University of Houston Cullen College of Engineering

[ParamETErs]

Fall 2002

neuro-engineering

Dean's Message

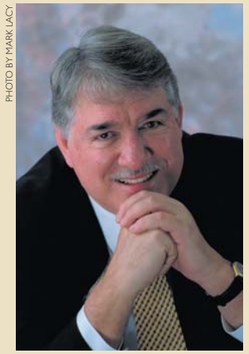

PHOTO BY MARK LACY

In this issue of *Parameters*, we highlight our active research program in neuroengineering. We are particularly proud of our newly established Center for Neuro-Engineering and Cognitive Science, which is headed by Professor Haluk Ogmen of our Electrical and Computer Engineering Department. This group is actively engaged with key medical faculty and professionals in the world renowned Texas Medical Center (TMC) to address critical research and clinical issues in this important area.

We also continue to move forward in our other biomedical engineering efforts that involve expanded research with the TMC, a new B.S. program in Biomedical Engineering, and plans to significantly expand our graduate programs. With the largest medical center in the country within five miles of our campus and a planned $2 billion bioresearch park under development, the opportunities for our biomedical engineering faculty researchers and graduates are unique and must be developed to the fullest extent possible.

We are extremely happy to announce the hiring of Professor Matt Franchek from Purdue University to lead our Mechanical Engineering Department as Chair, and to direct our interdisciplinary Biomedical Engineering Programs. Matt brings outstanding leadership and abounding energy and enthusiasm to these tasks. His immediate challenge will be to hire 8–9 new faculty to significantly expand and strengthen both Mechanical Engineering, as well as the Biomedical Engineering Programs.

On the broader front, including the faculty positions noted above, we will be searching for 18 new faculty this year, and all disciplines in the college will participate. These further additions of high quality faculty, coupled with the other top faculty we have added in recent years, will produce a new level of excellence in our college and programs.

Other highlights that I should mention include:

- Recruitment efforts of our staff and the departments are producing strong increases in enrollments (11% in undergraduate enrollments over 2001; 22% in graduate enrollments, particularly MS students).
- Our Industrial Scholar Interns Program (ISIP) continues to thrive with support from 17 companies and more than 108 students involved with an average SAT score of 1321.
- The College has more than $30 million in research funding in place and was a recent recipient in cooperation with several other universities of a $15 million NASA-sponsored University Research, Engineering and Technology Institute for Intelligent Bio-Nano Materials and Structures for Aerospace Vehicles in nanomaterials and spacecraft structures.
- A $3.8 million contract with the City will allow our Chemical Engineering Department to set up a major facility for diesel fuel emissions research and testing which will be critical to the clean air efforts in Houston and the region.
- Plans for the new 200,000 square foot Science, Engineering and Classroom Building are progressing, and we look forward to breaking ground on this important new facility next year.

Finally, I am sure those who have followed our college publications over the years have recently noticed a number of new publications, the enhancement of existing publications and a significant advance in our overall outreach communication efforts (including our website). In this connection, I give the highest kudos to our college communications group headed by Angie Shortt. They are doing a superb job for the college and the current *Parameters* is another example of their quality endeavors. I hope you enjoy it!

Sincerely,

Raymond W. Flumerfelt, Dean

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>

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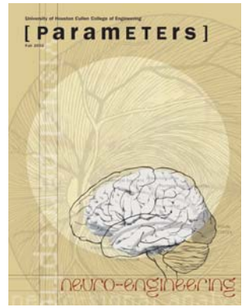


Neuro-Engineering
By studying the human visual systems and other aspects of the brain, researchers at the UH Cullen College of Engineering are aiming for breakthroughs in technology that may lead to exponentially better diagnostic tools and a new generation of treatments for mental illness and neurological disorders. In this issue of *Parameters*, we take a closer look at those efforts and the people that make it happen.

$3.8 Million Contract Approved by City for UH Air Quality Studies

In an effort to improve the region's air quality, the City of Houston recently approved a $3.8 million contract with the University of Houston Cullen College of Engineering to test new technologies that may help reduce emissions from the city's fleet of 2,800 diesel-powered vehicles.

The focus of the five-year project, headed by the Department of Chemical Engineering, is to conduct diesel emission research, technology development, testing and data analysis. In-kind contributions from the university will bring the total project cost to $4.6 million.

"Currently there are emerging technologies and several at the research stage that offer promising possibilities for reducing the polluting emissions found in diesel engine exhaust," said Michael Harold, professor and chair of the Department of Chemical Engineering and the principal investigator on the air quality project. "It will be UH's task to systematically evaluate the effectiveness of these technologies, especially in reducing nitrogen oxides."

Nitrogen oxides, or NOx, are precursor chemicals that react in the atmosphere to form ozone, a key component of smog. Common sources of NOx include cars, trucks, marine vessels, power generation and industrial processes.

"The opportunity for the City of Houston and the University of Houston to collaborate in assessing the relative effectiveness of innovative technologies designed to reduce diesel emissions is exciting," said Pamela Berger, the city's director of environmental policy. "It is a certainty that NOx emissions from on-road diesel-fueled equipment will have to be reduced by some 70 percent since the region cannot attain the one hour ozone standard if such reductions are not achieved."

The testing facility, to be located on the perimeter of the UH campus, will include a heavy-duty dynamometer, which is essentially a treadmill for trucks, and a state-of-the-art emission analysis system. The vehicles will undergo a series of sophisticated tests under simulated driving conditions.

"There is a notable shortage of facilities to test diesel emission control technologies for their effectiveness," Harold said. "We will fill a need in Southeast Texas. By analyzing data taken both before and after the vehicles are modified, we will be able to evaluate how effective these new devices are in reducing emissions. In addition, our tests will help the city make informed decisions about how to invest money in technology to reduce emissions in the city fleet."

PHOTO BY JONATHAN COBB

In addition to Harold, chemical engineering faculty members involved in the program include Vemuri Balakotaiah, Dan Luss, James Richardson, and Charles Rooks. Graduate and undergraduate students also will participate in the project's research.

Included in the contract is $100,000 for a two-year project headed by the UH Department of Civil and Environmental Engineering for research on coatings for concrete and clay brick surfaces, such as walls and roofs, that help prevent deterioration of the city's wastewater systems. An effective coating, for example, would reduce the frequency and extent of disruption associated with the repair and replacement of the city's sewer lines, especially when located under streets and sidewalks.

The coating research team will be lead by Cumaraswamy Vipulanandan, professor and chair of the UH Department of Civil and Environmental Engineering and director of the Center for Innovative Grouting Materials and Technology.

For more information, visit www.egr.uh.edu/news/0802/?e=cityaircontract.

UH Forges New Relationships with Texas Medical Center Institutions in Biotechnology Research

Academic leaders at the Texas Medical Center and the UH Cullen College of Engineering have laid the foundation for an unprecedented new relationship between engineering and medicine in Houston.

Dean Raymond W. Flumerfelt joined John Mendelsohn, president of the University of Texas M.D. Anderson Cancer Center, and James T. Willerson, president of the UT Health Science Center at Houston, as they revealed their vision for the advancement of biotechnology at a meeting on the BioTexas Research Park Initiative.

The meeting was designed to bring key academic leaders together with the CEO of General Electric Medical Systems, Joseph Hogan, and other key corporate leaders to share information on capabilities and plans for future biotechnology research in Houston's proposed new Biotechnology Research Park.

Other speakers included were Rice University's Nobel Prize winning physics professor Richard Smalley; UT Health Science Center's Vice President of Biotechnology S. Ward Cascells; and UH's world renowned expert in superconductivity, Paul Chu.

Willerson, who is also director of cardiology at the Texas Heart Institute, sees UH as a major partner with the Texas Medical Center institutions. "There's a wide open opportunity here for a partnership between GE, the University of Texas M.D. Anderson Cancer Center, the University of Texas Health Science Center, Rice, the University of Houston and other medical center institutions," Willerson said.

David Nghiem, the college's assistant dean of outreach education and research and director of the Telecom Center, organized a second meeting focusing on vulnerable plaque with 14 researchers from the UT Health Science Center and several UH faculty members.

Cardiologists now believe that vulnerable plaque is the triggering mechanism behind most heart attacks and strokes. Morteza Naghavi, director of UT's Center for Vulnerable Plaque Research, delivered a detailed presentation on the scope of the problem. He offered statistics indicating vulnerable plaque is the world's leading cause of death, especially premature death between the ages of 50 and 65.

Developing early detection is the primary goal of the research center, according to Naghavi. What makes detection so pivotal is the absence of warning signs and the deadly consequences of a rupture. In more than half the cases of vulnerable plaque, the first symptom is sudden death.

Using a revolutionary approach involving electromagnetics, UH's Nghiem has developed a patentable technology that may make early detection, both invasive and non-invasive, a reality.

For more information, visit www.egr.uh.edu/news/0802/?e=tmc.

PHOTO BY JONATHAN COBB

College Receives Awards for Website, Magazine

PHOTO BY JONATHAN COBB

Graphic designer Harriet Yim, director Angie Shortt and writer Brian Allen

The UH Cullen College of Engineering's Office of Communications received four recognition awards for the college's website and magazine.

The Public Relations Society of America (PRSA/Houston) presented the Gold Excalibur Award for the *Parameters* magazine, the International Association of Business Communicators (IABC/Houston) presented Bronze Quill Awards of Merit for the *Parameters* magazine and the college's website, and the Council for Advancement and Support of Education (CASE) District IV presented the Achievement Award for the college's website.

"Receiving this type of recognition from our peers is a wonderful tribute to the high-quality work that's being done in the Cullen College of Engineering," said Angie Shortt, director of communications for the UH Cullen College of Engineering.

The redesigned website (www.egr.uh.edu) launched on July 5, 2001 and the repositioned *Parameters* magazine debuted on September 14, 2001 with a complete redesign including major improvements in photography, design and writing.

Visit the team's portfolio at www.egr.uh.edu/news/team.

IABC/Houston's Bronze Quill Awards and PRSA/Houston's Excalibur Awards showcase Houston's best in public relations and communications. CASE District IV represents higher education institutions from Arkansas, Louisiana, Mexico, New Mexico, Oklahoma and Texas.

New NASA Institute To Boost UH Engineering, Science Research

A new $15 million, five-year research initiative involving NASA and six Texas universities will focus on developing advanced distributed intelligence and new materials for use in the next generation of aircraft and aerospace vehicles, the Office of Aerospace Technology at NASA announced.

The University of Houston is one member of the new University Research, Engineering and Technology Institute for Intelligent Bio-Nano Materials and Structures for Aerospace Vehicles, which will be based at Texas A&M University. Other institute members are Prairie View A&M University, Rice University, Texas Southern University and the University of Texas at Arlington.

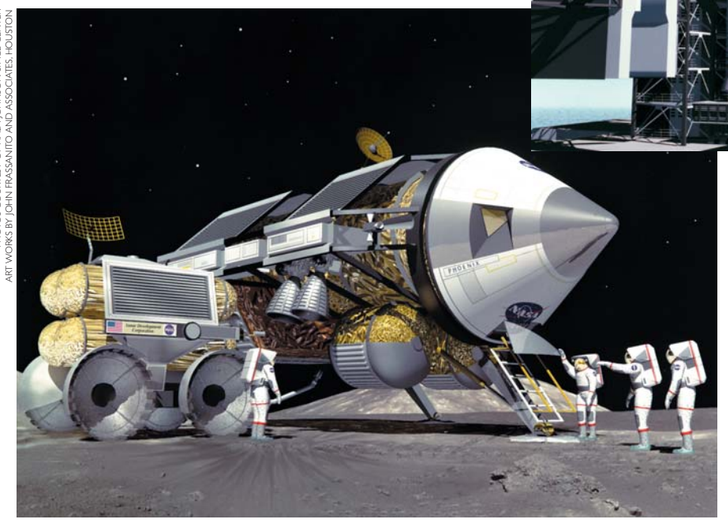
UH engineers and scientists will concentrate on two broad research areas. The major focus of the UH initiative will be to establish distributed intelligence architectures to improve flight and mechanical performance and safety of future aircraft and spacecraft. The second will focus on fabricating new nanomaterials that are stronger and lighter than conventional materials.

"Distributed intelligence systems would allow aircraft to monitor system 'health' and change their shape as they fly and adapt to different environments," said David Zimmerman, UH professor of mechanical engineering and an associate director of the institute.

NASA, in cooperation with the Department of Defense Research and Engineering Office, has with this announcement established seven University Research, Engineering and Technology Institutes nationwide. In addition to performing research and development, each institute will provide support for graduate and undergraduate students, curriculum development, personnel exchange, learning opportunities and training in advanced scientific and engineering concepts for the aerospace workforce. The agreement will fund each institute for an initial five-year period at approximately $3 million per year.

For more information, visit www.egr.uh.edu/nasaureti.

Top: A computer generated concept of a Magnum booster with fly-back boosters.



Bottom: (Artist's concept of possible exploration programs.) The lunar crew refills the propellant tanks on their spacecraft with oxygen produced on the Moon. This allows them to return directly to Earth, reentering the atmosphere in the conical crew module, and touching down at a prepared landing site. Technical concepts from NASA's Planetary Projects Office (PPO), Johnson Space Center (JSC).

