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# USC Engineer

A Journal for Alumni & Friends

## The 2002/2003 Freshman Class

The Best and the Brightest Meet Engineering

## Contour Crafting

Construction Technology for the Future

## Aviation Safety Program

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## NANOTECHNOLOGY AT USC ENGINEERING: WHEN LESS IS MORE

*Tiny Research with Big Results*

Spring/Summer 2003

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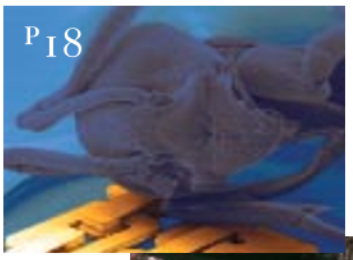




# departments




PhD student Fady Morcos's vision for an interplanetary vessel for space tourism. "I believe we should make space tourism possible before this decade is over, but this won't happen unless we start to take serious steps in colonizing the moon as a start, with other celestial bodies to follow."

Cover illustration by Scott Holmes; ant photo by Adam Cohen; freshman class photo by Michelle A. H. Smith; contour crafting photo by Irene Fertik and space hotel drawing by Fady Morcos

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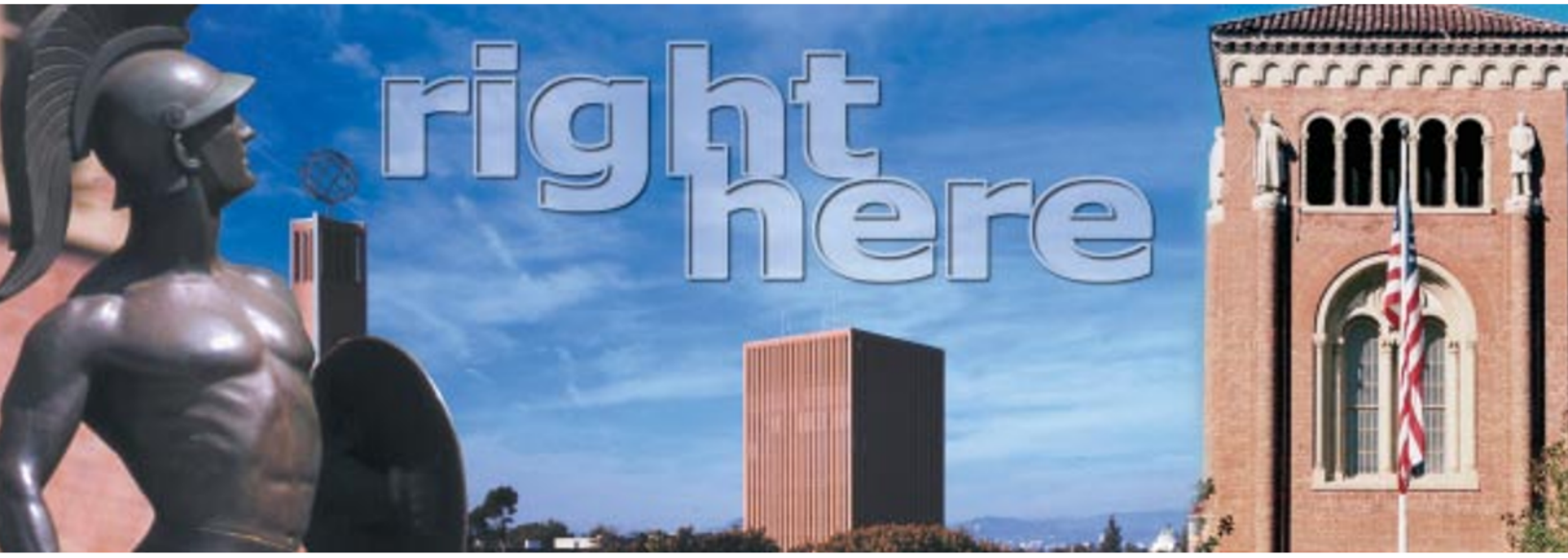


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Sr. Technical Recruiter
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# small things considered

The cover story of this issue of *USC Engineer* describes the School of Engineering's research efforts in the realm of nanotechnology. Nanotechnology promises to be one of the most exciting and important technology areas of this century. It is still in its infancy, and it is often difficult to separate real nanotechnology from the over-heated rhetoric and hype that sometimes surrounds it.

