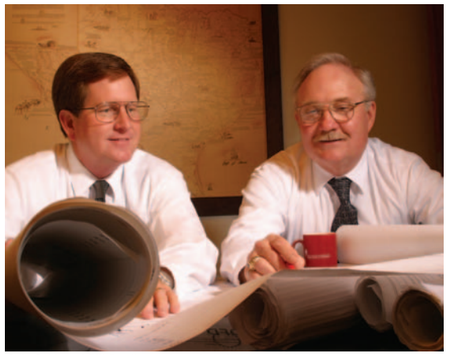
"Because I had to work hard to get where I am, I have a sense of accomplishment and value what I have," Fendley says.

Diving into business together at a young age worked out for the partners, but neither advises students to follow their path.

"Get a little more working experience before you venture out," Cobb says. "We started our business at age 32. When we called on the City of Houston, they looked at our business cards and wanted to know who we were and what we had done. Also, prospective entrepreneurs need to develop management skills, and not just rely on technical experience. Learning by trial and error is tough."

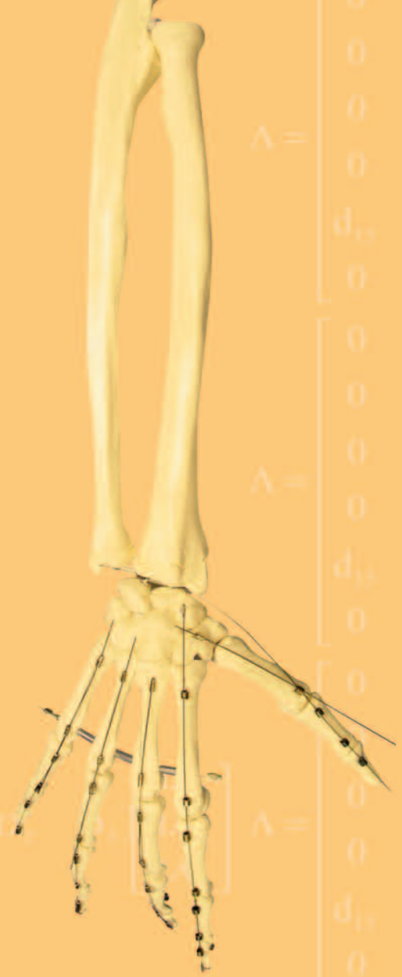
Though immersed in the inner workings of a flourishing business, they both make time to support the community and their alma mater. Fendley said that his desire to stay involved is two fold; not only does the university receive something, but he does as well.

"I enjoy it. The staff and faculty make us feel welcome," Fendley says. "And part of the attraction comes from giving back. Neither of us could have afforded to go away for a college education. Because we worked and went to school at the same time, neither of us would have finished college if the University of Houston hadn't been there." ▪



Odis Cobb and Bill Fendley review plans from one of their recent projects.

Thomas L. Melenric
Alejandro M. Mendiola
Gary Wayne Mensik
Mr. & Mrs. Edward H. Mergens
Lawrence E. Merkel
Clarence Wayne Meyer
Mr. & Mrs. Frederick J. Meyer, Jr.
Herbert J. Meyer
Karl Wayne Meyer
Gary Meyers
Mr. & Mrs. Alberto G. Mezzatesta
Patrick D. Miles
Gary A. Miller
Mr. & Mrs. Gary D. Miller
Mr. & Mrs. D. Scott Miller
Russell James Miller
Mr. & Mrs. Stuart C. Millsaps, Jr.
Mr. & Mrs. Glen J. Mizenko
Mr. & Mrs. Robert L. Montgomery
Mr. & Mrs. James Brock Moore, III
Robert Moreland
Michael J. Morrow
Kathryn A. Moye
Mr. & Mrs. Richard D. Munsch
Joseph P. Muscara
My Rock, Inc.
Dr. Kornel Nagy
Raghuram Narumanchi
Mr. & Mrs. Billy R. Neeley
Bryan Lee Nelson
Mr. & Mrs. Charles L. Newmann, Jr.
James Bon Ng
Shui-Hang E. Ng
Henry Nhan Nguyen
Phuong Kim Nguyen
Son Duy Nguyen
Son T. Nguyen
Than-Nhi Thi Nguyen
Mr. & Mrs. Rafael Ortega
Drs. James & Beatrice Ortego
Mr. & Mrs. Dwayne Emmett Ortmen
Chansothi Oum
Dr. Siddhartha Panda
William A. Parkan, Jr.
Tommy A. Parker
Marjorie A. Parmely
Hitenkumar Parshottambhai
Antony C. Parsons
Amish B. Patel
Mr. & Mrs. Harshadkumar R. Patel
Hirendra J. Patel
Mr. & Mrs. Kantilal H. Patel
Rashmikant B. Patel
Robert S. Patton, Jr.
David W. Pavlik
Mr. & Mrs. Otto B. Pedersen
Robert A. Pederson
Bridgette E. Perez
Mr. & Mrs. Jonathan James Petersen
Mr. & Mrs. Bill Phillips
Brian & Kim Pinkerton
Daniel A. Pitts
Dr. Nancy & David Pollard
Gary Young Poole
Michael A. Poole
Mr. & Mrs. Richard L. Prichard, Jr.
Barry R. Beggs
R. H. Klug
Mr. & Mrs. Joseph Edwin Ramsey
Sharath S. Rao
Michael Brooks Rasbury
Steve A. Reeves
Mark L. Reinke
Mr. & Mrs. Luis Reyna
Glenn R. Rieger
Dr. Ronda K. Rippley
Robert T. Beidler
Mr. & Mrs. Reynaldo Ray Rodriguez
Carlos Romero
Eric Rosenblum
Edward John Rosser, Jr.
Mr. & Mrs. John W. Rouse
John B. Royal
Mr. & Mrs. Robert Royce
Mr. & Mrs. Julio Cesar Rubiano
Mr. & Mrs. David M. Rubin
Jean H. Russell
Kurt Lloyd Sacks
Mr. & Mrs. Kenneth C. Saliger
Mohammad Khademals Samani
Daryl Santos
Dr. Luigi A. Saputelli
Charlene A. Sarver
Oron L. Schmidt
William E. Schmidt
Adam Schneider
Dr. John J. Bowders, Jr.
Joseph Andrew Scholl
Mr. & Mrs. Michael B. Schuldt
Robert F. Schwartz
Glenn A. Schwinn
David S. Seiver, P.E.
Vinod Sharma
Scot Alan Shaw
May B. Shek
Stephen Li-Chun Shen
Dekecha P. Shepherd
Richard E. Shepherd
Hang Shi
Gerald L. Shoults
Mr. & Mrs. Steven E. Simmons
Dr. Mohit Singh
Rakesh Singh
Melvin R. Skarke
Kenneth Ray Skweres
Maurice J. Slot
Kevin G. Smith
Mark M. Smith
John P. Soland
Dr. Mahesh K. Somani
Aditya Soni
Judy C. Soontiraratn
Mr. & Mrs. Christopher E. Speights
Jack L. Spradling
Sanjay Srinivasan
Robert Wayne Srubar
David Allen Stafford
Rick A. Stanford
Hollie M. Stanley, Jr.
James L. Steller
Luisiana Stevens
George E. Stovall
Timothy John Strauss
Susan Strausser
Edward Gilbert Strong
Studio Works, L.L.C.
Jingjing Sun
Rajeev Suri
Joseph Frank Svetlik
William P. Swaney
Dr. & Mrs. James M. Symons
Mr. & Mrs. Charles J. Tamborello
W. L. Tanner
Louis C. Tannick
Robert E. Taranto
Mr. & Mrs. David F. Tharp
Joseph M. Thayer
Mr. & Mrs. Alan Thomson
Mr. & Mrs. Lou J. Tichacek
Dr. Andrew A. Tiger
Mr. & Mrs. Tom Tilton
Frank C. Townsend
Mark E. Trainer
Robert C. Treadwell
Israel Trevino, Jr.
Mr. & Mrs. Larry Charles Triola
Brian Y. Tso
Mr. & Mrs. Gregory Thomas Tucker
Ronald Gary Turner
William A. Valka
Sridhar K. Valluru
Mr. & Mrs. Michael C. Vandewater
James A. Vasquez
John Edward Vaughn
Esau R. Velazquez
Wade D. Vinson
Dr. Cumaraswamy Vipulanandan
Mr. & Ms. Tim H. Vu
Carl Drew Wade
Thomas A. Wahlheim
Mr. & Mrs. Charles Leslie Waite, Jr.
Mr. & Mrs. Rolan W. Walton
Dr. Yeih-Jong Wang
Zhen Yu Wang
Zhijing Wang
Mr. & Mrs. John Bauer Wardell
Ilene A. Warnke
Mr. & Mrs. Guy Michael Warth
James D. Warwick
Mr. & Mrs. Dennis John Webb
Jacke Edwin Weber
Marvin E. Weber
Dr. Scott Wei
Carletha C. West
Michael William Westbrook
Dan N. Westigard
Mr. & Mrs. Richard Burton Whipple
Brandon L. White
Jacob Toneukanrin Wilkie
Jeffrey W. Williams
Michael Dwain Williams
Mr. & Mrs. Bradley Thomas Wilson
Mr. & Mrs. Michael Wisda
George Shaun Witmer
Mr. & Mrs. Franklin O. Wooten
Dr. & Mrs. Frank L. Worley
Lynn Michelle Wrablik-Reilly
Joseph H. Wunderlich
Daniel R. Wyant
Mr. & Mrs. James L. Wyatt
William T. Wycoff
Chiying Xu
William Yee
Mr. & Mrs. Joseph E. Yeo
Dr. Weisu Yin
Victor A. Zaloom
Xianfeng Zhang
Huage Zheng
Wei Zhuang
Mr. & Mrs. Herbert P. Zoch