PHOTOS COURTESY OF NASA JOHNSON SPACE CENTER
ART WORKS BY JOHN FRASSANITO AND ASSOCIATES, HOUSTON

New Science & Engineering Building to House Research Labs, Classrooms

The UH Board of Regents have approved the site location and rough schematics drafted by Cesar Pelli and Associates of New Haven, Conn., for a new science and engineering building. The local architect of record will be Kendall/Heaton Associates of Houston.

"To have a distinguished architect such as Cesar Pelli putting his imprint on this new building is exciting," said UH System Chancellor and President Arthur K. Smith. "The addition of this facility to our science and engineering complex will have a major impact on our academic and research programs for years to come. This new structure and Mr. Pelli's involvement in the project are signs that our university is continuing its climb toward Tier 1 status."

Pelli, who designed the Petronas Towers in Kuala Lumpur, Malaysia—the tallest building in the world—also designed Herring Hall at Rice University and the St. Luke's Medical Tower located in the Texas Medical Center in Houston.

When completed in 2005, the new UH building will accommodate about 40 research laboratories and include a 550-seat teaching auditorium. The 200,000 square foot complex will provide a "gateway" to the west side of campus and will feature a five-story laboratory building and a two-story classroom building.

"This will be a very efficient building and a very beautiful building," Pelli said when he presented his plans to the Board of Regents Committee on May 6. "It should help you recruit the best scientists."

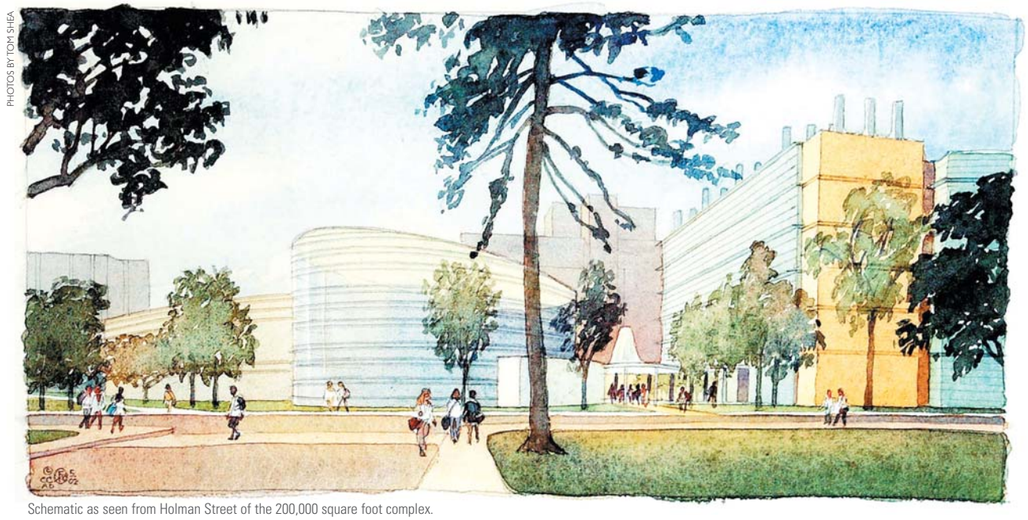
Edward P. Sheridan, UH senior vice president for academic affairs and provost, said UH scientists and engineers had input into the design of the new lab facility, which will rely on research faculty to fill up the much of the space with their own equipment.

"Major funding agencies have recognized that part of the grants they award go toward purchasing lab equipment, and our researchers are writing their grants with this in mind," Sheridan said. "As our deans recruit new faculty members the candidates are excited about being able to design their own labs."

Faculty members from disciplines across campus who will teach in large lecture halls in the new classroom building also made suggestions for the classroom designs.

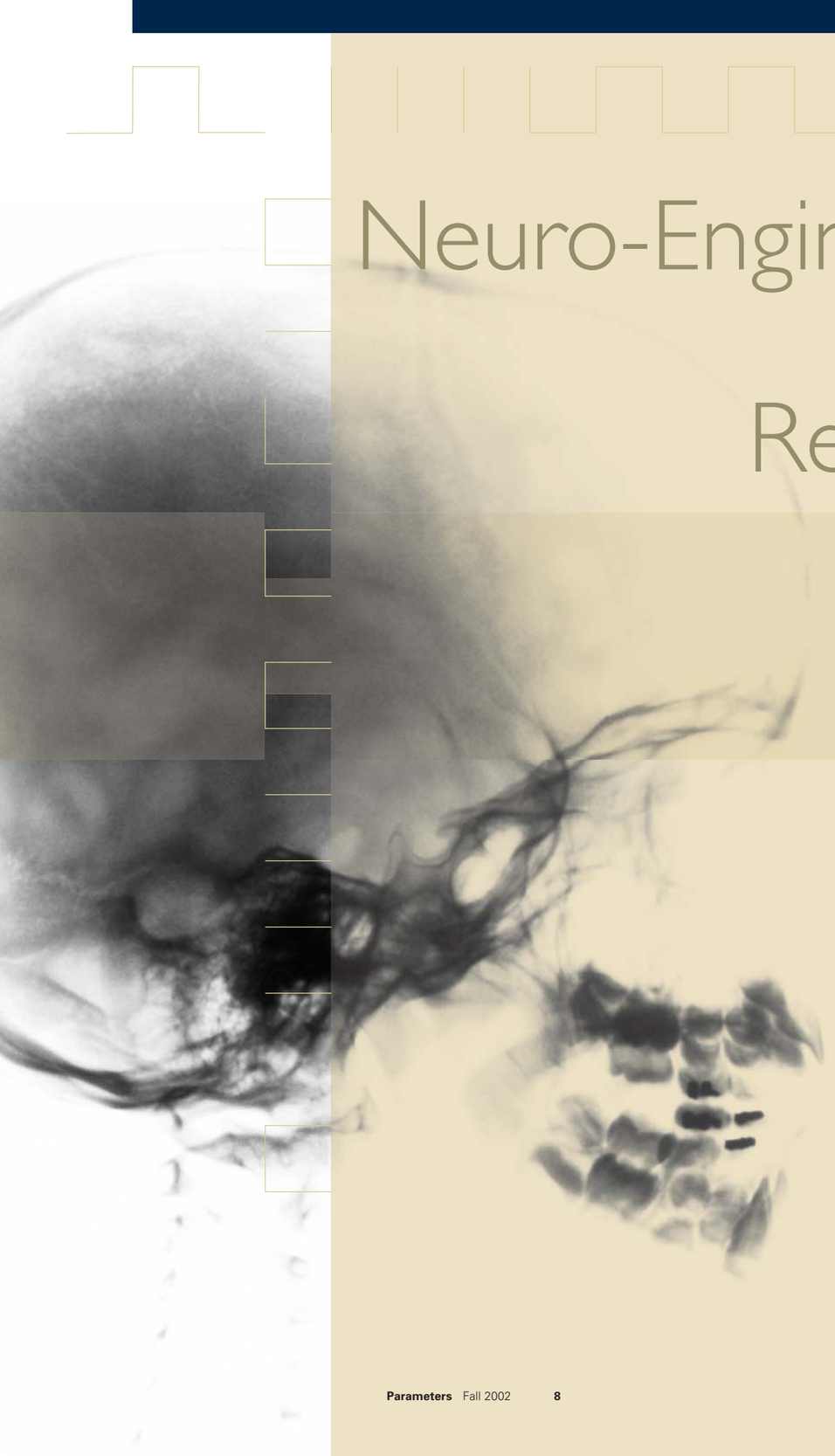
"This new facility will add a dramatic impact to our campus," Sheridan said.

Artistic rendering of the new Science and Engineering Building.



Schematic as seen from Holman Street of the 200,000 square foot complex.

PHOTOS BY TOM SHEA



Neuro-Engineering Research Hitting High Gear

By Brian Allen

Mental illness and neurological disorders present doctors and engineers with problems of staggering size and significance.

> About 1 in 5 adults in the United States suffer from a diagnosable mental disorder in a given year, according to the National Institute of Mental Health. That number is even greater when other forms of neurological disorders are taken into account. The total annual cost to our society is measured in hundreds of billions of dollars.

University of Houston engineers are responding to the problem by crafting a new generation of diagnostic tools and devices to provide vastly improved treatments of mental illness and other neurological disorders. Engineering professors at the UH Cullen College of Engineering are working with researchers at the world-class Texas Medical Center and other elite institutions such as Yale University and the University of California at Los Angeles. Their work is laying the foundation for tomorrow's breakthroughs in understanding and technology.

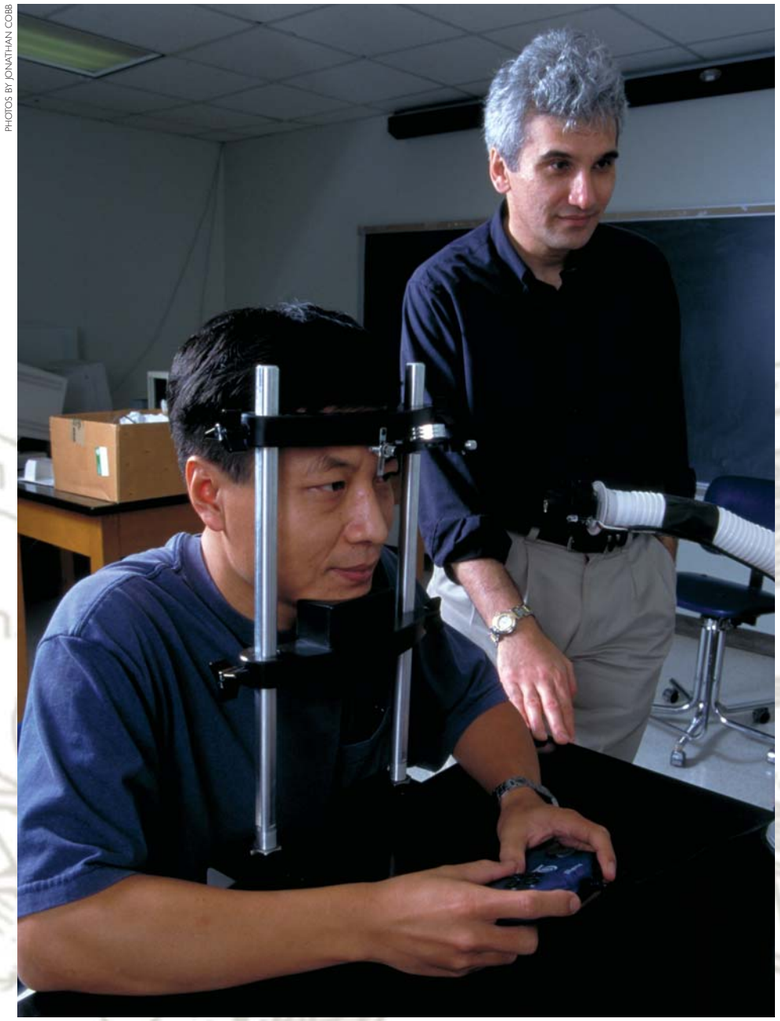
> Major efforts in neuro-engineering have produced 10 research grants totaling more than $3 million in 2001–2002 from the National Institutes of Health and the National Science Foundation. The college has also recently established a new multidisciplinary Center for Neuro-Engineering and Cognitive Science to provide the administrative structure needed to coordinate and expand the existing research activities.

The "Decade of the Brain" may be over, but the challenges of mental illness and neurological disorders have never been more formidable. The good news is, thanks to the efforts of UH engineering faculty and their colleagues in the medical sciences, the promise for new treatments—even cures—has never been brighter.

Neuro-Engineering Efforts

Point to New Understanding of the Brain

PHOTOS BY JONATHAN COBB



Professor Haluk Ogmen works with graduate student Jianzhong Ma in the college's Perceptual and Cognitive Dynamics Laboratory. The apparatus, which was designed to investigate how the brain computes brightness in real time, is part of Ogmen's NIH-funded research on the human visual system.

Throughout most of the history of science, the mind and the brain were considered out of bounds—an area beyond scientific inquiry.

Today, however, science is hot on the trail of exciting discoveries in almost every aspect of neuroscience, and University of Houston engineers are playing a vital role in that pursuit.

One UH engineering professor, Haluk Ogmen, is breaking new ground in neuro-engineering by using a multidisciplinary approach, and his insights are deepening our understanding of the brain.

His work is laying the foundation for the development of new technologies that may transform the way doctors diagnose and treat mental illnesses. It also provides promise for improvements in the design and creation of a new kind of artificial intelligence, one that more closely mirrors the human mind.

Ogmen, a professor in the Department of Electrical and Computer Engineering, is working with researchers and academicians from optometry, psychology and philosophy to gain new insights into how the central nervous system operates. The results are helping him "reverse engineer" the design principles of the nervous system and the way it solves sensory and sensory motor problems.

Reverse engineering, according to Ogmen, is the practice of studying a pre-existing product and modeling its design and function.

The task is a formidable one, and one made more difficult because so little is really understood about the inner workings of the brain and mind.

"If you look at neuroscience, it's really in its infancy," Ogmen says. "It's not as advanced as physics, for example. The mathematical tools needed for the study of biological systems are much more complicated—non-linear, time-varying—and they require a language which can not only express them but also be used to solve them. You can write down, for example, non-linear differential equations but you may not be able to come up with a solution. Computer simulations help us address this problem but simulations do not provide the generality of analytic solutions."