The idea of nanotechnology dates from a famous 1959 lecture by the physicist Richard Feynman, in which he stated that "the principles of physics, as far as I can see, do not speak against the possibility of maneuvering things atom by atom." Scientist Eric Drexler coined the phrase nanotechnology in his 1986 book "Engines of Creation." It comes from "nano," the Greek word meaning dwarf, and is a standard scientific prefix meaning "one-billionth." The basic unit of this new science is a single nanometer, which is a billionth of a meter.

This is truly small. A nanometer is to a meter as a grape is to the earth. The smallest things with which we are used to dealing are measured in millimeters. The period at the end of this sentence, for example, is approximately one tenth of a millimeter, or 100,000 nanometers, in diameter. That's also the approximate diameter of a human hair.

Biologists and computer manufacturers work at the micro level, where the unit of measurement is the micron. A micron is one millionth of a meter. A red blood cell measures about 7.5 microns, or 7,500 nanometers in diameter. The individual transistors in today's most advanced solid-state circuits created by photolithography are now about 0.1 micron, or 100 nanometers across. Photolithography technology, governed by the wavelength of light, is approaching the limit in reducing the size of features it can produce.

Today's Pentium chip moves about a billion electrons to express a single bit of data. In contrast, single electron transistors mean nanoscale devices would use almost no power while achieving unparalleled levels of sensitivity.

Our researchers are working to apply micro- and nanotechnology to bio-implants and drug delivery systems, engineered peptides and new quantum computing devices. These researchers will soon be housed in state-of-the art laboratories in the new Ronald Tutor Hall, which we will break ground on this May.

Nanotechnology has proven to be one of the most interdisciplinary areas of academic research. Teams of engineers and scientists from widely differing disciplines perform the research. It is a rich stew of physics, biology, bioinformatics, chemistry, chemical engineering, computer science, electrical engineering, photonics and other areas of study that all blend into each other. All of the ingredients can be found at USC.

We have expertise, momentum and enthusiasm, and we have a plan to exploit a specific niche where we believe we can do big things in nanotechnology. Our nanotechnology researchers are focusing on the intersection of materials science, biology and information technology, all areas of strength at the School and USC. Our research also builds on the success we have had with MEMS—micro-electromechanical systems.

The only thing not small about nanotechnology is the ingenuity on display by our School's researchers.

C. L. Max Nikias
Dean
School of Engineering

Nikias photo by Jeff Corwin

It has once again been a busy winter and spring season for the School of Engineering and our alumni. In creating this magazine twice a year, my office and the communications team at the School must, like our faculty colleagues, perform some research. We search for stories about the School that we want to highlight, sniff out the hot-topic research projects, shine a light on hot-shot faculty and uncover alumni success stories. We set about this research with the single mission of providing our readers with the best of the best. For other schools and other publications, it may seem a daunting task. However, at *USC Engineer,* we often find ourselves in the enviable position of having too much of the good stuff to cover!

Shining a light on cutting-edge, hot-topic and even newsworthy research and researchers has increasingly required our light to have a very broad focus. There is so much to talk about, so many successes, indeed, too much to contain in this magazine.

USC Engineering is in the news, members of our faculty are winning awards all around the world, our corporate partnerships are providing a leading edge for our students and our students themselves continue to amaze us with their well-run organizations, drive to excel in extracurricular competitions and overall competitiveness in the marketplace.

But to top it off, what I find most exceptional and exciting are our alumni stories. Once again, I am the fortunate observer of a steady parade of success stories that consistently march across my desk. My greatest challenge is which ones to choose for our scant 48 pages!

The profiles in this issue demonstrate the excellence and drive of our alumni, and I thank these individuals for sharing their stories with us. I am also grateful to all of the alumni who take the time to update us about their lives with class notes. We love to hear about you, right down to the greatest successes of all, your marriage or child's birth.