UH Engineering Professor Develops INTELLIGENT SYSTEMS That PRESAGE TOMORROW'S TECHNOLOGY

By Brian Allen

University of Houston's **Gangbing Song**, associate professor of mechanical engineering, and his colleagues are working on new applications for smart materials and intelligent systems—projects that will take us deep into the future of technological advances.

The merger of **artificial intelligence, neural networking and a deepening understanding of the connection between electricity and structural properties** are bringing futuristic visions of technology closer to reality. And Song's nationally funded research is leading the way, as he uses his own cutting-edge research to build new educational avenues for tomorrow's engineers at the UH Cullen College of Engineering.

In Song's **Smart Materials and Structures Laboratory**, all the major categories of smart materials are being studied and exploited by researchers and students, many of which are funded by Song's CAREER grant from the National Science Foundation. The grant emphasizes bringing cutting-edge research into the engineering curriculum.

"Part of my goals in my NSF CAREER grant was to make progress in engineering education," Song says. "By integrating new research results into the teaching process, we enhance teaching."

Song has developed two new courses based on the grant: *Intelligent Structural System—an Introduction* and *Control of Smart Structures*.

So, just what are these "smart" materials? They're shape-memory alloys, piezoelectric ceramics, magnetostrictive materials and electrorheological and magnetorheological fluids. Complex terminology, but what these materials do is nothing short of remarkable. They change shape, rigidity, position, natural frequency and other mechanical characteristics—almost like magic—in response to a slight change in temperature or electromagnetic fields.

Some examples of the kind of applications these material might have: an airplane wing flap changes position, a wire contracts to lift a heavy object, a cracked bridge pulls itself back together and strengthens its internal structure.

Smart materials are available in many forms, including bars, strips, wires, tubing, foils, thin films and even a porous NiTi. "And any heat source can be used to make the phase transformation—direct resistive heating," Song says. "What happens inside is an atomic-level phase transformation. The metal is actually changing itself." »

The ability to do work

In essence, the thing that makes smart materials so valuable is their ability to do work, to "actuate" some object that previously might have required an electromechanical motor or some other traditional machinery. They also act as sensors, which are a key component to providing the feedback and control needed in almost any application. In the best-case scenario, the same shape memory alloy (SMA) does both functions, as it does in one of Song's most notable new research projects.

The necessity of position sensors is a major cost of any SMA position regulation or tracking system. Electric resistance change during the phase transformation is an inherent property of an SMA actuator, and Song's research has taken advantage of this fact by inversely modeling the nonlinear relationship of displacement and resistance and using it to create a sensor.