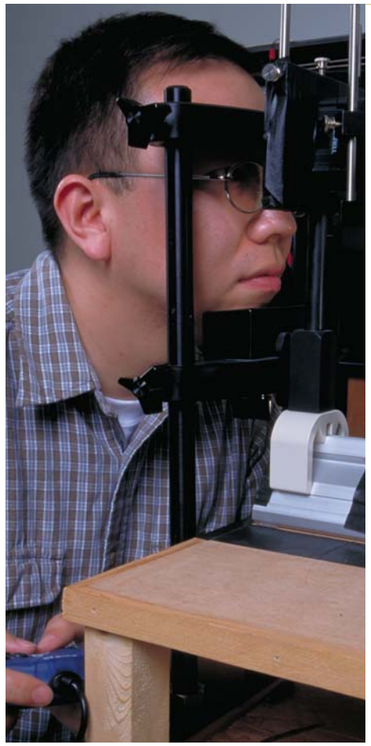
The gap between mathematical expression and solution can be enormous. Likewise, when dealing with the mind, the "explanatory gap" between mere physical description and true understanding can be cavernous.

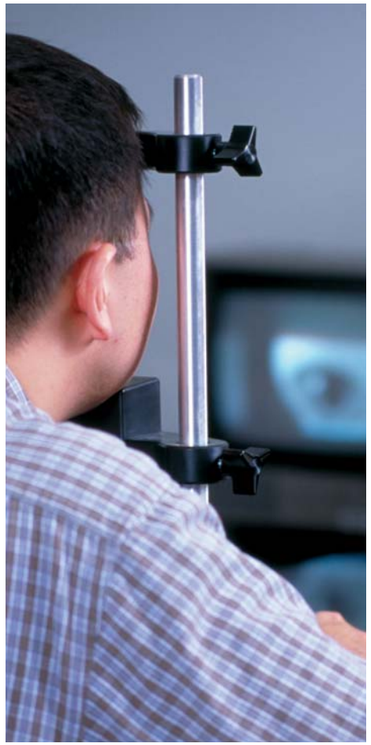
"In the sixties, the problems people thought were complicated problems—chess playing, theorem proving—were actually well-defined problems with well-defined rules," says Ogmen. "They turned out to be the simple problems. On the other hand, when you're interacting with the environment it's very difficult to come up with well-defined rules or a well-defined way of describing what the environment is. I believe you need a different set of principles to design those systems."

As Ogmen pieces together more and more of the puzzle of neural activity and its relation to perception and motor response, he moves neuroscience closer to realizing a new foundation for medical applications.

The potential for breakthroughs is enormous, but the path to discovery is a steep and thorny one.

"In the progression of science, the typical paradigm is that when you are studying something very complicated, in the very beginning you don't even know how to describe or how to define it," Ogmen says. "The more we learn about it, the more we start coming up with more precise definitions. As our understanding progresses, our definitions will be better, and better definitions will speed up and improve the studies, which will further our understanding. So, I think they will go hand in hand."





Jian Chen, electrical and computer engineering graduate student, peers into an optical device in the college's Perceptual and Cognitive Dynamics Laboratory.

Eyeing the Mysteries of the Brain

Ogmen's research focuses primarily on the human visual system but has implications that reach much farther.

"The visual system is perhaps the best-known part of the brain, and research typically involves the sense organs because it's easier to control the inputs to them. I can control very precisely the luminance, the geometry and the timing of the input, so one end of the system is very well defined. Then we study what's happening at the other end, and that's the difficult part."

Ogmen's approach has been to develop theoretical models based on known structural and functional properties of the brain and then, from these models, he can derive specific predictions.

Those predictions are then tested in the laboratory using psychophysical experiments. Psychophysics is the study of functional relations between physical variables and the psychological states induced by these physical variables. The experiments have two phases. First, stimuli such as flashes of light are introduced. Then the psychological states of the subject are estimated by asking for verbal or motor responses. Establishing the relationship between the perceptual state of the observer and the properties of the stimuli that gave rise to that perceptual state is called *outer* psychophysics.

"The more difficult part is *inner* psychophysics," Ogmen says. "Inner psychophysics tries to establish functional relations between psychological states and the underlying nervous activity."

That's where the psychologists and other experts come into play. Ogmen's richly diversified group of university colleagues is working under the organizational umbrella of a new center at the Cullen College of Engineering, the Center for Neuro-Engineering and Cognitive Science. Ogmen, who is the center's first director, receives major funding from the National Institutes of Health, from the National Science Foundation in collaboration with Bruno Breitmeyer from the Psychology Department, and from the Texas Advanced Research Program in collaboration with Harold Bedell from the College of Optometry.

Up to now, there has been extensive research revealing the response properties of neurons in different parts of the brain. But we still don't know what basic language the neurons use to talk to each other, according to Ogmen. Among other things, we look at "action potentials" or the "rapid spikes" in electrical pulses that neurons send to each other, but we don't fully know where the information resides or what form it takes.

Also complicating the landscape is the existence of multiple languages and multiple systems. Some parts of the nervous system can function completely separately, but a translation process enables different systems to talk to one another, says Ogmen. "Take representation, for example. Within the visual system, things are represented in terms of spatial relationships, but when you go to the motor system you have to represent actions in terms of motor system coordinates."

The Zombie Within

In one set of experiments that laid the groundwork for some of Ogmen's research in collaboration with Breitmeyer, the subject was presented with brief stimuli followed by second stimulus that is spatially and temporally nearby. Oddly, the second stimulus influences how the first one is perceived. Typically, the first stimulus called the "target" and the second one is called the "mask." It has been long known that the mask typically has to come after the target to exert maximum effect, but the mask can still reduce the visibility of the target when it is presented before the target.

"It's kind of a temporally backward effect," Ogmen explains. "In fact, it's called 'backward masking' because the mask comes after the target. And it's counterintuitive in the sense that you would think that the best way to mask it would be to present them together, and for certain stimulus conditions that's true."

But the experiments posed a puzzling question: If the mask comes later, how can it suppress the target, which was already in the brain?

"People in the sixties changed the criteria," Ogmen says. "Instead of asking how bright it was, they asked the observers to respond by a motor action; they asked them to press a button left or right depending on *where* the target appeared. What they found was surprising, in that the mask had absolutely no effect on their ability to locate the target correctly and to respond by a motor action. So this pointed to a disassociation between what we perceive consciously and what we can perform at the motor-sensory level without a concomitant awareness. The observers would say that they don't see the target, yet they would respond as if they were seeing it."

"So the information gets into the nervous system, can be used by the motor system but doesn't reach our awareness," Ogmen says. "That's the window to what we can call some kind of zombie within us."

Ogmen and Breitmeyer's research has revealed that the two systems are not dissociated. They "talk" to each other. In one of their studies, they changed the order of the target and mask. Instead of presenting the mask after the target, they presented it before. Then they simulated their model and predicted that reaction times should change. What they found is that when they presented the mask first, it affects both perception and the motor response. But unconscious perception is only affected when the mask comes first, and if the mask is presented second, it only affects conscious perception.

The upshot? The two systems, the automatic sensory motor system and the perceptual system where we have awareness, talk to each other when the timing of their activities is "right."

From Ritualistic Zombies to Insightful Minds

According to Ogmen, understanding the interplay between the zombie-like sensory motor system and the system giving rise to our awareness may be key to designing truly intelligent systems that can generate novel and creative solutions to unforeseen complex problems. How can a simple, relatively fixed system be transformed into a highly flexible one?

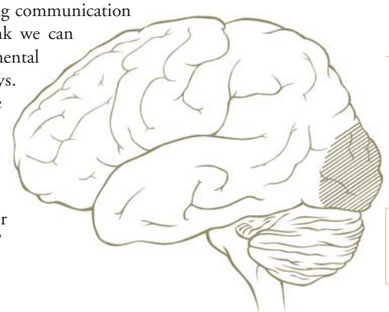
Ogmen addresses this question in the domain of visual perception in collaboration with Harold Bedell from the College of Optometry and Saumil Patel, a research assistant professor of electrical and computer engineering. Together, they probe the nature of neural mechanisms whereby the relatively stable coding in the early stages of the visual processing can be transformed to generate the enormously rich repertoire of complex tasks that human observers can carry out.

Tough Questions

Ogmen's research dares to ask difficult questions: What is awareness and do we really need it? Is awareness something important in designing an intelligent system? Can an intelligent system be a complete zombie? Does awareness have an essential role in solving sensory or sensory-motor problems? Can we make computers or artificial systems conscious?

These are tough questions, but perhaps even more compelling is the quest to convert a deeper understanding of the brain into new diagnostic tools and new treatments for various brain maladies.

"If we start understanding communication in the brain then I think we can start addressing some mental disorders," Ogmen says. "We may, for example, be able to design a device to operate in the brain, one that artificially enhances the neural signals necessary for normal brain function."

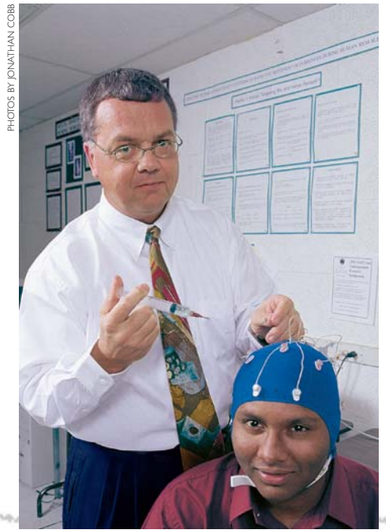


UNDERSTANDING **SCHIZOPHRENIA**

UH Engineer Pioneers New Method for Studying Mental Illness

University of Houston engineering professor Ben H. Jansen is working with Yale psychiatry professor Nashaat N. Boutros to deepen scientific understanding of how the normal brain processes information and what goes wrong with that process in patients with schizophrenia. Jansen is the co-principal investigator with Boutros on a six-year study, "Phase Resetting and Sensory Inhibition in the Central Nervous System," funded by the National Institutes of Health. The researchers are entering the third year of research, which is designed to ferret out new details on the neural activity involved in auditory information processing. Those details may pave the way for a new generation of treatments for mental illness.

PHOTOS BY JONATHAN COBB



Professor Ben Jansen and graduate student Vijay Grandhi demonstrate how electrical recordings will be performed during Jansen's NIH-funded research investigating how the brain processes information.

Using data collected at the Veterans Administration Hospital in West Haven, Connecticut, the teaching hospital for Yale Medical School, Jansen is decomposing electroencephalograms, or EEGs, into their component parts and then delivering original insights into the workings of the brain.

Jansen begins by examining the auditory information process. First, patients and normal controls are presented with very short tones, or clicks, while taking EEG readings. Then Jansen applies a unique analysis tool, a piece of software that was developed by Jansen's former graduate student, Violet Garoosi, to uncover new facts about the inner workings of the brain.

The analysis tool provides researchers with a novel way to enhance tiny bits of information that were previously undetectable, says Jansen.

"There are various frequency components in the EEG signal; you may think of these as sine waves," Jansen says. "Our software isolates these individual components for individual analysis. You could think of it as similar to looking through a microscope at individual atoms that make up molecules or compounds."

In the clinical portion of the study, test subjects are presented with pairs of identical short tone bursts, each tone separated by half a second, in a test protocol that Jansen describes as "the double click paradigm."

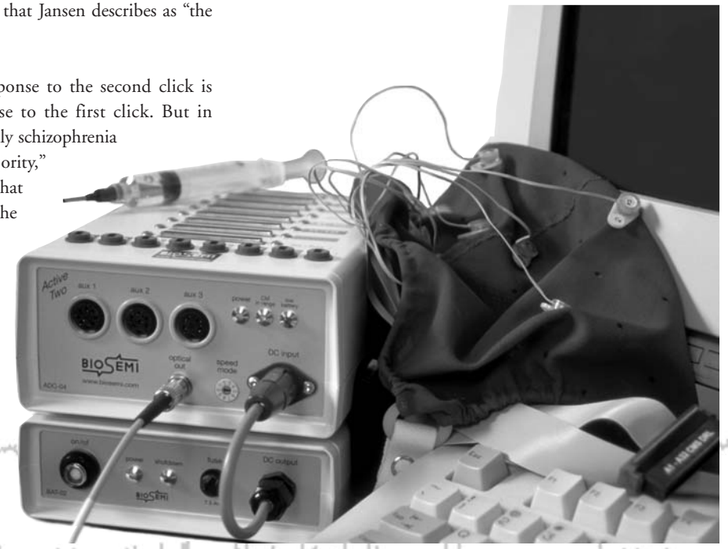
"In normal subjects, the EEG response to the second click is generally smaller than the response to the first click. But in psychiatric populations, and especially schizophrenia patients, we don't see that in the majority," Jansen says. "Our conclusion is that there is a deficiency in what we call the gating mechanism, which is the brain's automatic system for ignoring irrelevant information."

What Jansen's unique approach has revealed is that the important difference between normal and schizophrenic subjects is not what scientists had previously assumed. EEG readings had demonstrated that the response to the second click was less in normals and the same in schizophrenics. Jansen's research has shown that what matters most is the inability of the schizophrenic subjects to respond properly to the first click. He asserts that an auditory stimulus induces a phase resetting, or phase synchronization, but only to the first click.

"When we talk about phase resetting, we say the stimulus seems to affect the phase of this oscillation," Jansen says. "For example, think of a backyard swing. If we have two swings that are swinging together, side-by-side, then we say they are in phase. If they are out of phase and you give them a strong enough push, you can get them into phase with each other. You can think of the brain as a set of oscillators, swings, which are primarily out of phase, but because of an external stimulus, the click, they are temporarily pushed into phase. And that's what we quantify. We were the first to observe that the random phase gets aligned after the first tone is presented."