*Timur Taluy and I at the "Taste of USC" event in Ventura this February*

Some alumni continue to involve us in very direct ways. We have hosted a number of regional alumni receptions in the past several months. Timur Taluy (BSEE '98), who is a member of our Dean's Circle and Alumni Relations Advisory Board, helped to organize a successful alumni event and wine-tasting in Ventura, California this past February. Timur came to me and said, "Hey, let's get everyone together, invite Dean Nikias to speak and have an event in Ventura. There are a lot of alumni up here that want to stay connected to the School." Timur was right, and the event was a success.

Once again, my job made easy by the spirit, the excellence, the best of the best of the USC School of Engineering.

Annette Blain
Director, Alumni Relations

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SCHOOL OF ENGINEERING

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*Letters to the editor and comments are welcome. Please send them to: USC Engineer, Alumni Relations Office, Olin Hall 300, Los Angeles, California 90089-1454, or email them to uscengineer@usc.edu*

STRAIGHT & *to the* POINT

# Fabric That Hears? USC AND VIRGINIA TECH STRETCH THE IMAGINATION

Engineers from USC and Virginia Tech have turned to one of mankind's oldest technologies—weaving—to produce a high-tech prototype e-textile with very good ears. The joint venture is called Stretch, which is not an acronym but the name of the program.

The new fabric, currently undergoing field tests, is interwoven with microelectronic components. It functions as a supersensitive detection array to pinpoint sources of faint sounds, specifically the sounds of distant vehicles moving on future battlefields. According to its creators, Stretch fabric is the first e-textile that can perform all aspects of such a complicated process.

"Modern methods of making fabrics allow extraordinary control over materials and properties," says Robert Parker, director of the Arlington, Va., campus of the USC School of Engineering's Information Sciences Institute (ISI), and co-principal investigator on Stretch. "Cloth has properties that can be very useful for certain electronic applications. We can easily and cheaply make very large pieces of cloth, light and very strong, that can be stretched over frames into any desired shape."

The material created by Parker and his co-investigator, Mark Jones of the Configurable Computing Laboratory at Virginia Polytechnic Institute and State University in Blacksburg, Va., could be deployed as a parachute, a tent, a camouflage net or simply as bolts of cloth that roll compactly away when not needed.

Modern methods of detection utilize arrays of detectors, arranged in a pattern. Sophisticated algorithms combine the individual reports from each of the detectors into a detailed image.

For some time, Parker and his ISI colleagues have been working on arrays made up of small, stand-alone detectors, individually placed in the environment, that communicate with each other by radio.

Embedding similar units in fabric has significant advantages, according to Parker. "The signals they exchange can be carried on wires in the fabric. This greatly lowers the power requirements to operate the system."

Additionally, signal exchanges by radio might be picked up by an adversary, giving away not only the fact that surveillance is under way, but also the position of the surveillors—a potentially fatal drawback on a battlefield.

"Forming it into a fabric makes it electronically silent," says Jones. And, while embedding the detectors in fabric sacrifices some of the flexibility of individual stand-alone units, it guarantees the units will be in the right positions relative to each other.

The researchers still have some significant problems to resolve. "While fabric manufacturing technology is advanced," Parker notes, "we expect that the large number of components and the inherent imprecision in the process will make it difficult to weave very large, fault-free arrays."

Making this fabric array tough enough to stand up to weather and rough handling might seem a challenge. Yet in preliminary tests, the material has proven robust. It can be rolled and unrolled (though not folded) without damage. And even when individual units within the array fail, the detector is still able to function effectively.

Parker says researchers currently attach electronics to the fabric after the normal weaving process. However, their goal is to produce individual yarns that perform an electronic function such as a power source, a transistor array, a sensor or an actuator.

*Fabric with built-in ears is shown in this artist's rendering of a sound-detection array woven into a new e-textile.*

"These yarns are conceived to be very thin and flexible and able to be woven into the cloth on a loom in a standard high-volume cloth manufacturing process," he explains. "The type of fabric chosen would be determined by the final use of the fabric and could vary from cottons used for blouses or shirts, to heavy

*continued on page 6*

# Read All About It! SCHOOL OF ENGINEERING IN THE NEWS

**The USC School of Engineering continues to strut its stuff in national and local media. Here are some of the highlights:**

On March 6, the ***New York Times*** Circuits section focused on **MONICA NICOLESCU**, computer science graduate student, and **GEORGE BEKEY**, professor emeritus of computer science, in a story headlined "Making Robots More Like Us". Pictured in the story were Nicolescu and her adviser, Associate Professor **MAJA MATARIC**.