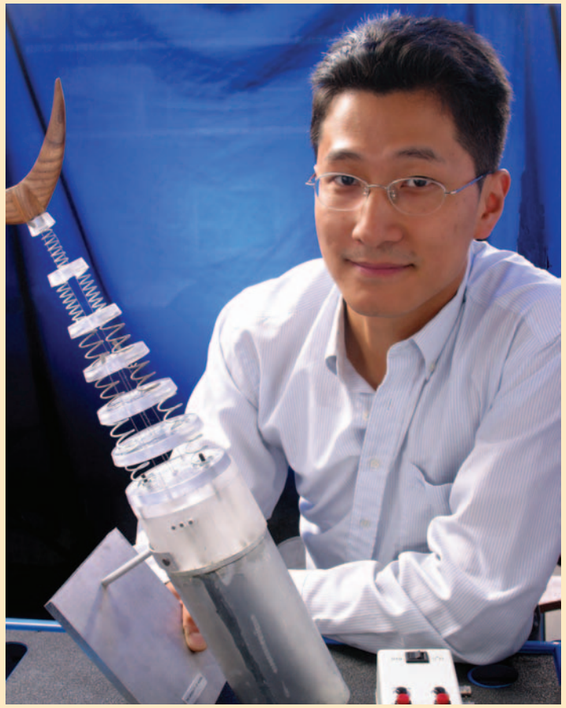
"In the realm of position controls for shape memory alloys," Song says, "we use the SMA's own electrical resistance for feedback control. In this way we can eliminate the use of an additional sensor, and this can dramatically decrease the cost of a shape memory alloy positioning system."

In another undergraduate design project that Song supervised last Fall, a team of senior Capstone Design students developed an SMA project that dealt with angioplasty, the process by which a blood vessel is repaired by inserting a balloon-tipped catheter to unblock it or by rebuilding or replacing a section of the vessel.

The idea was to modify a guidewire with SMAs so doctors could navigate through a vein more easily and quickly. The students used an SMA, which is trained, through an initial high temperature heating process, to acquire a predetermined shape when heated at a later time. By placing two small strips of the SMA wire and superelastic wire on opposite sides of the guidewire and applying an electric current to selectively heat one or the other strip, the guidewire is forced to bend. In theory, this could enable doctors to move quickly and efficiently through the veins.

In their oral presentation, the students—Erik Daniel, Brett Thomas, Wayne Baptise and Shawn Thomas—said the primary advantage of their guidewire was timeliness.

Professor Matt Franchek, chair of the Department of Mechanical Engineering, explains further how such a guidewire could benefit physicians. "If a doctor is placing a stent into someone's body to repair a damaged blood vessel, sometimes the doctor has to poke and jab and watch where it is on the computer screen to get it through the winding pathways of the blood vessel. Wouldn't it be nice if the doctor could steer it? With the use of smart materials, you could specifically determine which direction you want that stint to go. It does very precise things."



Ning Ma, Ph.D. student, is with a robotic fish actuated by shape memory alloy actuators.

Super elasticity and shape memory effect

The two most important characteristics of smart materials are super elasticity and shape memory effect. Super elasticity, which was discovered in 1932 with gold cadmium alloys, is the ability to return to a preset form or shape upon unloading. Shape memory effect, which was discovered in 1951, is the ability to return to a preset shape when heated. These unique properties are the backbone of technological advances using smart materials.

The useful shape-recovery and superelastic properties of shape-memory alloys are the outward changes that reflect an atomic transition between two crystal forms: a malleable (martensitic) phase below the transformation temperature band and a stiff (austenitic) phase above the band. This transition is rapid and readily reversible, meaning positions can be changed back and forth on demand without degradation of accuracy or effect.

Most smart materials were developed for aerospace or military technology, but the realm of possible applications grows bigger every day, Song says.

"Magneto Rheological fluid, for example, can change its viscosity from a liquid to something like paste or cheese. The material morphs itself, and this has a lot of applications, for example, we can utilize it to build brakes, clutches, vibration controls," he says. "MR fluids are already used in Cadillac suspension systems."

Laying foundation for the future

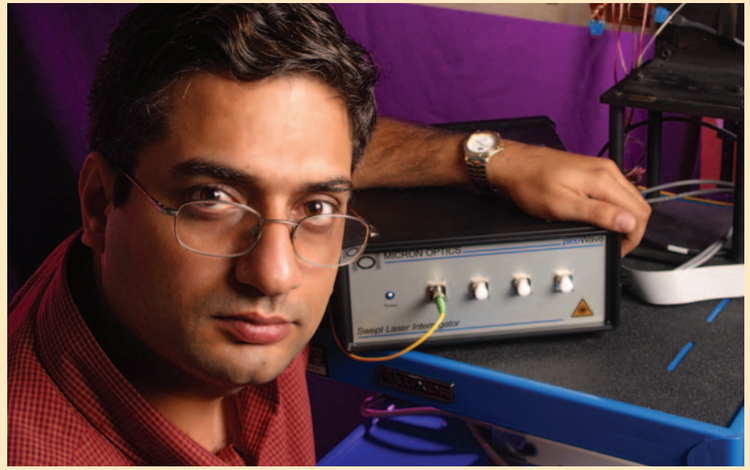
Song is also conducting truly pioneering work in vibration control, where he has demonstrated the effectiveness of smart materials to calm the violent agitations of lengthy steel beams.

"We use very small piezo patches to achieve significant vibration reduction of large structures," Song says. "That may have applications in spacecraft, or even in civil structures like buildings and bridges."

Given the multifaceted nature of smart materials, what area does Song consider ripe for future breakthroughs?

"I think the breakthroughs are likely to come in the bioengineering area, using smart materials in robotic surgery tools. This has a lot of potential in civil engineering, and even in chemical and petroleum engineering, and the offshore industry. There is also an emerging interest in MR fluids in civil engineering."

Franchek sees Song's work as integral to preparing next-generation engineers for the changes to come. "Dr. Song is telling the engineers that we are sending out to market now: 'Your world is going to rock, because the things you know today are going to be old, lethargic, too classical.' We're talking about integrated products and efficient products. It's a matter of cost and component integration, systems engineering. And he's saying the enabler here is smart materials, with the controls, with understanding the dynamics, with understanding the design."



Vineet Sethi demonstrates the usage of Fiber Optic Equipment in an experiment for the vibration control of flexible structures.

From Wuhan to Houston

Song has journeyed far from his hometown of Wuhan, China, a city of six million people. He describes Wuhan as an industrial city known primarily for its steel production, and not unlike Pittsburgh. He remembers going to school six days a week, from eight in the morning to five in the evening. School days were long and rigorous, and also filled with some more menial chores that would surprise most Americans.

"We didn't have janitors in schools because the students cleaned everything, the glass, the windows, the floors. We would wipe down the tables and desks. We cleaned everything."

Song's parents, both still in China, are also engineers.

After completing his bachelor's degree in mechanical engineering at Zhejiang University in 1989, Song came to the United States and obtained his master's and Ph.D. from Columbia University in 1991 and 1995, respectively. Shortly afterward, Song developed his interest in smart materials.