Two possible treatments for this kind of deficiency are new pharmaceutical drugs and the placement of electrodes deep in the brain, which Jansen describes as a kind of pacemaker.

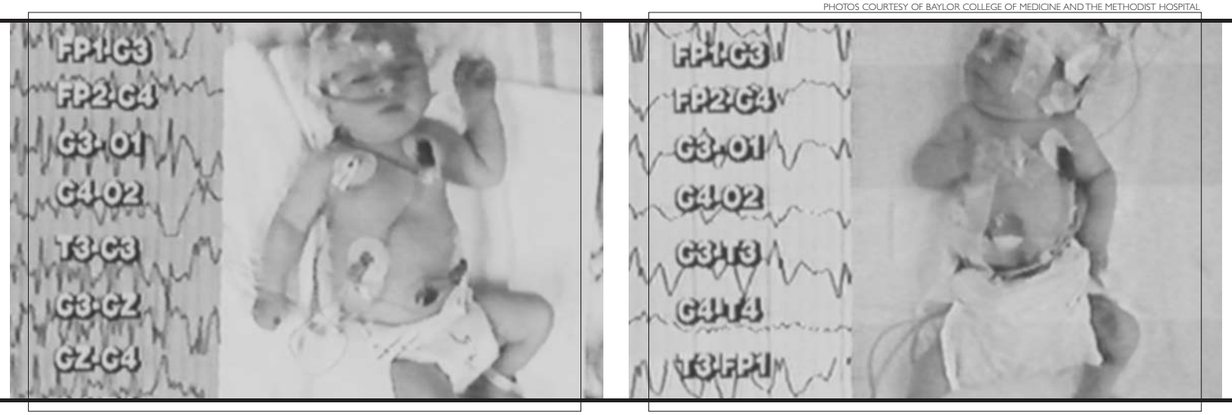
"In theory, if we can fix the gating deficiency, this group of patients may be cured," Jansen says.



UH Professors *Developing*

AUTOMATED SEIZURE DETECTION SYSTEMS *for* Newborn Babies

PHOTOS COURTESY OF BAYLOR COLLEGE OF MEDICINE AND THE METHODIST HOSPITAL

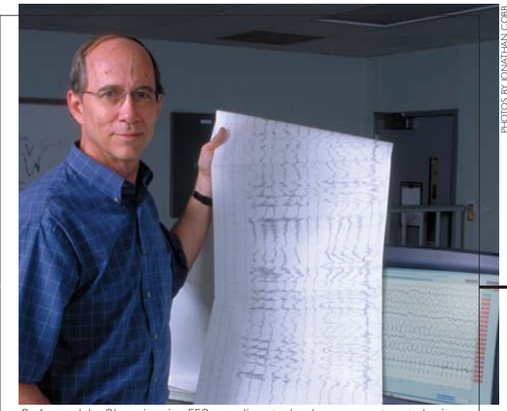


EEG/video split screen images of newborn babies will provide some of the data for three UH engineers who are developing two automated seizure detection systems.

University of Houston Electrical and Computer Engineering professors John Glover, Periklis Ktonas and Nicolaos Karayiannis are working with researchers at Baylor College of Medicine and The Methodist Hospital to develop two new automated, intelligent systems to detect and characterize epileptic seizures in newborn babies.

A quick and accurate diagnosis is paramount to detecting seizures in newborn babies because each seizure can damage the developing brain and the most effective anticonvulsive drug treatment depends on timely detection and assessment. Unfortunately, today clinicians must analyze visually lengthy data (records of the electrical activity of the brain called EEG—electroencephalogram) and watch hours of video recordings to identify seizures.

The research is funded by two separate grants from the National Institutes of Health, one to develop a tool employing EEG recordings, the other to develop a tool based on video recordings of babies.



PHOTOS BY JONATHAN COBB

Professor John Glover is using EEG recordings to develop a new automated seizure detection system for newborn babies.

Glover, the principal investigator of the study employing EEGs, will pair with Baylor College of Medicine's Eli Mizrahi, Richard Hrachovy and James Frost. Karayiannis, the principal investigator of the video-based study, will work with Baylor's Mizrahi, Frost, and Merrill Wise. The two systems turn out to be complementary because some seizures in neonates are only detectable by behavior while others require an EEG.

Glover will receive assistance from co-principal investigators Ktonas and Karayiannis as he creates an EEG-based neonatal seizure detection system. Although Glover's basic area of expertise is intelligent, or rule-based, signal processing, he says he has always liked biomedical applications. He chose to study newborns because, while considerable progress has been made in the automated detection of seizures in adults, relatively little work has been done in the neonatal area.

"Detecting seizures automatically in neonates is a difficult problem. We decided to tackle it," says Glover. "Our goal is to develop a reliable system for detecting neonatal seizures that people would want to use and would trust as a screening system."

The current screening procedure is a time-consuming process involving long-term EEG monitoring and the visual interpretation of graphic records. Glover proposes a multi-stage, hybrid approach using a combination of signal processing, pattern recognition, artificial neural networks and expert rules. During each stage, multi-channel neonatal EEG data will be analyzed to detect and classify electrographic seizures.

Glover expects that the information he collects from the research will not only lead to the development of a practical seizure detection system but also will reduce the cost of reading and interpreting neonatal EEGs. The information may also prove useful in future seizure research studies.

Multiple Algorithms that Mirror the Mind

"Our approach is modeled after the one humans use when they address the problem of detecting seizures," Glover says. "A physician can generally reliably look at the EEG record and say whether a patient has had a seizure. But a machine is going to have to bring many, many techniques into play to be able to reach accurate conclusions."

Glover's approach begins by mirroring the human visual image recognition system.

"The human brain's ability to recognize patterns with our eyes is fantastic," Glover says. "The neural network we have for doing that is just amazing. Then you throw in the ability to compare different data channels, take in general context and remember what happened before. There are multiple techniques that a human brings into play. Our approach is to bring all those human techniques together into one automated program."

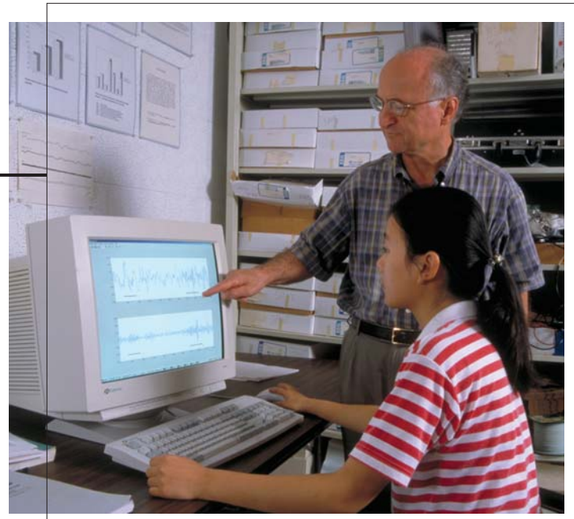
After the initial detection based on pattern recognition techniques, the system will employ a rule-based stage that throws in all the context information that resembles human intelligence. The best rules will be ones that accurately account for the common false alerts that plague most current systems.

"First, we detect patterns within the EEG and then we get to a rule-based system that tries to take in all relevant context and says, 'Okay, it looks like we have something right here,'" Glover says. "But we are also watching other data channels—the respiration channel, for example. So a reading that looks like a seizure in an EEG channel may turn out to be an artifact due to breathing."

Later in the study, Glover will make use of a clustering algorithm that gathers information over time and space, correlates data from different channels and expands the comparison process. The clustering algorithm gathers all the information together and asks, "Do I have enough evidence to identify a seizure?"

The preliminary data for this study was based on similar approaches Glover has used in previous work.

"We proved that the rule-based approach works when we studied epileptogenic EEG spike (epileptic waveform) detection," he says. "Now we're applying the same methods to the detection of seizures."



EEG-based Biological Markers for Neuro-psychiatric Disorders
In the past few years, researchers have been elaborating on a connection between pathologies such as depression, schizophrenia and Alzheimer's and brain wave (EEG) forms called sleep spindles. These waveforms are generated by the thalamus to apparently "block" incoming information from the environment, and, accordingly, to allow the cortex to rest during sleep. It seems that the changes in brain biochemistry due to the above pathologies affect the generation mechanisms of sleep spindles. Professor Periklis Ktonas, pictured above with student LingLi Hu, is working with doctors at the Sleep Disorders Laboratory of the Veterans Administration Hospital in Houston to develop a method for the automated quantification of occurrence patterns in these waveforms (see picture). If successful, Ktonas' work will help establish quantitative biological markers for objective differential diagnosis of mental illnesses such as depression and Alzheimer's.

Teaming with Professor Ktonas

Teaming up with Glover as a co-principal investigator is Ktonas, an expert in automated EEG analysis and the director of the college's graduate program in biomedical engineering. Ktonas and Glover have been working together since the mid 1980s on epileptogenic EEG detection. Their previous work also was funded by NIH grants.

"One of the main reasons why this project will be so important to clinicians is their need to fine-tune anticonvulsive drug dosage quickly and accurately, without undergoing a lot of trial and error," Ktonas says. "The clinicians want to tailor the drug treatment to the individual case, and if they have a system to analyze the lengthy EEG record and quantify the various parameters of the seizure, then they can do that."

The system will also provide more numbers for the clinician to consider when making decisions.

"Today, a clinician may simply look at an EEG record and see where the seizure starts and ends," Ktonas says, "but our system may reveal some subtle parameters, some subtle information concerning succession of EEG waves or a pattern in the waves that may have clinical significance. Right now, clinicians don't have that information."

The system not only will mirror human understanding and analysis, it will strive to go farther, ferreting out new information that may identify and characterize seizures even more accurately.

"Right now, the alphabet the clinician uses is subjectively derived," Ktonas says. "We're trying to establish an objectively derived alphabet of seizures. In other words, clinicians do a qualitative assessment of the abnormal EEG manifestation. What we are creating is a quantitative assessment that they can rely on for a richer and more objective understanding."

The Video Modality

Karayiannis is the principal investigator on an equally compelling project, the development of automated video processing and analysis procedures aimed at the characterization and recognition of neonatal seizures.

His team will rely on recent developments in computer and video technology to extract, process and analyze novel quantitative information on the behavioral characteristics of neonatal seizures. The long-term goal is the development of a stand-alone automated system that could be used as a supplement in the neonatal intensive care unit to provide 24-hour-a-day, noninvasive monitoring of infants at risk for seizures.

"The need for earlier, better detection is clear," Karayiannis says. "Today nurses and doctors do the observation of babies. The problem with the current practice is that unless a nurse or a doctor identifies the seizure, the baby may have a seizure and the seizure may go unnoticed."

Professor Nicolaos Karryiannis analyzes video recordings of newborn babies as he develops a new automated seizure detection system for neonates.

And missing it can have serious consequences: "A seizure is the first and perhaps the only manifestation of early neurological problems, and the seizure itself can be damaging to the developing brain," says Karayiannis. "These disturbances in cerebral function may result in significant long-term adverse effects, such as neurological handicaps, mental retardation and postnatal epilepsy. And because seizures tend to beget more seizures, an unnoticed seizure is a missed opportunity to begin the earliest possible treatment."

Karayiannis will begin with the extraction of quantitative information from video recordings of neonatal seizures. This requires the identification of the body part that moves due to a seizure. He and his colleagues are only interested in tracking the part of the body that moves during seizures—usually the hands and feet—and then quantifing that movement.

Karayiannis and his team just began working on the study officially in July, but they have been preparing for the opportunity to do the work for three years.

"We did a preliminary investigation, analyzed some data here in the lab using video processing and analysis techniques," Karayiannis says. "We received the grant in July, and now we are working on quantifying neonatal seizures from video recordings. We are developing further the video processing and analysis procedures that are going to allow us to quantify neonatal seizures from video."

Learning on the Job

Karayiannis plans to develop a seizure identification and characterization system based on neural networks, which are nonlinear computational models capable of learning on the job. "We can train those models to perform human-like tasks by presenting them with examples," he says.

Each video recording will produce a set of temporal signals that quantify the motion of the body parts affected by the seizure. Karayiannis' hypothesis is that each seizure has a signature signal. For example, a focal clonic seizure, which is characterized by repetitive movements, is expected to produce a temporal signal that is periodic. The hope is that each kind of seizure is going to lead to distinct signature signals.

"We will subsequently attempt to extract features out of these signals by trying to identify some unique behavioral characteristics, such as periodicity or fast and abrupt changes," he says. "Our hypothesis is that those features are going to be unique to certain seizures. These features will then be used to train a neural network to identify and characterize neonatal seizures. Over the years, we have developed a variety of adaptive learning algorithms that can train neural networks to learn by example."

"Once developed, the system may have other applications beyond monitoring neonatal seizures in hospital settings, including telemedicine," Karayiannis says.

Instead of asking patients with sleep problems—sleep apnea-related awakening, for example—to go to the hospital and sleep in a lab, a doctor might send the patient home with the software and let them use their own Web cam to make a video recording of their sleep. Then the software would extract the relevant awakenings, which then could be sent via the Internet to the appropriate clinicians for final analysis.