Dean **C. L. MAX NIKIAS** had an op-ed article in the ***San Diego Union Tribune*** on February 27 about how Hollywood can prosper in the new era of digital TV, movies and the Internet. Nikias penned another article for the ***Sacramento Bee*** on February 11 calling for increased broadband access to connect to "the next generation Internet" and thus complete the Internet revolution.

On February 6, **KELLY GOULIS**, executive director of the Distance Education Network (DEN), and DEN, were heavily featured in a worldwide ***Voice of America*** story about distance learning.

**NAJMEDIN MESHKATI**, associate professor of civil engineering, and his graduate student **KRISTA SLONOWSKI** wrote an op-ed article published in the ***Orange County Register*** on February 20 calling for a task force to address the high fatality rate at street-level rail crossings before new light rail projects begin operating.

Astronaut-trained Professor of Aerospace and Mechanical Engineering **PAUL RONNEY** was the principal investigator of the doomed Columbia's key scientific experiment. In the aftermath of the disaster, in February and March, he was widely quoted in the nation's media, becoming a strong advocate for manned space flight. Some of the media included the ***New York Times,*** the ***Washington Post, Florida Today***, the ***Los Angeles Times***, the ***L.A. Daily News***, the ***Boston Globe, Japan Public TV, Science, Reuters, Associated Press, United Press International, Space.com, Automotive News***, the ***Discovery Channel*** and television stations KCBS-TV, KNBC-TV, KABC-TV and KTLA-TV. He also found time to talk to the campus through the ***Daily Trojan*** and the ***USC Annenberg News Service***. Some of the stories also featured **MOHAMED ABID**, a postdoctoral fellow working with Ronney. *See stories on Ronney and his work on pages 15 and 48.*

Kitty Felde, hostess of "Talk of the City" on public radio station KPCC-FM, broadcast a grading of eleven Los Angeles infrastructure systems by the local chapter of the American Society of Civil Engineers (ASCE). Joining public officials for the panel discussion of local infrastructure were **JOSEPH DEVINNY**, professor of civil and environmental engineering *(see Devinny op-ed on page 8),* and **JAMES MOORE**, professor of civil engineering and public policy and management. **HARVEY GOBAS**, (BSCE '72, MSENV '75), current president of ASCE, presented the report card, and **HANK KOFFMAN**, past ASCE president and director of the construction engineering and management program in the School, organized the event. In addition to KPCC-FM, many other local radio stations, including KNX-AM and KFWB-AM covered the report card, as did the ***L.A. Daily News*** and Spanish TV station KVEA-TV. The discussion was broadcast on Channel 36, L.A.'s cable television public access channel, and it can be viewed on the School's web site at: http://www.usc.edu/dept/engineering/news/news.html


*KPCC-FM's Kitty Felde, far right, hosted a discussion of L.A.'s infrastructure broadcast Feb. 12. The panel, from left to right, included County Supervisor Chair Yvonne Brathwaite Burke; James Moore, professor of civil engineering; Beverly O'Neil, Mayor of Long Beach; economist Jack Kyser; Andy Lipkis, president of Tree People and Joseph Devinny, professor of environmental engineering.*

**HERB SCHORR**, senior associate dean and executive director of the Information Sciences Institute (ISI), was quoted in a ***New York Times*** story January 9 about "virtual worlds," a sort of digital Club Med for online guests.

**CARL KESSELMAN** (MSEE '84) from ISI, was chosen as a global leader in innovation for his work in grid computing and featured on the cover of the February issue of ***Technology Review***. Wired.com presented Kesselman's views on the impact of grid computing in January.

The Integrated Media Systems Center's **ALBERT "SKIP" RIZZO**, and his use of virtual reality technology to assess and treat Attention Deficit Hyperactivity Disorder and other cognitive problems, was the subject of a story on ***FoxNews.com***. That story led to a television story on KCOP-TV.

## Fabric That Hears? *continued from page 5*

canvas or Kevlar used for heavy-duty applications." Future wearable fabrics could be integrated cell phones, navigation systems or personal warning systems.