"When I was doing my post-doc work at the Naval postgraduate school I was exposed to smart materials, such as shape memory alloys and piezo ceramics, and it was there that I really developed an interest in this kind of active material and realized they had very good potential."

The potential to take technology deep into the future. ■

CLASS NOTES & ALUMNI NEWS

::::: 1950's :::::

RAFAEL TUDELA (1954 BSME) was named to the board of directors of Essentially Yours Industries, Inc. He is the president of Tamanaco Inter-Continental Hotel. He has served as a five-term congressman in the Venezuelan government, an Ambassador in Special Missions for the executive branch of the Venezuelan government. He has heralded many charitable causes and earned countless awards in Venezuela and throughout the world. Among many awards, he wears the Great Cross of the Order of Malta, conferred by his Holiness, Juan Pablo II. He received his Ph.D. from the Universidad Central de Venezuela.

::::: 1960's :::::

ROD CANION (1966 BSEE, 1967 MSEE) was named chairman of the Houston Technology Center (HTC) board, where he will serve a two-year term. Canion, who is a leading figure in the technology industry since co-founding Compaq Computer Corp. in 1982, is currently chair of Questia Media Inc. A founding member of HTC's board of directors, Canion succeeds Lloyd M. Bentsen III, who served as chair since 1999. HTC is a business accelerator that assists Houston-based emerging technology companies within several key sectors, including energy, information technology, life sciences, nanotechnology and NASA technologies.

FRANK MARINO (1967 BSCE) was recently named senior vice president of public works for Turner Collie & Braden. He has been with TC&B for 31 years, serving most recently as vice president of civil design.

::::: 1970's :::::

EBRAHIM FATEMIZADEH (1972 BSIE, 1974 MSIE) was recently named president of Stone & Webster Power Group, part of the Shaw Group Inc., and has a specific objective of creating an integrated power and process EPC business unit. Prior to joining the Shaw Group Inc., he was vice president of Fluor Corporation, where he was responsible for the management of global operations for Fluor's Chemical Business Unit. Previously, he was senior vice president of operations and general manager for Duke Fluor Daniel in Aliso Viejo, California, where he managed P&L for the power generation business.

::::: 1980's :::::

JUDY (THOMAS) VERA (1980 BSME) is the owner of a new business Vera & Associates in Tulsa, Oklahoma, which specializes in engineering and drafting design work for the gas compression industry. She is also the author of *Packaging Compressors* in McGraw-Hill's Compressor Handbook published in 2001. She married Oscar Vera in 1983 and they have three children: Oscar, 17, Maria, 15, and Stephen, 3. Judy can be reached at judyv14@juno.com.

BERYL BUSHNELL KAMINSKY (1984 BSIE) graduated in December 2003 with her MEd in counseling from UH, a step in her career transition toward becoming a bereavement counselor. She is now working part time as a Licensed Professional Counselor Intern at the Bering Memorial United Methodist Church's counseling center. The center serves people who are infected and/or affected by HIV and AIDS. She is also responsible for the psychosocial needs of the residents of Bering Omega House, an eight-bed AIDS hospice. She continues to volunteer at Bo's Place, a grief center for children and their families, where she facilitates a group for women who have lost a child to death. She also has an International MBA degree from the University of South Carolina.

ABDELDJELIL "DJ" BELARBI (1986 MSCE, 1991 PhD CE) received the 2003 Governor's Award for Excellence in Teaching. Gov. Bob Holden and members of the Missouri Coordinating Board for Higher Education recognized Belarbi and other award recipients during the Governor's Conference on Higher Education in Springfield, Mo. Belarbi represents Missouri's 8th Congressional District on the 11-member Missouri Commission on Human Rights. His primary research efforts include the modeling of reinforced and pre-stressed concrete structures, developing and evaluating fiber-reinforced-polymer composite for use in concrete structures, and monitoring of civil engineering structures and the use of smart sensors. He is a professor of civil, architectural and environmental engineering at the University of Missouri-Rolla. He was also recently awarded the prestigious Fulbright Scholar grant to lecture and conduct research at The American University of Sharjah in Sharjah, United Arab Emirates starting in the Fall. Belarbi will lecture on the intelligent optimal design and rehabilitation of civil engineering infrastructure as well as exchange civil engineering instructional materials and teaching methods.

TIM SHEN (1987 MSEE, 1991 JD) is the founder and a principal of Tim Shen Consulting LLC, which specializes in intellectual asset management. Prior to forming his own consulting firm, he served as senior counsel and acting general counsel for BMC Software. Previously, he has worked for the law firm of Baker Botts and as a computer systems analyst for Chevron Corp. He is a licensed attorney in the State of Texas and a registered patent attorney, licensed to practice before the U.S. Patent and Trademark Office. He recently ran for Houston City Council District G.

ALUMNI NEWS BRIEFS

Homecoming 2003

LeRoy Laycock (1953 BSCE) was given the opportunity to catch up with friends he has not talked to in 50 years when he was asked to serve on the calling committee for the Golden Cougar Reunion, an event hosted by the Houston Alumni Organization that celebrates the 50th reunion of UH graduates during Homecoming.

"The people I called to inform them about the reunion remembered me as soon as I told them who I was. And, I remembered them," Laycock said. "It was like no time had passed."

Along with University-wide Homecoming activities that engineering alumni like Laycock actively participated in, the Cullen College of Engineering and the Engineering Alumni Association also hosted events to bring alumni back to campus.

Alumni, faculty, staff, students and friends came out to the Engineering Alumni Association's annual Homecoming tailgate party on Saturday, Nov. 8. Besides eating barbecue and reuniting with old classmates, many participated in the competitive Armchair Olympics, which teams an alumnus, professor and student by academic department to compete by shooting basketball hoops, throwing darts and putting on the green. The highlight of the afternoon was the raffle of dozens of UH items.

LeRoy Laycock (1953 BSCE) took a moment to thumb through his old yearbook (his photo from 1951 appears at the bottom). He was asked to serve on the calling committee for the Houston Alumni Organization's Golden Cougar Reunion at Homecoming.

For its active involvement, EAA received the Houston Alumni Organization's 2003 Red Banner Year Award at its Annual Meeting. This was the fifth year that EAA has won this prestigious award. Also honored was Osman Ghazzaly, professor of civil and environmental engineering, as an Outstanding Faculty Award Recipient for demonstrating outstanding teaching skills and having countless accomplishments and faculty and student recommendations.