"Video is a very new modality in medical imaging," says Karayiannis. "So the sky is the limit."

Former Dean Retires from Faculty and Leaves a Legacy of Achievement — Roger Eichhorn

Former Dean Roger Eichhorn retired from the UH Cullen College of Engineering faculty in August 2002, leaving behind a legacy of academic and administrative achievement—and many devoted friends and colleagues.

Under Eichhorn's leadership, the college raised student admissions standards, elevated the quality of the faculty and greatly expanded the college's public identity and community presence.

Professor Charles Dalton, who served as associate dean for undergraduate programs early in Eichhorn's term, credits Eichhorn with prompting an increase in the admissions standards for first-year and transfer students. "He encouraged faculty to increase the admissions standards, and the SAT and ACT scores that we required went up," Dalton says.

Despite facing a national downward trend in enrollments—and the budget restraints that followed—Eichhorn spurred efforts to continue to recruit highly credentialed faculty. "The quality of the people we looked for as potential faculty continued to improve," says Dalton, "and as a result we kept getting people who had more and better potential to be successful faculty members."

Perhaps the most obvious of Eichhorn's accomplishments were the ones that helped shape a strong community presence and public identity for the college. During his tenure, the Engineering Alumni Association worked with Dion McInnis, former director of external relations, to initiate several annual events that are still successful today, events such as the Distinguished Engineering Alumni Awards Dinner, the ASME/UH Cajun Crawfish Boil and the Engineering Golf Tournament.

"I think the alumni organization took off because Roger decided that was important. Of course, without good alumni it couldn't happen either," says Professor David Shattuck, who also served as associate dean of undergraduate programs. "But Roger was the one who engineered the conditions that made the alumni organization take off."

The initial thrust for an invigorated engineering alumni group came in the mid 1980s, when Ray Meyer (1973 BSCE, 1978 MSCE) and Rafael Ortega (1981 BSCE, 1985 MBA) approached Eichhorn about starting a Civil Engineering Alumni Association. Eichhorn wanted only one association for the college, so they concentrated on promoting the Engineering Alumni Association, which has grown into the largest on campus.

Some other key facts about Eichhorn's term as dean:

- John Lienhard, M.D. Anderson Professor of Technology and Culture, developed the nationally syndicated radio program, the Engines of Our Ingenuity, in response to Eichhorn's request for a radio program to promote the college.
- College hit historical peak in student enrollment at 3,835 in 1983.
- College's highly regarded Program for Mastery in Engineering Studies (PROMES, formerly known as the Program for Minority Engineering Students) expanded from 85 students in 1982 to 311 students in 1996.
- Student body became more diverse as percentages double for Asian American, Hispanic, international and female students.
- College hit historic peak of more than $10 million in research awards in 1994, a level the college has only now begun to approach again.
- Eichhorn created the Patricia Eichhorn Scholarship for female students in his wife's memory.

After stepping down as dean in 1996, Eichhorn joined the faculty in the Department of Mechanical Engineering, where he taught several core undergraduate courses and made an impact on the curriculum, particularly on a junior year undergraduate lab, MECE 3360 Experimental Methods. He restructured the course so that other faculty members could teach it more easily.

Eichhorn earned a reputation among the students as a tough, but fair, professor. In 1998, the UH American Society of Mechanical Engineers Student Chapter named him Professor of the Year.

A former faculty member at Princeton, Eichhorn came to UH from the University of Kentucky, where he had also served as dean. He holds the rank of Life Fellow of the ASME and Fellow in the American Association for the Advancement of Science.

Before shifting his career focus to administrative positions, Eichhorn had been an acclaimed researcher whose work earned him the distinction of the 1982 Memorial Award for Heat Transfer Science from ASME.

Faculty Promotions

Han Le (ECE) was granted tenure.

Jeffrey Williams (ECE) was promoted to professor with tenure.

New Faculty

Adam Capitano joined ChE as an assistant professor. Previously, he was a postdoctoral fellow in the Griffith Liver Tissue Engineering Group at the Massachusetts Institute of Technology Division of Bioengineering and Environmental Health. He also served as an imaging and optical sensing specialist for a Liver Based Toxin Sensing Program. He received his B.S. in chemistry from the University of Iowa in 1994 and his Ph.D. in chemistry from the University of Michigan in 1999.

Vince Donnelly joined ChE as a professor. He received his B.A. in chemistry from LaSalle University in 1972 and his Ph.D. in physical chemistry from the University of Pittsburgh in 1977. Upon receiving his doctorate, Donnelly continued his research as a post-doctoral fellow at the Naval Research Laboratory. After two years, he went to work for Bell Laboratories in Murray Hill, NJ, where he worked for 22 years before joining the college.

Matthew Franchek joined ME as a professor and chair. Previously, he was a professor of mechanical engineering and deputy director of the Electro-Hydraulic Control Research Center at Purdue University. He received his B.S. in mechanical engineering from the University of Texas at Arlington in 1987 and his M.S. and Ph.D. in mechanical engineering from Texas A&M University in 1988 and 1991.

Gangbing Song joined ME as an associate professor. Previously, he was an assistant professor of mechanical engineering at the University of Akron. He received his B.S. in energy engineering from Zhejiang University, P.R. China in 1989 and his M.S. and Ph.D in mechanical engineering from Columbia University in 1991 and 1995.

Faculty Awards

Vemuri Balakotaiah (ChE) received the Ya. B. Zeldovich Award from The Dow Chemical Company. He was also named John and Rebecca Moores Professor, which is a five-year position beginning with the 2002–2003 academic year.

Richard Bannerot (ME) received the Meritorious Service Award from the American Society of Mechanical Engineers South Texas Section.

Shankar Chellam (CEE) received the CAREER Award from the National Science Foundation.

Guanrong Chen (ECE) received the M. Barry Carlton Award for Best IEEE AES Transactions Paper from the IEEE Aerospace and Electronics Systems Society.

Ovidiu Crisan (ECE), **Charles Dalton** (ME), **John Hunsucker** (IE), **Kishore Mohanty** (ChE) and **Michael O'Neill** (CEE) received the college's 2002 Outstanding Teacher Awards.

Charles Dalton (ME) received the 2002 Dean W.R. Woolrich Award/Engineer of the Year from the American Society of Mechanical Engineers South Texas Section.

Michael Economides (ChE) received a Doctor Honoris Causa from the Petroleum and Gas University of Ploiesti in Romania.

Demetre Economou (ChE) received the 2002 Sigma Xi Faculty Research Award from UH.

John Glover (ECE) received the Outstanding Engineering Educator Award from the Institute of Electrical and Electronics Engineers Region 5.

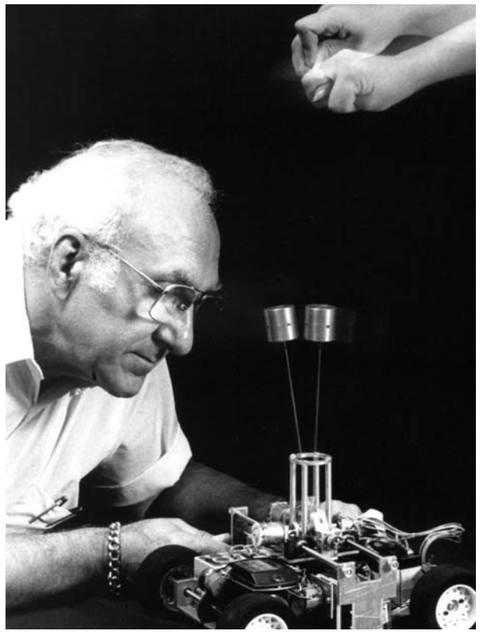
Todd Helwig (CEE) received the 2001 Collingwood Prize from the American Society of Civil Engineers. He also received the college's Junior Faculty Research Award.

Ernest Henley (ChE), professor emeritus, received the 2002 Computers and Chemical Engineering Award from the American Society for Engineering Education.

Fazle Hussain (ME) received the Fluid Dynamics Award for 2002 from the American Institute of Aeronautics and Astronautics.

Ramanan Krishnamoorti (ChE) received the Best Fundamental Paper Award from the American Institute of Chemical Engineers South Texas Section.

Excellence in Teaching, Research on 'Project Mohole' Highlight Professor's Career
— William Schneider



The audience at last spring's Faculty and Staff Meeting gave a much-deserved standing ovation for Professor William P. Schneider, who retired from the faculty of the Department of Electrical and Computer Engineering after 37 years of teaching at the Cullen College of Engineering.

Schneider is an UH alumnus with bachelors degrees in both mathematics and engineering, with an original connection to the university that goes back 57 years. He has been recognized with numerous awards for his teaching excellence throughout his career.

One of Schneider's many successful former students, Dennis Webb (1976 BSEE), remembers the professor's helpful teaching style. "I took a couple of electronics classes from Professor Schneider in 1973 and '74," says Webb, who is now manager of NASA's International Space Station Integration for Mission Operations. "I remember it as one of the most pleasant and productive courses I had while I was at UH."

In addition to teaching, Schneider also pursued a high-profile research career that was highlighted by work in the 1960s on Project Mohole, a nationally funded effort to drill a hole through the earth's crust beneath the floor of the ocean to reach the interior of the earth. His later research on the deep-sea drilling exploration vessel, the Glomar Challenger, helped confirm the theory of continental drift.

Paradoxically, it was the lure of the sky—not the earth—that originally propelled Schneider toward a career in engineering.

As a boy, he loved to build model airplanes, and growing up in St. Louis gave him the opportunity to cultivate his interest by visiting the airfield where aviator Charles A. Lindbergh's airplane was housed in the 1930s.

As it turned out, those childhood experiences shaped Schneider's destiny. In 1940 he joined the United States Air Force. He enlisted at the age of 18 and was sworn in at Randolph Air Force Base in San Antonio, where he learned about airplanes.

"That's the reason I went into the service," Schneider says, "to learn how to fly."

When Schneider left the service, he considered going to Rice but decided against it when he learned Rice only accepted new students in September. "I was anxious to go to school and the University of Houston allowed us to go in during the middle of the year. Some of the classes were being taught in old barracks. In fact, we had some rooms that would leak water when it rained. But one of the things that I've always said is that it's not so much what kind of equipment you have; it's who the professor is. And we had some excellent teachers."

After graduating from UH, Schneider received a full scholarship from the Massachusetts Institute of Technology and was the first UH graduate to attend MIT. "I got my master's degree in electrical engineering and then I came back to the University of Houston in 1951 as an assistant professor and started working during the summer for Schlumberger." He went from Schlumberger to Brown & Root and the Project Mohole.

According to documents at the National Academy of Engineering, Project Mohole represented the earth sciences' answer to the space program. If successful, the exploration of the intraterrestrial frontier would provide invaluable information on the earth's age, makeup, and internal processes. In addition, evidence drawn from Mohole would be brought to bear on the question of continental drift, which at the time was still controversial.

The project lost political support and funding before the goal of drilling to the mantle could be reached, but two technologies developed during Mohole had significant impact on the offshore drilling industry: the dynamic positioning system and the sonar system for hole re-entry. As Brown & Root's staff engineer in charge of downhole logging and scientific measurements, Schneider was intimately involved in the development of both.

Philip Schneider (1974 BSEE), William Schneider (1949 BSEE), Cheryl Schneider, Mary Schneider, Ann Schneider and Don Schneider (1982 BSEE)

Han Le (ECE) received the United States Defense Advanced Research Project Outstanding Performance Award from the U.S. Defense Department.

John Lienhard (ME), professor emeritus, received an honorary Doctorate of Humane Letters from UH.

John Martinez (ChE) and **Charles Rooks** (ChE) received the college's Outstanding Lecturer Award.

Hanadi Rifai (CEE) received the 2001 Wesley W. Horner Best Paper Award from the American Society of Civil Engineers.

William Rixey (CEE) received the 2002 Enron Corporation Teaching Excellence Award from UH.

Jerry Rogers (CEE) was installed as vice president of the American Society of Civil Engineers.

Liang Shen (ECE) received the Gold Medal for Technical Achievement Award from the Society of Professional Well Log Analysts.

Leang-San Shieh (ECE) received the 2002 El Paso Energy Foundation Faculty Achievement Award from UH.

Cumaraswamy Vipulanandan (CEE) received the college's Senior Faculty Research Award.

Key-Han Wang (CEE) received the college's W. T. Kittenger Teaching Excellence Award.

Lewis Wheeler (ME) received the 2002 Dean Claude L. Wilson Award for lifetime achievement from the American Society of Mechanical Engineers South Texas Section.

Richard Willson (ChE) received the Van Lanan Award from the American Chemical Society.

John Wolfe (ECE) received the college's Fluor Daniel Faculty Excellence Award.

Staff Awards

Dawnelle Prince, Industrial Scholar Interns Program coordinator, received the Rising Star Award from the Texas Association of College Admissions Counseling.

Mary Schulz, academic advising specialist, received the 2002 Dean's Meritorious Staff Service Award at the college's Annual Staff Appreciation Day. She received the award from peer nominations and recommendations.

College faculty/staff gave the highest contributions on campus for the State Employee Charitable Campaign. This is the second year in a row that the college received this honor for faculty and staff contributions.

Student Awards

Russell Crake III (ECE) received the 2002 Jefferson Award for public service from the American Institute for Public Service.

Benjamin Fasenfest (ECE) received a graduate fellowship from Tau Beta Pi.