Parker concluded with a vision reminiscent of the recent film "Minority Report":

"Think of your blouse or slacks interacting with the environment as you pass through it. Think of walking into a mall and your blouse tells you where you can get that special gift item that has been on your must-get list for months."

Will soldiers' wardrobes someday include sound detector sweaters, satellite signal antenna hats or chemical sniffer vests? Not right away, but perhaps soon. It's not a big stretch of the imagination.

*Stretch was funded by the Defense Advance Research Projects Agency (Darpa). In addition to Parker and Jones, the research group includes Ron Riley at USC/ISI and Don Leo, Louis Beex and Zahi Nakad at Virginia Tech/CCL.*

# A Milestone for Engineering & Biomedical Technology

*Alumnus Endows Chair in Biomedical Technology*

David W. Chonette (MSME '60, ENGME '64) has pledged $2 million to endow a new chair in support of the Biomedical Technology Initiative, which was launched by Dean C. L. Max Nikias in 2001 to enhance the School's strengths in the fields of biomedicine and biotechnology.

"I wanted to endow this chair as an expression of appreciation to USC for the education I received there," says Chonette. "It gave me the capability and confidence to become a very competent engineer. I've chosen to support the field of biomedical technology because I worked as an operating executive in this discipline for nearly two decades, leading product development, manufacturing and marketing, helping to make new technologies available to patients."

The creation of the **Chonette Chair in Biomedical Technology** is the latest milestone in the School of Engineering's quest to lead the nation's research and expertise in this rapidly evolving discipline. Throughout society, medical and scientific advances have produced unprecedented demand for new categories of medical and healthcare products, services and technology, noted the dean. He said that scientists are decoding the human genome, that biomedical and biotechnology industries are producing new products and increasing their success in fighting disease and maintaining health.

"We stand at the dawn of a technological revolution in the biological sciences—a revolution that will affect how we live our lives every day," says Nikias. "Since engineering advances will surely determine the future of this revolution, the Chonette Chair in Biomedical Technology strategically positions the USC School of Engineering to capitalize on this emerging technological revolution. I'm very grateful that Dave Chonette has chosen to support this important initiative."

School of Engineering faculty are working on major advances in diagnosis and treatment of disease. They are pushing the boundaries of research in the fields of biochemical engineering, biomaterials, nanotechnology, bio-MEMS (micro-electro-mechanical systems), device and diagnostic technologies and neural engineering with the goal of improving human health and well-being.

Under the umbrella of the Biomedical Technology Initiative, the School's faculty and students are also conducting important research in cellular engineering, drug and gene delivery, drug targeting, tissue engineering, metabolic engineering and biophotonics. They take advantage of the School's highly interdisciplinary research environment to respond quickly to emerging research opportunities.

This entrepreneurial approach appeals to Chonette, who for the past 16 years as a venture capitalist has directed investments in innovative research by small companies. "It is my sincere hope that the Chonette Chair in Biomedical Technology will serve as a catalyst, encouraging new approaches and advances in this incredibly important discipline."

Chonette, who has served as a member of the School of Engineering Board of Councilors since 1997, is a general partner of Brentwood Venture Capital, and adviser to Versant Ventures, a successor fund specializing in health care venture investments. He joined Brentwood in 1986 after 19 years with American Hospital Supply Corporation, where he served as president of Edwards Laboratories (now Edwards Lifesciences Corporation), which grew under his management from $10 million in revenues to more than $200 million. He also served as group vice president responsible for several medical device and pharmaceutical divisions totaling $350 million in revenue.

Chonette has served as a director of Advanced Rehabilitation Resources, Biopsys, Cardiovascular Devices, Catheter Technology, General Surgical, Imagyn Medical, InterFlo Medical, Interpore Cross, KeraVision, Neomorphics and Webster Laboratories. He is currently a director of Interpore Cross and several private companies.

After earning his Bachelor's degree in engineering from MIT in 1957, Chonette returned to his Southern California birthplace to work in the burgeoning aerospace industry. Working full-time, with a family to support, he nonetheless knew he wanted to pursue graduate studies in engineering. "USC was well attuned to the needs of working professionals," he says. "The School of Engineering offered both day and evening courses, so I was able to develop a schedule that worked for me and my family."