Trishia Saulog, freshman chemical engineering student, was one of the winners of the Engineering Alumni Association's raffle during the Homecoming tailgate festivities.

Top Far Right: Michael Massey, director of corporate outreach and development, talks with Alice Elrod, wife of J. T. Elrod, former chair of the Department of Industrial Engineering from 1967–77, at the college's Homecoming Brunch.

Bottom Far Right: UH students Jesse Barton and Amie Blake, senior chemical engineering major and Industrial Scholar Intern working for Schlumberger, show their Cougar pride.

Engineering Alumni Association Establishes Faculty Endowment

With $21,000, the Engineering Alumni Association recently established the first faculty endowment for the dean of Cullen College of Engineering to allocate money to help recruit and retain quality faculty. This initiative, which has been years in the making, was lead by past president Dale Rudick (1991 BSCE).

CLASS NOTES & ALUMNI NEWS

::::: 1990's :::::

SUNIL THAKKAR (1990 BSME) is producer and co-screenwriter of "Where's the Party Yaar?" currently making its way through America after releasing in Chicago and Houston in September. The film includes scenes shot on the UH campus.

EMILY NIKOO (1991 MEE) was recently named vice president of marketing and technical services for Blonder Tongue Laboratories, Inc., a manufacturer of electronics and systems equipment for the franchised and private cable television industries. She will be responsible for spearheading the Blonder Tongue Triple Play offering that serves the cable community with voice, video and data products. She joined the company as a product manager and has been promoted steadily to several supervisory and management positions over the past nine years. Previously, she was with Lockheed Martin. She also holds a bachelor's degree in electrical engineering from Purdue University.

MAURIZIO CHELI (1994 MSAeroE) recently flew a Eurofighter Typhoon IPA 2 in a memorial event organized by the Italian Ministry of Defense to celebrate 100 years of manned flight. The event took place at the Italian Aeronautica Militare air base at Grosseto, the first Italian unit to receive Typhoon in Italian service. He is an Alenia Aeronautica Chief Defence Aircraft Test Pilot. He joined the Italian Air Force in 1978. He is a graduate of the Italian Air Force Academy. In 1992 he was selected by the European Space Agency and assigned to NASA Johnson Space Center where he became an astronaut in 1993 and in 1996 he participated as Mission Specialist to the STS-75 Tethered Satellite mission. He joined Alenia Aerospazio in 1996 and in 1998 he became chief test pilot for combat aircraft. Cheli has logged approximately 4,000 flight hours in more than 50 different types of aircraft and helicopters and 320 hours in space.

::::: MARRIAGES :::::

JEFFREY GARASCIA (1992 BSEE) married Valoria Hoover on Oct. 18 in Cincinnati. He is a senior associate with Booz, Allen & Hamilton Inc.

KAREN SUSAN COYM (2000 BSChE, 2001 MSChE) married Dr. Jeffrey Allan Kabin on Aug. 9 at the UH Hilton Hotel. Karen is currently working on her Ph.D. in chemical engineering at UH. Jeffrey is a graduate student in the MBA program at UH.

COLBY WRIGHT (2002 BSCE) married Sonia Ghaffari on Nov. 15 in Houston. Colby is an associate with Traffic Engineers, Inc. and can be reached at colby@trafficengineers.com.

::::: DEATHS :::::

CHARLES ROMALD HOFFMAN (1952 BSME) died Jan. 26 at the age of 74. He was a startup engineer and District Manager for Combustion Engineering, Inc., retiring in 1985. He is survived by his wife of 52 years, Jo Ann; three children; and five grandchildren.

CHARLES MONTGOMERY NETTLES (1954 MSIE) died Nov. 26 at the age of 80. He received a bachelor's degree in engineering from Texas A&M University. He volunteered to be a Navy Aviation Cadet where the V5 program took him through the program in Athens, Georgia and Dallas, finalizing his flight training at NAS Pensacola. Upon graduation, he was selected for the Marine Corps so he left Florida with a "Marine Green" uniform, Second Lieutenant bars and gold Navy Wings. His next orders were for MCAS El Centro and flying the famous torpedo aircraft, TBF-TBM, in July 1943. A few months later his new assignment was MCAS Santa Barbara where he was a Corsair Fighter Pilot and a new member of the Fighting Falcons, VMF 221. Charlie embarked with the squadron on the USS Bunker Hill and he became a carrier pilot to fight the war against the Japanese in their homeland of Honshu and Kyushu. He participated in fighter-bomber air support for the Landings on Iwo Jima and the fight at Okinawa. He received the Distinguished Flying Cross and four Air Medals for his actions in combat. At the end of World War II, Charlie returned to civilian life, retained his Reserve Commission, and again served in the Korean War as a Forward Air Controller and a tour as liaison officer with the Korean Marines. He remained in the Marine Reserves Detachment until he retired in 1966. From 1952 until his death, he worked at Tex-Trude, Inc., the family-owned plastic manufacturing facility, where he served as president and later as chair of the board. He was an active member of the Masonic Lodge #298 in Alexandria, Scottish Rite Houston Consestory, Arabia Shriners, Houston Engineering and Scientific Society, Lakeside Country Club, Texas Society of Professional Engineers, Petroleum Club of Houston, Marine Corps Association, Navy League of the U.S. Marine Corps, Reserve Officers Association, Association of U.S. Army, Retired Officers Association, and Marine Corps Aviator Association. He was recently preceded in death by his wife, Rose Marie; and survived by three children; and five grandchildren.

FELIX DANIEL BELLOW (1955 BSME) died Oct. 8. He was a veteran of World War II and was honorably discharged after serving four years in the U.S. Navy. He is survived by his wife of 52 years, Veronita; three children; and seven grandchildren. All his children are UH graduates.

ALUMNI PROFILE

UH Alumnus Says Engineering Degree Useful in Political Career

By Portia-Elaine Gant

Bill Callegari (1972 MSCE) has come a long way from his childhood days growing up in Cottonport, Louisiana. Today, the UH engineering alumnus is a Texas State Representative from Houston. Callegari, who serves as vice chairman of the Natural Resources Committee, says his engineering education has been useful in his political career.

> "We need more engineers in the legislature," Callegari says. "We tend to be more detailed oriented and look at facts and figures. Some of the questions we ask are because we see things in a different light. Part of how legislature works is seeing things from different points. Engineering brings a unique aspect to the legislature which is healthy."

Callegari's legislative efforts have focused primarily on traffic and water, tort reform and budget issues, which he said are most important.