Sandy Geffert, ME graduate student, won the gold medal for women's point fighting (under 55Kg) and silver medals for softstyle and team kata at the 2002 World Karate Association's World Championship in Pisa, Italy.

May Shek (ChE) received the 2002 Wilbur L. and Judy L. Meier Outstanding Senior Award.

Rosalia Wisinger (ChE) was named a National Action Council for Minorities in Engineering (NACME) scholar.

UH Robotics Team claimed third place at the Institute of Electrical and Electronics Engineers (IEEE) Region 5 Student Robotics Competition.

Key:
ChE — Department of Chemical Engineering
CEE — Department of Civil & Environmental Engineering
ECE — Department of Electrical & Computer Engineering
IE — Department of Industrial Engineering
ME — Department of Mechanical Engineering

UH Alumnus Makes First Trip to Space

By Brian Allen

At T-minus six seconds, the main engines ignite. At T-minus zero, the solid rocket boosters light, the Shuttle begins to shake, and the ride of a lifetime begins.

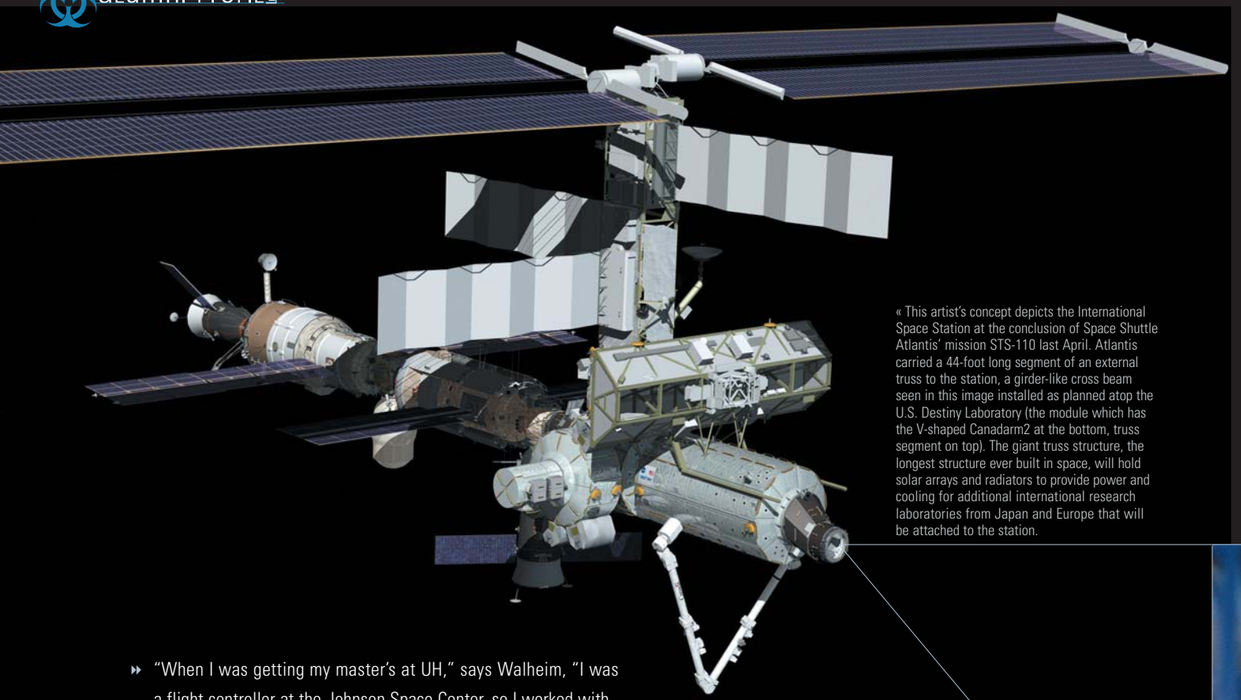
Astronaut Rex J. Walheim (1989 MSIE) has felt these sensations before—the G-forces and the shaking—but that was in the simulators. This time it's real, and the 39-year-old Air Force lieutenant colonel knows his dream of space flight is finally becoming a reality.

Walheim, who characterizes himself as a "window-seat" kind of guy, was determined to enjoy the spectacle of space travel—including the liftoff, which is normally difficult to view, even from the flight deck.

"I had a little wrist mirror that I had on my left arm so I could look out the overhead window behind us, and when the main engines came up I could see the smoke from the exhaust coming up," says Walheim. "A little later I looked up again and I could see the beach out the back window, and I could see it just fading away. It was just really amazing to see how fast we were climbing. You're going about 100 mph by the time you clear the pad so it doesn't take long. You're really screamin'."

Walheim, a native of San Carlos, Calif., made his first trip to space last April, completing two successful spacewalks during NASA's Atlantis STS-110 mission to the International Space Station. But he might never have made it to space, were it not for his decision in the mid eighties to pursue a master's degree at the UH Cullen College of Engineering.

PHOTO BY MARK LACY



« This artist's concept depicts the International Space Station at the conclusion of Space Shuttle Atlantis' mission STS-110 last April. Atlantis carried a 44-foot long segment of an external truss to the station, a girder-like cross beam seen in this image installed as planned atop the U.S. Destiny Laboratory (the module which has the V-shaped Canadarm2 at the bottom, truss segment on top). The giant truss structure, the longest structure ever built in space, will hold solar arrays and radiators to provide power and cooling for additional international research laboratories from Japan and Europe that will be attached to the station.

» "When I was getting my master's at UH," says Walheim, "I was a flight controller at the Johnson Space Center, so I worked with astronauts and knew what they were looking for in backgrounds."

He knew he needed an advanced technical degree, and he knew he needed flight experience if he was ever going to realize his dream of becoming an astronaut.

"I was working here as a lieutenant in the Air Force as a flight controller for the shuttle program when a friend of mine told me about this master's program that he was starting in industrial engineering," says Walheim, who received his bachelor's degree from the University of California at Berkeley. "It seemed to me it would open some doors for me in the future, so I decided before I committed to it I'd try a class. I tried it, and I enjoyed the class, so I kept with it and decided to go through the whole program and get the degree."

Walheim's experience at UH will sound familiar to many graduates of the urban research university. He worked all day and attended classes at night to boost his career into a whole new orbit.

"I had to go to class after work and study after work so it was difficult for a while," says Walheim. "One nice thing that the Air Force did is they allowed me to go to school full-time for six months, so I was able to finish the last portion of the degree program full-time. But for the first year and a half, I was doing it after work. That was considerably more difficult, but it was still rewarding, especially when I finished up."

After completing his master's degree in Industrial Engineering at the Cullen College of Engineering, Walheim, already a captain in the United States Air Force, was one pivotal step closer to becoming an astronaut. Once he was accepted to test pilot school, he gained the necessary flight experience, and he was ready for astronaut training.

"Before I left here in 1989, I hadn't flown for the Air Force before," says Walheim, who knew as a child that he wanted to fly someday. "As a kid it was something I enjoyed reading about and thinking about. To a certain extent, I always wanted to be a pilot and ended up being an engineer through a roundabout set of circumstances."

That engineering education came in handy during Walheim's first-ever spacewalk, when he had to solve some unexpected mechanical problems on the fly.

The primary mission was to deliver and install the first segment of an external truss structure that will support additional power and cooling systems for future international laboratories. Both problems arose in the installation of the segment. »

Searching the Stars

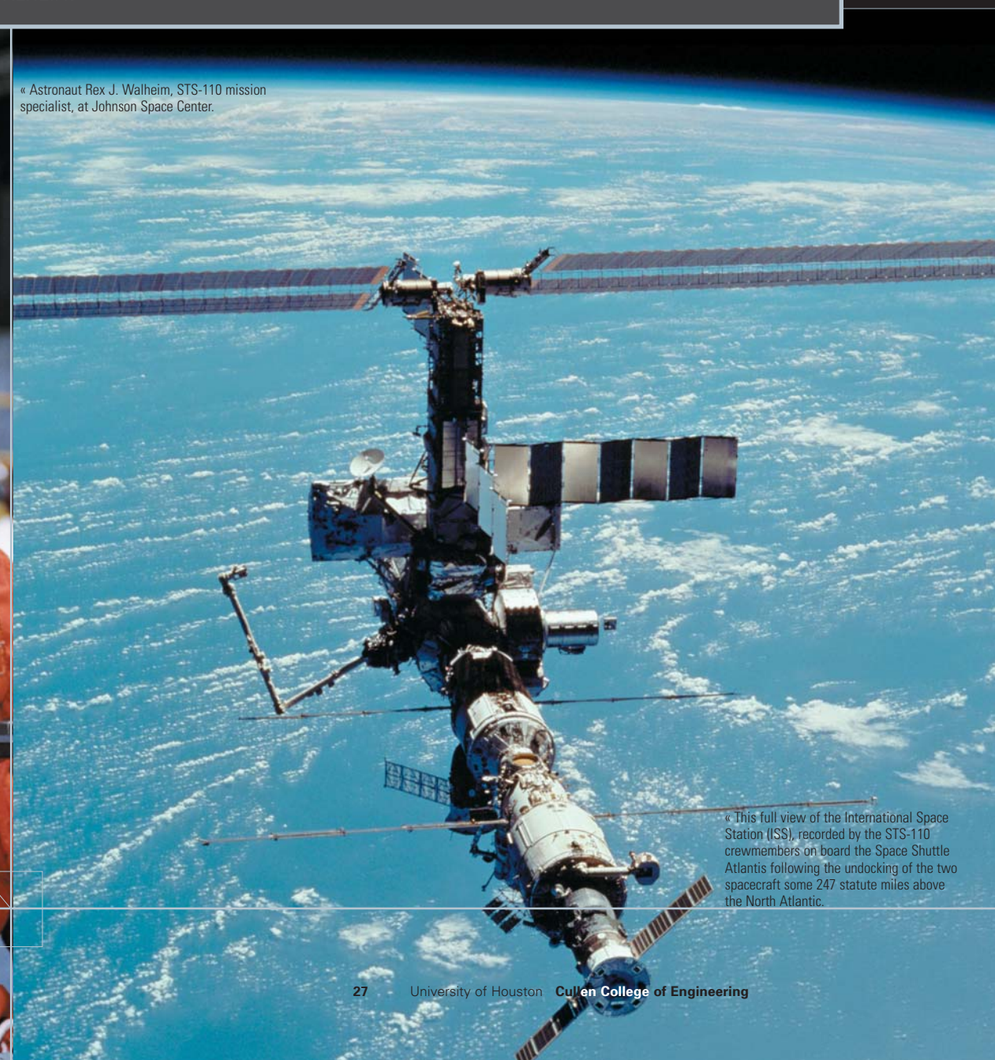
It's just past sunset when a woman and her two young sons head out to the front yard and search the evening sky for two bright lights.

Alex and Jeffrey, ages four and five, are joining their mother, Margie, as they look for their father's spaceship, the Space Shuttle Atlantis, and the International Space Station. Both should be made visible by sunlight while the sky is still dark.

"My wife and boys had a chance—just after we undocked from the space station—and they could see both the shuttle and the space station fly over," says astronaut **Rex Walheim**.

The ground tracks for every shuttle mission and the space station are available on the Web (http://liftoff.msfc.nasa.gov/temp/StationLoc.html), and under fair weather conditions both are clearly visible when the flight path takes them overhead. As more segments are added to the station in the coming months, it should become larger and easier to see, says Walheim.

« Astronaut Rex J. Walheim, STS-110 mission specialist, at Johnson Space Center.



« This full view of the International Space Station (ISS), recorded by the STS-110 crewmembers on board the Space Shuttle Atlantis following the undocking of the two spacecraft some 247 statute miles above the North Atlantic.

First, Walheim and fellow spacewalker Steve Smith had trouble with the bolts that attach the truss segment to the top of the lab. "We had an electric drill, a power tool that we bring out with us, and it wouldn't release these bolts originally and it was a little bit tighter than we thought so we went to a manual ratchet mode and were able to manually break the bolts free to some higher settings and then we were able to release them."

The pair then dealt successfully with another jammed object, a tray-like attachment to the truss. "We also had a problem with a tray that swings down from the s zero truss," says Walheim, "and it was supposed to swing down fairly easily. My partner was supposed to be able to do it by himself, and he couldn't get it all the way down so I went back there and helped him pull it down and latch it into place. But we got that deployed and we were able to continue with the work that we were supposed to do. So there were a few contingencies that we had to deal with but it worked out okay."