> *"It is my sincere hope that the Chonette Chair in Biomedical Technology will serve as a catalyst, encouraging new approaches and advances in this incredibly important discipline."*

Chonette and his wife Suzanne reside in Newport Beach and family has always been important to them. They are the parents of five children and the grandparents of nine. "My father, W.C. Chonette, and my uncle, O.W. Chonette, were also professional engineers," he says. "Together, they influenced and guided me into this discipline. I chose the name of this chair as a way of honoring and thanking them both."

# Organic Foods: The SUVs of Agriculture?

*by Joseph Devinny*

Are organic foods becoming the sport utility vehicles of agriculture? The new Department of Agriculture rules for organic foods seem to favor a boutique food industry in which well-heeled consumers will pay premium prices for perceived safety benefits that are mostly illusory, while increasing the burden on precious environmental resources.

Organic farming, a concept that arose from genuine health and environmental concerns, first grew wild as a political ideology and now has been set in bureaucratic concrete.

The rules assure consumers that foods labeled "organic" are grown on a farm where most pesticides are banned. Genetically modified organisms are proscribed and soluble (manufactured) fertilizers are almost entirely eliminated in favor of manures. Other rules require soil conservation and humane animal care.

Organic farming sounds good because farming does cause horrendous ecological damage. Fertilizer runoff pollutes streams.

The most important environmental impact of farming occurs when natural wildlife habitat is first converted to farmland. Forests are cut down, prairies are plowed under… Virtually every wild species in the habitat disappears.

Pesticides migrate from farms to kill wildlife. Soil erosion reduces farm fertility, destroying a resource that should be indefinitely renewable, and fills lakes with silt. Worst of all, farming destroys wildlife habitats.

People should be wary of pesticides, which, after all, are designed to be toxic. Studies show that organic produce does contain fewer pesticide residues. But the amounts now found in foods are generally below government limits, so organic foods will not significantly improve public health.

Plants absorb the same nutrient chemicals whether they come from soluble fertilizers or from manures, so there is no identifiable difference in food quality. Indeed, the manure fertilizers favored by the new rules can be dangerous. There have been several outbreaks of E. coli from produce and water contaminated by manure, and in some cases the victims have died. There are about 50 diseases infecting both cattle and humans, and some may be transmitted via manure.

Soluble fertilizers pollute rivers and lakes, not because they are toxic, but because they fertilize algae as well as crops. The slower nutrient release from manures may reduce runoff in some cases, but there are abundant examples of manure polluting waterways. Proper fertilizer management by farmers will prevent pollution in either case.

Organic food advocates worry that genetically modified crops may be dangerous to consumers or the environment, but banning them means giving up tremendous opportunities for better health and environmental quality.

Modified strains—tested to screen out those that are threatening—can resist insects, reducing the need for pesticides. Crops made resistant to herbicides will grow in fields where biodegradable compounds are used in place of a plow to kill weeds, virtually eliminating soil erosion. Genetically modified cattle can produce low-fat meat, while altering peanuts could eliminate the protein that causes allergic reactions. Designed plants may produce precisely structured pharmaceuticals, avoiding the environmental impacts of drug factories while improving human health.

The most important environmental impact of farming occurs when natural wildlife habitat is first converted to farmland. Forests are cut down, prairies are plowed under and grassy meadows that support diverse ecosystems become monotonous rows of corn. Virtually every wild species in the habitat disappears.

*Professor Joseph Devinny*

A long-term study in Switzerland recently showed that organic farming used 50 percent less energy, 97 percent less pesticide and 51 percent less fertilizer than traditional farms—all good results. Productivity declined by "only" 20 percent; an inefficiency to be made up by charging higher prices to consumers.

But if we want to produce the same amount of food organically as we do with traditional methods, a productivity reduction of 20 percent will increase the land devoted to farming by 25 percent. Something like 850 million acres of wildlife habitat would be put to the plow worldwide—an ecological disaster of the first magnitude.

Certain aspects of organic farming represent valuable progress, but rigid adherence to an ideology will not produce the best results. Farming needs an ongoing program of sound research on all alternative methods and access to a flexible array of techniques. We should focus our greatest efforts on increasing farm productivity—using innovative pest control, fertilizers, better crop strains or other new methods—to stop habitat destruction, and even to restore existing crop land to the wild.