"My background is in water issues," Callegari says. "But I'm also interested in other things such as school and educational issues, our severe tax problem that we've got to do something about, and traffic problems. I have some possible solutions for moving traffic and expanding I-10 and 290. Since my district sits between I-10 and 290, my constituents drive on both freeways and are concerned about how to get where they're going."

Callegari, a republican, was first elected in 2000, then won re-election in 2002 and plans to run again this year. Since his first term, he has maintained a near perfect record in passing legislation and has been recognized by his constituents.

"I'm very fiscally conservative, and I think the state needs that," Callegari said. "This session, we were able to accomplish a lot of things like tort reform and the budget. We were able to balance the budget without increasing the taxes. As a group, we all worked hard to make that happen."

Callegari majored in agricultural engineering as an undergraduate, but he received his master's degree in civil engineering from UH.

"I went into agricultural engineering because I came from a farming community," said Callegari, who graduated in 1968 from Louisiana State University. "Also, most of the scholarships were for agricultural engineering and I was putting myself through college."

In high school, Callegari was a sports fan and set his sights on engineering towards the end of his high school career.

"I wanted to be a coach because I loved sports," Callegari said. "My cousin, who was an agricultural engineer that I idolized growing up, talked to me about it, and that's when I started thinking about what I wanted to do in broader terms."

Though Callegari already had his bachelor's degree, he received a job offer at Shell and moved to Houston.

"The University of Houston was better than most colleges as far as its night program," Callegari said. "I took the job with Shell with the intention of getting a master's."

Callegari, who values education, said he briefly considered an MBA but found that the program did not suit his needs.

"I looked at an MBA, but I decided against it," Callegari said. "I liked being an engineer. Most engineers who got their MBA ended up in banking or real estate or financial management. Also, it took 60 hours to get a master's in business and 30 hours in engineering. With a family and a full-time job, I needed to go the engineering route."

After working at Shell, founding his own company and working in the state legislature, Callegari still stands behind his decision.

"I've never regretted that," Callegari said. "When an engineer talks to me about a master's, I tell them engineering is the way to go. I've never suffered; it's actually helped me be more successful."

FRED PHILIP APFFEL (1959 BS Math, 1963 BSChE) died Sept. 7 at the age of 73. He started his own engineering company, ACFD, Inc., during the 1970s. He was a member of Prince of Peace Catholic Community in Northwest Houston. He is survived by his wife, Carol; three children; and five grandchildren.

SAMUEL M. TILOTTA (1959 BSCE) died Feb. 8 at the age of 69. He was a dedicated employee for CLR Engineering Company as a civil engineer. He is survived by his wife, Loyce; three children; and three grandchildren.

WILLIAM A. "BILL" BAKER (1962 BSCE) died Jan. 30 at the age of 78. He was a veteran of World War II serving in the U.S. Navy. He retired from Southern Pacific Railroad after 30 years of dedicated service. He assisted in the development of the first Boy Scout Troop in Kirby, Texas. Sharing outdoor activities and fishing with family and friends was very important to him. He had many interests, building things by hand, writing poems and raising cockatiels. He is survived by his wife, Jessie Mae; four children; and six grandchildren.

MAURICE JOSEPH MEYNIER, III (1963 BSME) died Oct. 27 at the age of 63. He continued with a career in management. He was an avid hunter and fisherman, and an inventor hobbyist. He is survived by his wife of 40 years, Karen; three children; and two grandchildren.

JAY CROCKETT WOODS (1975 ME) died Oct. 18 at the age of 75. He worked in the petrochemical refractory engineering business for over 35 years in the Houston area. While working at Humble Oil-Exxon, he earned his engineering degree from UH. He then embarked on a professional career with several well-known Houston area companies, including Leavesley and Sons, Hartney Construction, and Southwest Refractories, followed by starting his own business, WT Specialties, Inc. He was a member of the First United Methodist Church in Willis, Texas. He is survived by his wife of 54 years, Mary Ann; four children; 11 grandchildren; four great grandchildren; and his special feline companion, Bitty Kitty.

CHARLES WILLIAM SVEC (1976 BSEE) died Dec. 8 at the age of 60. He worked for over 30 years as an electrical engineer for Wide-Lite and Brown & Root. Charlie is survived by his wife of 38 years, Mary Ann; four children; and three grandsons.

DAVID HIGGINS (1986 BSCE, 1995 MSCE) died March 13 at the age of 42. He began his engineering career with the U.S. Army Corps of Engineers in the Fort Worth District. He held positions with Brown & Root, Bechtel, Kvaerner, Burk-Kleinpeter, and most recently with Alliance Wood Group. He was a professional member of ASCE for 17 years. He received his Professional Engineering License in 1993 from the State of Texas. He was active in the Structural Engineers Association of Texas Houston/Gulf Coast Chapter, where he was president, and served on the building committee for All Saints Church in the Heights. He received the Distinguished Young Engineering Alumni Award from UH in 2001. David is survived by his wife, Alma, and daughters, Eva Rae and Emma Rose.

Key:
AeroE — Aerospace Engineering
BioE — Biomedical Engineering
ChE — Chemical Engineering
CE — Civil Engineering
ComE — Computer Engineering
EE — Electrical Engineering
EnvE — Environmental Engineering
IE — Industrial Engineering
ME — Mechanical Engineering
PE — Petroleum Engineering

CLASS NOTES

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ALUMNI PROFILE

UH Alumna Uses Problem-Solving Skills to Launch Career at Shell

In the average engineering program, with such a rigorous curriculum, many students lack the drive to become involved in other activities. Alumna **May Shek** (2002 BSChE), however, says that at the Cullen College of Engineering she was encouraged to engage in a variety of activities outside of the classroom. That diversity of interests that she learned as a chemical engineering student is something Shek says she still values today.

As a field technical support engineer for Shell Chemical Company, Shek still has the opportunity to utilize her problem-solving skills.

"I support the ethylene plant," Shek says. "Ethylene is a petrochemical, and it's material for a lot of stuff we use daily like plastic, detergents, etc. I make sure that the units are running properly, functioning safely and that we're environmentally friendly. If there's any problem with the unit, I work on troubleshooting and solution development."

Her preparation for such a position, Shek says, came from her engineering classes as well as summer internship and research experience in her senior year at the college.

"I did my undergrad research with Dr. Ramanan Krishnamoorti. My research was in conjunction with my Senior Honors Thesis, and I basically calculated theoretical calculations of phase diagrams for block copolymers," Shek says. "I don't deal with polymers right now, but this research project really exposed me to an area outside of books because it was something I did after class. It gave me a really good flavor of what doing research is like, and it helped me with problem-solving skills. With writing skills and tackling the problem, the more you practice the better you are at it."