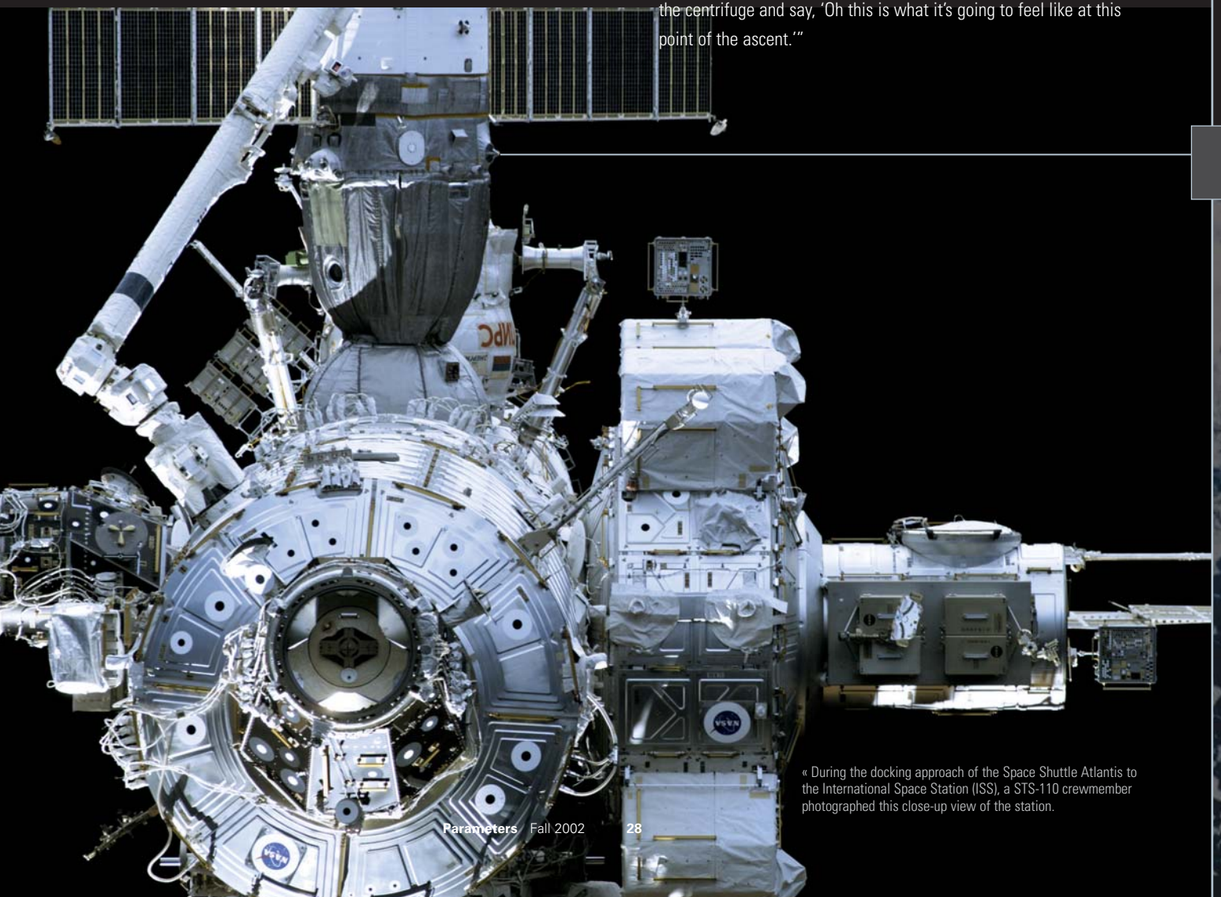
The key to being able to handle the unexpected glitches of a mission is in the training and preparation, Walheim says.

"The training was really good," he says. "I was really pleased with the mock-ups we have in the pool. It really makes you feel comfortable because you get out on the space station and it feels like you've been there before. You're familiar with almost a muscle memory of where hand-holds are and how the task should feel and the position you should be in."

The training in the pool had its limitations too. "With the water you have some viscosity effects which slow you down and make it easier to stay in one place, but out in space you don't have that so it's easier to start moving but it's a little bit harder to stop moving because you don't have the water slowing you down."

Walheim says the simulator can simulate the shaking but in order to simulate the G-forces, the astronauts traveled to San Antonio, where they had access to a centrifuge.

"They spin us around to the G-profile of an ascent, and that was very useful because when you are sitting here in the regular simulator you just don't feel how it's going to feel when you have three G's pushing on your chest. It was really kind of an eye opener to go into the centrifuge and say, 'Oh this is what it's going to feel like at this point of the ascent.'"



« During the docking approach of the Space Shuttle Atlantis to the International Space Station (ISS), a STS-110 crewmember photographed this close-up view of the station.

The mission itself provided Walheim with plenty of opportunities to put his training and education to use, but it also provided him with many memorable "window-seat" moments.

"We were fortunate to have a lot of good day passes over the United States, which included several passes over California, which is my home state," Walheim says, "and we flew over Texas a couple of times too. When we flew over Southern California, I could gauge our speed and distance by watching these two lakebeds that are very large and easy to spot. I would continue to watch them as they receded into the distance. I could see them all the way past Salt Lake City into Wyoming on the horizon. So you could see over a thousand miles in any direction. It was really spectacular."

Walheim was also particularly excited about the opportunity to work on the space station, which he believes is the future of our space program.

"The Hubble Space Telescope has made great contributions to the understanding of the universe," Walheim says. "We can build on that and do a much wider variety of research on the International Space Station. We can do Earth observations and observations of the universe, but you're also doing medical science, research on new types of drugs, on combustion science, on the effects of long-duration space flight on humans. We're trying to prepare ourselves for going farther—maybe going back to the moon or to Mars—and the way we're going to do that is through space station research. I think the more people learn about it and see it as it gets bigger and bigger, they will get more excited about it."

Now that the mission is over, what's next for the spacewalking UH graduate?

"I'll get another technical job. I've been here for six years now and up until I got assigned to the flight last year I had various technical jobs. So I'll go back to having a new job, maybe in the spacewalk area, the area that helps plan and prepare for spacewalks in the future and helps out with some of the groundwork for the people who will be doing spacewalks."

Walheim is aware that many people perceive astronauts as heroes. Does he ever think of himself as a hero?

"You don't feel like one. You just do your job the best you can, but you are aware of the fact that what you do has the chance to inspire kids and students of tomorrow to try and realize their dreams. That's the main message we try to get across to them: Try to follow your dreams because—as we can show—they really do come true."

PHOTOS COURTESY OF NASA JOHNSON SPACE CENTER

Cougars In Space

CURRENT ASTRONAUTS:

Bonnie Dunbar (1983 PhD BioE)
Mike Fossum (1997 MS, UHCL)
Richard Mastracchio (1991 MS, UHCL)
John Olivas (1993 MSME)
Rex Walheim (1989 MSIE)

FORMER ASTRONAUTS:

Guion Bluford (1987 MBA, UHCL)
Maurizio Cheli (1994 MS AeroE)
Nancy Currie (1997 PhD IE)
Greg Harbaugh (1986 MS, UHCL)
Bernard Harris (1978 BS)
Donald Holmquest (1980 JD)
Bruce McCandless (1987 MBA, UHCL)
Story Musgrave (1987 MA, UHCL)

Astronaut information is available at http://www.jsc.nasa.gov/Bios/astrobio.html

1970's

Paul Sarvadi (1976 BSChE) received the Service Entrepreneur of the Year Award from Ernst & Young. He is president, CEO and co-founder of Administaff, a Kingwood-based company that provides businesses with an array of human resources services, including payroll, benefits, recruiting, hiring and work site safety inspecting.

Gregory R. Hurley (1977 BSEE) has been appointed as Fluor's project manager on a major EPCM project to convert a chemical processing complex from feedstock based on coal liquefaction technology to feedstock using natural gas auto-thermal reforming technology. Greg and his family have relocated to South Africa to lead this strategic project. Greg is based in the project management group of Fluor's Houston office and recently celebrated his 25-year service anniversary with Fluor. He can be reached at greg.hurley@fluor.com.

1980's

Hamlet Hovsepian (1982 BSCE) was promoted to acting assistant director of public works and engineering for the City of Houston.

Daniel Wong (1983 BSCE, 1985 MSCE, 1988 PhD CE) was sworn-in as a council member for the City of Sugar Land on May 21, 2002. He is president of Tolunay-Wong Engineers, Inc. and can be reached at dwong@tweinc.com.

Alan Black (1985 BSCE) has rejoined FKP Architects, Inc., a Houston-based architecture firm, as an associate project designer. Previously, he was a medical planner for them from 1994 – 2000. He has more than 10 years of experience in healthcare design and planning.

Satish (Swamy) Ananthaswamy (1987 MSEE) is a senior portfolio manager for the Regents of the University of California, where he is responsible for the investment management of the UC system's pension, endowment and 403(b) money. He completed his MBA in 1992 from the University of Southern California and is also a CFA charter holder. He lives in the bay area with his wife Arathi and daughters Nidhi (7) and Gowri (5). Satish was recently elected as the San Francisco Regional Director for the Global Association of Risk Professionals (GARP) and has published several papers in the area of Asset-Liability Management and the use of derivatives in investment portfolios. He can be reached at satish.swamy@ucop.edu.

1990's

Dale Rudick (1991 BSCE) was promoted to city engineer for the City of Sugar Land. Dale is past president of the Engineering Alumni Association.

Wade Schoppa (1991 BSME, 2000 PhD ME) received the 2002 Andreas Acrivos Dissertation Award in Fluid Dynamics from the American Physical Society.

Lindsey Bredemeyer (1992 BSME) has started Bredemeyer Engineering to provide engineering services to the pressure equipment industry. He specializes in assessment support for the European Pressure Equipment Directive. Lindsey can be reached at lindsey@lbredemeyer.com.

Charles (Xiaosha) Liu (1994 PhD CE) became a diplomat for the American Academy of Environmental Engineers in April 2002. He is a senior staff scientist of Pall Corporation, a global leader in manufacturing and supplying membrane filtration and separation equipment and systems. Charles can be reached at charles_liu@pall.com.

Marriages

Julio Rios (1997 BSIE) married **Jennifer White** (1999 BSEE) on Oct. 20, 2001 at the UH Chapel. Jennifer is a Firmware engineer in the portables division at HP and can be reached at jennifer.rios@hp.com. Julio is a web/graphic designer for Fuelquest and is also working towards a master's degree in management information systems at UH Clear Lake with an expected graduation date in Spring 2003. Julio can be reached at jrios@fuelquest.com.

Michael J. Morrow (1999 MSEnvE) married Kimberlee Shelton on Dec. 1, 2001 at First Christian Church in Beaumont, Texas. He works for the Texas Department of Protective and Regulatory Services.

Births

Frank Patrick Dylla (1988 BSCE) and wife Debbie welcomed home their third child, Chloe Nicole, on May 20, 2002. She weighed seven pounds and measured 20 inches long. Older siblings, Frankie and Celeste, are excited about the new addition to the family. Frank is an aerospace structural analyst for Vought Aircraft Co. and can be reached at frankdylla@earthlink.net.

Alumni News Briefs

Distinguished Engineering Alumni Awards

The Engineering Alumni Association honored **Frank Adamek** (1972 BSME, 1975 MSME) and **Dennis Petersen** (1978 BSIE, 1979 MBA) as Distinguished Alumni at the 2002 Distinguished Engineering Alumni Awards Dinner on June 7 at the Four Seasons Hotel. **Kathy Rhodes** (1969 BS English) received the Roger Eichhorn Leadership Service Award and Texas State Senator Rodney Ellis delivered the keynote address.

PHOTOS BY PHIL BUSBY

Top: Dennis Petersen, Kathy Rhodes and Frank Adamek
Right: Texas State Senator Rodney Ellis

Kathy Williams Rhodes [Roger Eichhorn Leadership Service Award]

Since graduation **Kathy Rhodes** (1969 BA English) has worked predominantly in external relations and publications. Before joining the UH in 1979, she worked in the Rice University Public Relations Office and with a research group at the University of Texas M.D. Anderson Cancer Center. Kathy split her 21 years at UH between the College of Business Administration and the Cullen College of Engineering.

During her six years with engineering, she coordinated the UH/ASME Cajun Crawfish Boil and provided the Engineering Alumni Association staff support for the Engineering Golf Tournament, the Engineering Alumni Awards Dinner, Homecoming and other EAA activities. Kathy also was the campus liaison and planner for annual outreach programs for students in middle school and high school, including Engineers Day, Cullen College of Engineering's spontaneous design contest, and the local competitions for MathCounts and the National Engineering Design Competition.

She is currently director of marketing for Cobb, Fendley & Associates, Inc.

George Kilford, Mike Williams, Jill Kilford, Nefi Williams, Greg Williams and Kathy & Greg Rhodes

Bob Woodward (1997 BSIE) and wife Shari welcomed home Ryan Christopher on Jan. 12, 2002. He weighed seven pounds and 13 ounces and measured 20.25 inches long. Bob is a project expediter for ABB Lummus Global and can be reached at woodwardbs@aol.com.

Paul Ruchhoeft (1998 MSEE, 2000 PhD EE) and wife **Jenny (Svoboda)** (1998 MEd) welcomed home Emma Catherine on Jan. 24, 2002. She weighed seven pounds and nine ounces and measured 20.25 inches long. Paul is an assistant professor in the UH Department of Electrical & Computer Engineering (ECE) and can be reached at pruchhoeft@uh.edu. Jenny is the infrastructure manager for the ECE Texas Engineering and Technical Consortium Grant and can be reached at jennyr@uh.edu.

Deaths

George Strouhal (1952 BSME) died July 12, 2000 at the age of 70 in Friendswood, Texas. A graduate of Alvin High School, Strouhal also earned a master's degree from the University of Texas and a doctorate from Rice University. He was employed for more than 30 years at NASA's Manned Spaceflight Center, and his contributions touched all major projects, from the Gemini program through the space shuttle and the international space station. He served for two years in the U.S. Army in the mid 1950s. He was a registered professional engineer. Strouhal is survived by his wife Jean, whom he married in 1955 in Bend, Texas, and by his son, Paul, and daughter, Jennifer McAninch.