*Joseph S. Devinny is a professor of civil and environmental engineering at the USC School of Engineering.*

# SPACE SCHOOL

In engineering design, we often work in tightly partitioned processes, grasping one element but perhaps not the entirety of a program," says Madhu Thangavelu, the self-described "conductor" of the Space Exploration Architectures Concept Synthesis Studio. The School of Engineering's aeronautical and mechanical engineering department and the School of Architecture offer the graduate course jointly. In the Synthesis Studio, students conceive and present designs and business plans for space vehicles and space habitats. Thangavelu, a guest lecturer, has taught the course annually at USC for several years now.

**The Synthesis Studio encourages unconventional thought. It is a class that forces students to balance their dreams of space travel against cold hard reality.**

"The mind expansion needed for my course takes time, because these students come from very tightly constrained disciplines," Thangavelu says. "In the Synthesis Studio, students must bring all those tools of analysis they have learned elsewhere, on campus or in their aerospace careers, and grow beyond them."

The Synthesis Studio encourages unconventional thought. It is a class that forces students to balance their dreams of space travel against cold hard reality. To resolve "the conflict between what's possible and what's daydreaming," Thangavelu says, "it is necessary to arrive at creative, passionate solutions."

## EXPERTS FROM THE PROFESSION

The Synthesis Studio syllabus is nearly nonexistent, with no assigned reading beyond one of Thangavelu's books. Guest lecturers from the space industry are featured each week, but final grades are based primarily on space architecture concepts that the students present for midterms and finals.

In assessing and critiquing those two projects, Thangavelu, who is a regular consultant on space architecture concepts for NASA, is joined in class by a rotating panel of industry professionals, men and women who have managed programs for NASA and JPL.

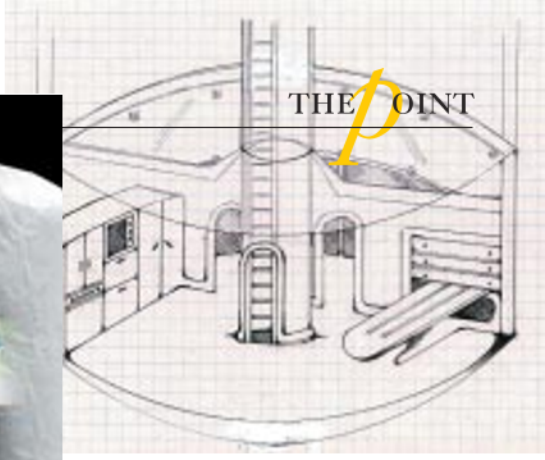
Where Thangavelu teaches through encouragement and positive reinforcement, the panelists shine the harsh light of reality. Their critiques and advice foster creative thought, but often they are merciless in skewering proposals that are not tethered to reality.

Students must keep in mind the same questions the industry panelists live with every day: Will elected officials buy the idea? Will the project and its goals withstand the inevitable scrutiny of taxpayers?

## THE UNIVERSAL APPEAL OF SPACE

"Most of my students come from engineering," Thangavelu explains, "but over the years we have had students of law, the sciences, communications, as well as most disciplines of engineering. We've had everything except perhaps someone from the fine arts. That is the magical thing about space. It appeals to everyone, and it demands genius from every discipline of human learning."

Sometimes the boldest thinking comes from those students outside the engineering school. "One student, an M.D./Ph.D. candidate completing her studies in San Diego, outlined a concept for a manned interstellar spacecraft,



*Student Casey Bauer played on two major themes of the most recent Synthesis Studio, space tourism and finding commercial applications for the International Space Station. Bauer, who works at Raytheon, developed a concept for a space-based hotel and resort.*

something that is far beyond human ability at this time," Thangavelu says.

The student explored existing and emerging propulsion technologies. She delved into the various unmanned craft that NASA has aimed at distant sectors of our solar system. She gathered data about the human life cycle from sources including the AARP. Finally, she concluded interstellar travel might require many generations of people living on a space ship to reach another star system. As a medical student, she was keenly interested in the human factors of creating a ship that could support multiple generations of humans.