As a student, Shek was also involved in the Society of Women Engineers, PROMES, American Institute of Chemical Engineers, Engineering Ambassadors and an active member of the national engineering honor society, Tau Beta Pi. Though she graduated two years ago, she still has an opportunity to interact with current students.

"Tau Beta Pi recently had an initiation banquet, and they invited me back as a speaker," Shek says. "I like to be able to meet more people and do things that benefit the community. As a student, my involvement with student organizations allowed me to develop my people and communication skills. Everything I do at work is essentially teamwork."

Through her job at Shell and by her own accord, Shek has stayed active in community service in the Deer Park and Pasadena areas. She also organized Meals on Wheels last Christmas.

While Shek said that a willingness to help, rather than engineering skills, is all one needs to volunteer, she still credits her success to the university and the college.

UH Professor Sees Bright Future For Tissue Engineering

New Whole-Organ Biosensor May Enhance HOMELAND SECURITY

By Brian Allen

Wouldn't it be nice if we could simply grow new, healthy body parts in the lab whenever we needed to replace diseased or damaged ones?

Need a kidney? No problem. Just grow a new, healthy kidney from your own genetic make-up, get a surgeon to transplant the new organ, and presto! You're good to go.

That is the ultimate goal of tissue engineering: to grow replacement body parts on demand, says Adam Capitano, assistant professor of chemical engineering at the University of Houston Cullen College of Engineering.

TARGETING Replacement Body Parts

And the good news is we already know it can be done. After all, as Capitano points out, our own bodies provide the proof.

"One of the things I like about this kind of science is we know the outcome is possible," Capitano says. "We all start from egg/sperm and grow from those two cells, so theoretically we know it is possible to grow everything that is you. When I was in graduate school working on experiments in physical science, often times we didn't know if something was possible. But in this case we know it will work; it's just a question of whether we are smart enough to do it."

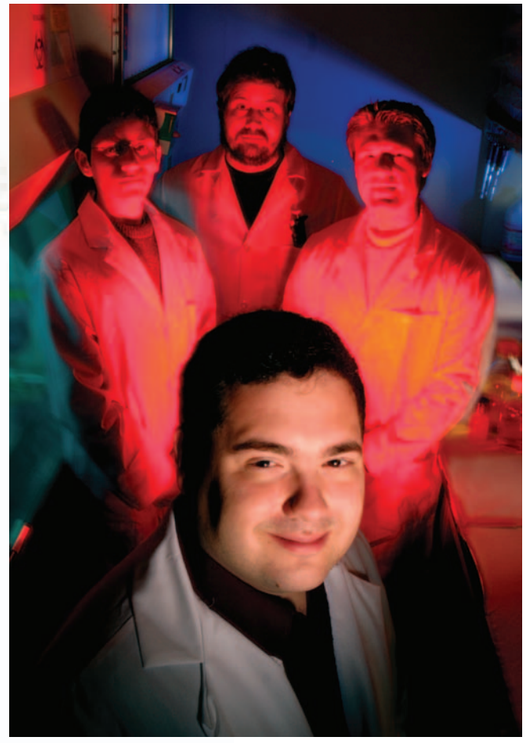
Capitano came to UH last year after completing nationally funded post-doctoral work at the Griffith Liver Tissue Engineering Group at the Massachusetts Institute of Technology. Now the resident expert in tissue engineering, Capitano teaches lower division courses in thermodynamics and processes, and an upper division course in advanced materials.

The Iowa native holds a Ph.D. in chemistry from the University of Michigan. He is currently developing a course in tissue engineering that may be offered at UH as early as next Fall. Capitano, who is head of the Applied Tissue Engineering Laboratory in the Department of Chemical Engineering, likes to compare the idea replacement body parts to auto parts for car repairs.

"If you wreck your car and you get a dent in the side, you don't throw away your car," Capitano reasons. "You get a replacement part, a new fender, and you put it in. In a parallel circumstance, if you hurt yourself, say if you lose an arm, you can't really throw yourself away. But neither can you go to Wal-Mart and buy yourself an arm. So two of the fundamental questions for tissue engineering are, 'How can we make replacement parts?' and 'Why don't they exist?'"

How to make replacement parts is yet to be answered sufficiently, but why they don't exist is fairly well understood. In fact, some success has been made in growing replacement bone and cartilage, but it will be more difficult to grow an entire organ, Capitano says.

"You can't just place cells from your organs on a petri dish and end up with your organs," he says. "It's not that simple. It would be nice, but what happens is the cells know who their neighbors are supposed to be. They also know what the flow conditions of blood and other things are supposed to be. Cells are the world's greatest feedback systems."



Assistant Professor Adam Capitano and student researchers (left to right) Dan Bauer, James Camp, and Jeremiah Whittenten conduct research in the Applied Tissue Engineering Laboratory.

So what happens if a cell detects that it is not where it is supposed to be? It dies. It runs an "internal program" called apoptosis, or programmed cell death, which triggers activity that safely bundles possibly harmful enzymes, and then the cell simply shuts itself down.

"Cells have very toxic things inside of them, primarily because you have to do digestion," says Capitano, "so severely injured cells, for example, might throw off digestion enzymes that could harm neighboring cells. But if the cell knows it's going to die, it runs a program that says 'I want to die,' and it packages everything up nice and neat to minimize the damage."

In what sense do cells "know" whom their neighbors should be?

The cells are programmed by their DNA to respond to biochemical signals that exist in blood, Capitano says. "Cells not only know who their neighbors should be, they know where their neighbors should be—to the left, right, above and below—and if these contacts are incorrect, problems start occurring."

A NEW HOPE FOR
Better Poison Detection

Capitano is employing advanced tissue engineering techniques to develop biosensors that may one day protect water and food supply from biological and chemical weapons.

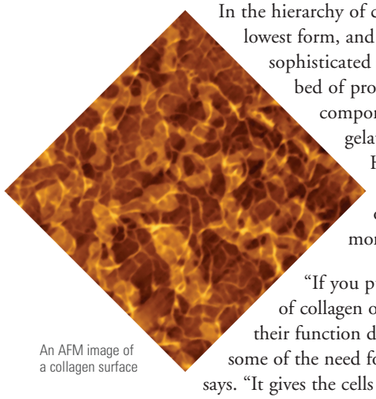
"If I am a tissue engineer then I should be able to take what science has discovered and build new and interesting things," Capitano says. "So one of my goals is to try to use **tissue engineering** constructs—things that behave like organs—as opposed to just doing mere drug discovery. I want to use this to try to solve part of the issue of detection of chemical and biological warfare agents. The idea is this: In order for something to kill you, it has to be harmful to you."