David Griffin Killough (1956 BSME) died on Nov. 28, 2001 at the age of 84. He graduated from A&M College of Texas in 1939 with a B.S. in electrical engineering and was a Texas Registered Professional Engineer. He was a retiree of ExxonMobil Corporation with 34 years of service, where he excelled at computer systems engineering. After retirement, he served eight years as a lecturer in applied computer science engineering in the UH Cullen College of Engineering. He was married to his wife Anna for 61 years.

Owen Karl Payne (1990 BSME) died on July 3, 2002 at the age of 40. He was a senior staff engineer for Shell Pipeline Co. L.P. He was a member of the Fellowship Bible Church of Pearland, serving as elder and youth leader. He is survived by his wife of 18 years Elizabeth, three children Samuel, Sarah, Rachel, his mother and stepfather Christine and Glen Frisbie, his father Olynn Klyde Payne, two half sisters Kimberly Payne, Samantha Semora, two aunts Jeanine Cole and Virginia Starnes and numerous friends and family.

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

Send us your alumni news about new jobs, promotions, honors, moves, marriages, births, etc. Attach additional news clips or photos separately. Please include a self-addressed stamped envelope if you want your photos returned.

All Class Notes should be sent to:
Parameters Magazine, UH Cullen College of Engineering
E316 Engineering Bldg 2, Houston, TX 77204-4009
E-mail parameters@egr.uh.edu or visit www.egr.uh.edu/parameters

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News _____

Alumni News Briefs

Frank Adamek [Distinguished Alumnus Award]

A 30-year veteran of the oil and gas industry, **Frank Adamek** (1972 BSME, 1975 MSME) has held a variety of engineering, research and development, and quality management positions, domestically and internationally, at ABB Vetco Gray since 1975. Frank is Vice President of Customer Quality with worldwide responsibilities, which include the leadership and direction of Six Sigma Quality throughout the corporation's oil and gas facilities in 8 countries.

Frank is a member of the Board of Directors of the Offshore Technology Conference and the Offshore Energy Center. He has held numerous positions in the American Society of Mechanical Engineers (ASME). In support of education, Frank serves on the UH Mechanical Engineering Industry Advisory Board, providing a link between academia and industry needs for future mechanical engineers. From its inception 14 years ago, the UH/ASME Cajun Crawfish Boil, has benefited from Frank's support and guidance while generating in excess of $350,000 for scholarships and other programs for UH, Rice, Texas A&M and Prairie View A&M.

Frank, a native Texan, is a registered Professional Engineer in Texas and holds 10 U.S. and foreign patents in high pressure sealing technology related to Subsea and Surface Wellhead and Valve Design.

Elisa Adamek, Shelley & Frank Adamek, Melanie Adamek, Mary Adamek and Han Dang

Dennis Petersen [Distinguished Alumnus Award]

Dennis Petersen (1978 BSIE, 1979 MBA) is president of Lockwood, Andrews & Newnam, Inc., an engineering and architectural firm. A licensed professional engineer, Dennis contributes his time to the Cullen College of Engineering Leadership Board and is a member of the Texas Space Leadership Council, working with honorary chair Governor Rick Perry to promote and integrate new space technology. He also serves on the Greater Houston Partnership Government Relations Advisory Committee and the Texas Council of Engineering Companies Executive Committee, where Dennis chairs the Alternate Project Delivery Task Force.

In recognition of his expertise and leadership, Houston Mayor Lee P. Brown appointed Dennis in 1998 to serve on the Mayor's Transition Team, where he co-chaired the Public Works and Engineering subcommittee.

In addition to his professional commitments, Dennis has a strong interest in community service and is active in many local associations. As past chair of the Clear Lake Economic Development Foundation, he implemented a strategic planning process focused on strengthening the Foundation's direction and relationships with local governments, municipalities and area agencies.

Lora Petersen, Elsie Rhea, Ron Petersen, Beverly & Dennis Petersen, Arlen Petersen, Sharlene Petersen and Dana Petersen

We are extremely proud of our students at the UH Cullen College of Engineering, and for good reason. It's no exaggeration to say that we have many stars and future stars among us. Here, we highlight two of the exceptionally talented engineering students that call our college home. For more information on our students and their achievements, visit us online at www.egr.uh.edu.

Spotlight on Students

By Tara Mullee

Sophomore Honored at White House for Public Service

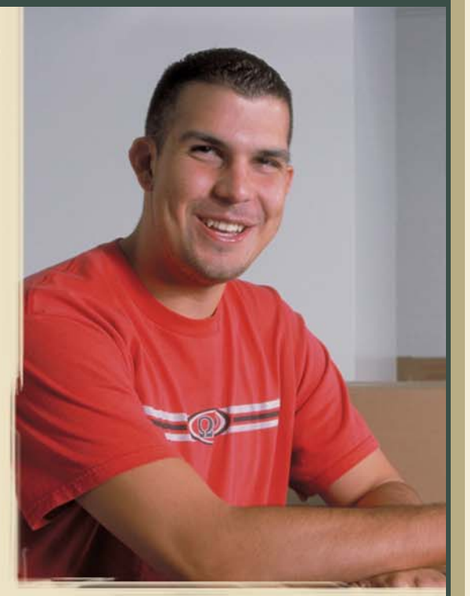
The American Institute for Public Service honored UH electrical engineering student Russell Crake III this summer in Washington, D.C. He received the 2002 Jefferson Award for public service from Sen. Kay Bailey Hutchison, R-Texas, and was honored at the White House.

KPRC-TV nominated Crake for the Jefferson Award after hearing of his work organizing his Hispanic fraternity's participation in a project that delivered 157 boxes of school supplies and dozens of textbooks to Acuna, Mexico, last summer. Most of the residents of Acuna live in abject poverty. Many of them live in houses made of plywood, cardboard, tires and concrete blocks.

"We collected school supplies from a number of different high schools, mainly in the Clear Lake area, and also at Bellaire High School," says Crake, who was a member of the National Honor Society while attending high school in Bellaire.

After packing the supplies in a rented truck, Crake and 10 other volunteers made the trip to Acuna, near the U.S.-Mexico border, where educational resources are scarce and children must attend class in shifts because of a severe shortage of teachers.

Russell attends UH on a scholarship from the Cullen College of Engineering and plans to graduate in May 2005.



Musically Inclined Engineering Student Orchestrates a Future in Research

Kathleen Akkerman works a summer job at NASA, plays the viola in a community orchestra, participates in eight engineering student societies, builds computers as a hobby and performs professionally in a string quartet. Somehow, she still finds time in her schedule to study electrical engineering.

Due to the amount of time Kathleen spent earning her music performance minor—six hours a week of orchestra practice for only one credit hour—she is entering her fifth and final undergraduate year this fall. Now that the rigors of her music minor are over, she can concentrate solely on engineering.

She has mentored elementary school kids through the HOSTS (Helping One Student To Succeed) program, which challenges children to learn engineering skills by building polymers out of silly-putty and structures out of straws and index cards. They also brought the students to UH and showed them the labs and projects in the UH Cullen College of Engineering.

PHOTOS BY JONATHAN COBB

Kathleen comes from a family of engineers and first became interested in engineering after hearing her relatives talk about their careers.

Her music is also intertwined with her decision to study engineering. One of her science fair projects was a scientific study of the viola bowing technique. During the fair Kathleen began talking to several of her judges, who were electrical engineers. She discovered that the methods she used in her viola project were also used in electrical engineering.

Through the UH-NASA design partnership, Kathleen spent her summer working with NASA on computer simulations. This program selects five students to work on NASA design projects and continue their work the following school year for a senior design class.

"Basically, there are two parts to any computer simulation," Kathleen says. "One is visual, where they actually set up the shapes so that you can see them, and the other is the part that makes each object have a surface so that one object won't go flying through another one. I'm working on the second part."

The second part is called a "contact force model." It sets the boundaries of each shape within a simulation by detecting if contact is occurring between two shapes and, if so, how much force there should be as a result of that contact.

Kathleen's project focuses on a battery box on the outside of the International Space Station. It is her job to help design a training simulation for astronauts to practice the battery replacement operation using the station's robotic arm.

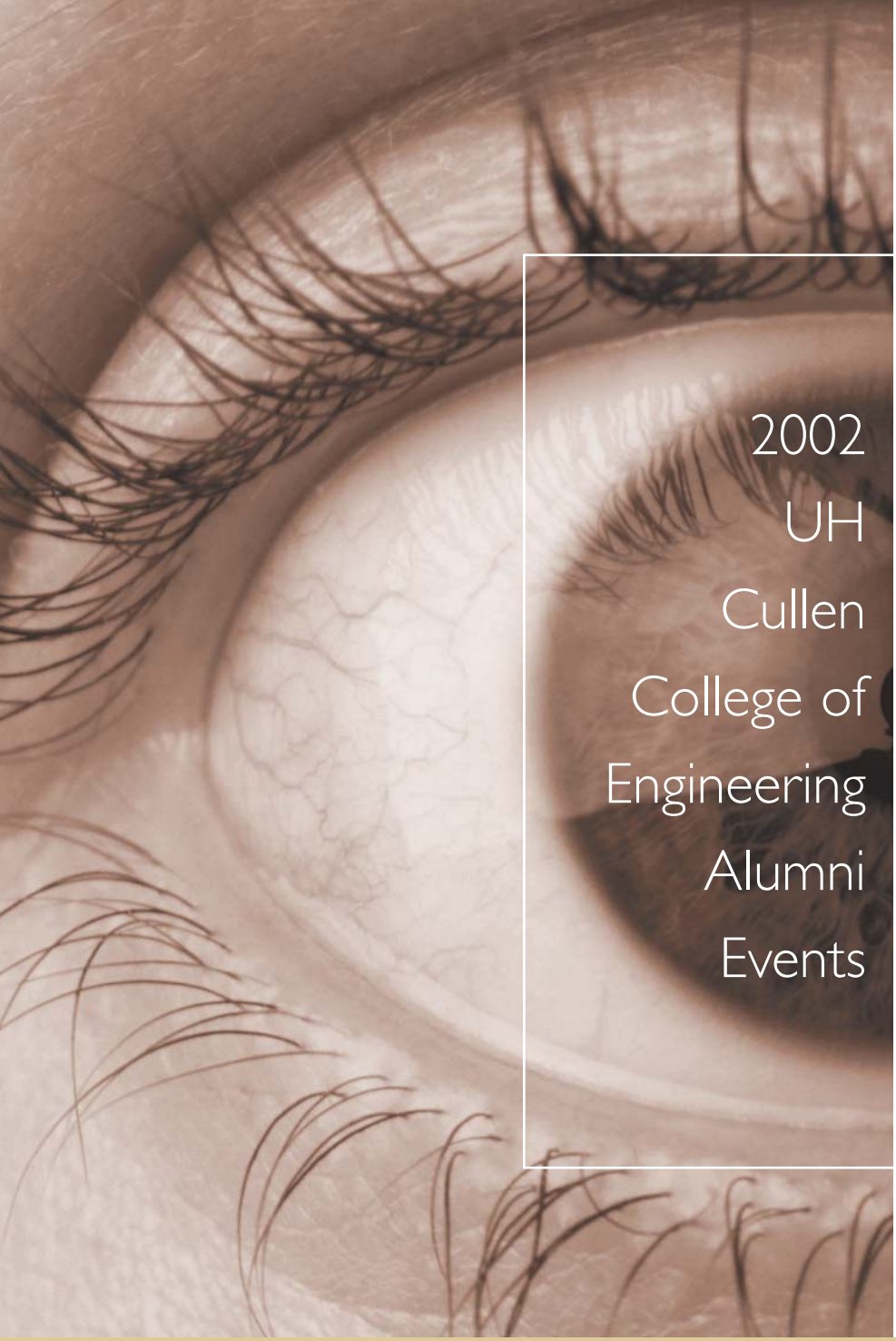
Raised in nearby Friendswood, Kathleen decided to attend UH because it allowed her to pursue music and engineering.

"A lot of other places that I looked around at either required me to basically be a music major or to forget about it altogether," said Kathleen. She was also impressed that both the music school and the engineering college have good reputations.

"I always knew I wanted to go into research and design, so graduate school was a foregone conclusion," says Kathleen. She realized that the scholarship support UH offered her would allow her to go to graduate school directly after earning her bachelor's degree.

After she earns her Ph.D., Kathleen wants to work with electromagnetics in the areas of communications and antenna design.

"I like research work," she said. "I like coming up with something new that no one else has done."



2002 UH Cullen College of Engineering Alumni Events

Second Thursday of each month

Engineering Alumni Association Board Meetings
All engineering alumni are welcome
5:45 p.m.
Dean's Conference Room (E421 Engineering Bldg 2)

November 9

Homecoming Reception
Honoring engineering alumni from 1940 – 1959
10:30 a.m. – 12 noon
The Commons, Engineering Bldg 1

Engineering Alumni Association Tailgate
UH vs. East Carolina
Tailgate cost: $15 adults, $5 kids, free under age 6
11 a.m. Tailgate, 2 p.m. Kickoff
West side of Robertson Stadium, UH campus

November 23 and 30

Engineering Alumni Association Tailgates
November 23: UH vs. South Florida
November 30: UH vs. Louisville
12 noon Tailgate, 2 p.m. Kickoff
West side of Robertson Stadium, UH campus

December 20

Engineering Convocation
4 p.m.
Cullen Performance Hall, UH campus
Reception immediately following in the Engineering Commons

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.

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