As it turns out, the best poison detector is something that reacts with human physiology, which is why Capitano and his research team are using tissue engineered constructs as toxin sensors. He chose to study liver cells because the liver processes a lot of toxins in the body naturally. Using these liver functions, or liver simulates, they measure physiological changes in the cells and search for biological changes that occur when a defense against toxins is taking place. One of the advantages to this approach is it will work even against unknown toxins.

"In a perfect world, nobody tries to kill anybody," Capitano says. "But in a slightly less than perfect world, you know exactly what the other guy is going to kill you with, and so you design a sensor to detect that toxin. But if your enemy is reasonably clever, he doesn't tell you what he is going to attack you with. In that case, what is needed is a sensor that can detect anything that is ultimately harmful."

Another advantage to Capitano's approach: It will also eliminate many of the false positives. If a substance is not harmful to the cells, then the system will just ignore it. But there are times when a more sensitive detector is preferable, Capitano says. For example, when a small chronic dose turns out to be lethal over time.

THE ART OF
Cell Culturing



An AFM image of a collagen surface

In the hierarchy of cell culturing, placing cells on a petri dish is the lowest form, and produces the poorest results. A slightly more sophisticated approach would be to place cells on top of a bed of protein, such as collagen, which is one of the natural components of the extra-cellular matrix, a semi-porous gelatin-like substance that fills the area between cells. Higher still would be an approach that included layering the top of those cells with another coating of collagen, creating a "blanket-like effect" that more greatly resembles conditions inside the body.

"If you put collagen, a layer of cells and then another layer of collagen on top of the cells, many cell types will improve their function dramatically because that structure starts answering some of the need for a three-dimensional environment," Capitano says. "It gives the cells a sense of up and down."

The underlying premise that drives tissue culturing is the notion that cells will thrive in direct correlation to how closely their environment replicates the conditions inside a living organism.

"Protein scaffolds provide a three-dimensional environment where you can place cells to try to replicate the three-dimensional shape of your organs," Capitano explains. "And the reason that you can't just pile cells on top of cells indefinitely is eventually you starve somebody. There needs to be blood flow. If you look at how your body is organized, everything is only so far from a blood vessel."

How far from a blood vessel can cells live and remain healthy? "Depends on the cell type," says Capitano. "Usually three to four layers. Then on top of that there is also a protein layer that cells can exist on. And these protein layers give them signals about who they are and what they're supposed to be. Collagen is one example."

DEVELOPING
Whole-Organ Biosensors

In a new project Capitano will use an entire animal liver to become the sensor, rather than trying to create liver function in a cell culture. "As opposed to taking the liver apart and trying to reconstitute it, why don't I just try to keep an entire liver alive?" he asks.

Capitano and his team will apply the fundamental theory of tissue engineering. They will get all the inputs and outputs correct, get the temperature right, and the structure will be—by definition—right, because they will use an animal liver. In short, they will closely mirror the conditions of the living organism. That alone will be a notable achievement. But they plan to do much more. They plan to discover the biological signals associated with different toxins and develop the detection technology to make the artificially supported liver work as a biosensor against harmful biological and chemical agents.

"The liver device we are working on now will ultimately be about shoebox size," Capitano says. "Because you have to have things that replicate the functionality of the heart and the kidneys, it's hard to get the size down too much. You could hook this up to a system that intermittently samples a reservoir, for example. We would start with an initial filtration that removes large pieces of dirt and other things that would give you false positives. That replicates how the nose or stomach processes things. Once that is done, we can admit some of that sample to the system, test it and see what happens."

What happens may be vitally important to homeland security, because our current methods of ensuring the safety of water and food supply are sometimes no more sophisticated than a chain-link fence.

How will Capitano know when the liver is beginning to defend itself against a toxin? One way is by identifying certain measurable metabolic changes that occur. One area where they have already had success is with a family of enzymes called cytochrome p450.

"We've shown that this metabolic pathway, this enzyme, will actually turn off its functionality as the cell begins to fight toxins," Capitano says. "So we can use this as a generic toxin detector. And we can determine the activity of this enzyme by using another molecule that responds to light. Whenever this enzyme is active, it makes the molecule respond to light and the sample will glow orange. Whenever the toxin is present, it stops attacking this molecule, it stops responding to light and you see it dim."

Student researchers in Professor Capitano's lab work with cell culture media in a sterile tissue culture hood.

Cytochrome p450 is just one of the 20,000 to 30,000 proteins that the liver produces. Capitano wants to study the various phenomena of the liver associated with some of those proteins and how they relate to different levels of toxicity and different toxins.

Visual detection is one method. Another is to measure the weight of the proteins. The idea is to capture specific proteins and measure their weight to determine if changes are occuring.

"We call ourselves an **Applied Tissue Engineering Lab**," Capitano says. "What we really like to do and where I'd like to see myself is not so much developing a lot of these new culture systems, but instead discovering what can you do with them once they are developed. What technologies can help facilitate these culture systems? It's not so much making a new organ or a new tissue. It's seeing what you can do with the tissue beyond the obvious goal of replacing body parts." ▪

Clockwise from top left: Shawn Thomas (2003 BSEE), Brett Thomas (2003 BSME), Erik Daniel (2003 BSME) and Wayne Baptist (2003 BSEE). Learn more about their work with Professor Gangbing Song, featured on pages 22–25.

2004 UH Cullen College of Engineering Alumni Events

For more information about any of these events, call 713-743-4200, e-mail alumni@egr.uh.edu, or visit www.egr.uh.edu/events.

Second Thursday of Each Month
Engineering Alumni Association Board Meetings
All engineering alumni are welcome
5:45 p.m. | Dean's Office, E421 Engineering Bldg 2

May 2
16th Annual ASME/Cajun Crawfish Boil
1–5 p.m. | Lynn Eusan Park, UH campus

May 14
Engineering Commencement
1 p.m. | Cullen Performance Hall, UH campus

June 4
Distinguished Engineering Alumni Awards Dinner
6 p.m. | Four Seasons Hotel, Downtown Houston

June 7–July 30
Summer Camps for High School Students and Teachers
For a full listing of summer camps offered to high school students and high school teachers by the Cullen College of Engineering, visit www.egr.uh.edu/news/?e=camps

June 22
Civil & Environmental Engineering Alumni Luncheon
11:30 a.m. | HESS

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