"Though her proposal could not be fulfilled in her lifetime," Thangavelu says, "it was considered the best proposal of that year's studio, because in spite of its bold targets, it was rooted in logical thought and clearly laid out the challenges and potential costs."

## THIS YEAR'S CROP

This year, the majority of midterm and finals presentations focused on space tourism and the International Space Station.

The project that best exemplified the balance between daydreaming and what is possible came from Bryan Richardson, a longtime Boeing employee and naval aviator. Richardson proposed an International Space Station "life boat" that was an obvious and intentional evolution of the proven reentry capsules used in the Gemini and Apollo programs

*continued on page 16*

*This year's winners (left to right); David Aguilar, James Zimmerman and Ryan Kashfian, with their invincible, robotic cube-catching bulldozer.*

student works

## LEGO WARS: ATTACK OF THE MINI-BULLDOZERS

Battle Bots they are not, but the LEGO robots built by students in Hadi Moradi's computer science 443 class help them explore the fundamentals of contemporary robotics. The course is open to any student with rudimentary programming ability, an interest in robotics and an affinity for LEGOs.

Moradi, an assistant professor of computer science, previously spent several years working at the School's Information Sciences Institute, where he participated in the World RoboSoccer championships.

In CS 443, students learn the history of robotics and the theories behind the simple robots they build. LEGO robot kits are available at the campus bookstore. They come with laser sensors to guide movements, electric motors that connect to drive wheels and microprocessors that must be programmed. The robots, which look like miniature bulldozers, have to gather ping-pong balls and small cubes scattered around a 5-foot-square "robot stadium." Instead of a bulldozer's scoop, the robots usually feature something akin to a rabbit trap, which can capture the balls and cubes.

The students work in teams and are free to design with as much creativity as they please, as long as the finished product works autonomously. They are not radio-controlled vehicles. However, teams have been known to nudge robots that get stuck in corners or hooked together, which draws derisive catcalls and hoots from colleagues.

At the end of the semester, the class competition pits robot against robot in head-to-head elimination matches. The team that gathers the most cubes or balls is the winner. It rates as one of the more amusing events at the School of Engineering, constitutes 20 percent of the final grade for students and validates the learning process.

## *U.S. News & World Reports* Ranks School in Top 10 for Second Straight Year

In the latest *U.S. News & World Report* rankings of the nation's best graduate schools, released just as *USC Engineer* went to press, the School of Engineering placed eighth.

"I'm ecstatic that we're ranked number eight for the second straight year. Five years ago we were number 16," says Dean C. L. Max Nikias.

He said that the engineering school had intensified efforts on urgent national priorities since the 9-11 attack and that fully 70 percent of the School's more than $120 million in annual research funding is defense-related. Averaging almost $1 million per professor, the School has the most research funding per tenured faculty member.

"This is an excellent engineering school and the funding agencies know it," Nikias says. "We will continue to climb in rankings as more of our peers learn about the academic excellence we are building in our research and education programs."

The dean also expressed his gratitude to the faculty. "The faculty should take pride that their hard work and academic prowess is increasingly being recognized. I am proud of their success."

| | |
|---|---|
| 1. | Massachusetts Institute of Technology |
| 2. | Stanford University |
| 3. | University of California-Berkeley |
| 4. | University of Illinois-Urbana-Champaign |
| 5. | Georgia Institute of Technology |
| 6. | University of Michigan-Ann Arbor |
| 7. | California Institute of Technology |
| 8. | UNIVERSITY OF SOUTHERN CALIFORNIA |
| 9. | Purdue University-West Lafayette |
| 9. | University of Texas-Austin |
| 11. | Carnegie Mellon University |
| 11. | Cornell University |
| 11. | University of California-San Diego |
| 19. | University of California-Los Angeles |

## George Chilingar Endows Civil Engineering Scholarship Fund

*Dean Nikias, Professor George Chilingar and External Relations CEO Christopher Stoy at a luncheon celebrating the Chilingar Scholarship Endowment.*

Civil Engineering Professor George Chilingar (BSPE '49, MSPE '50, PhD GEOL '56) has donated over $100,000 to create the George V. Chilingar Scholarship Endowment in Civil Engineering. "I am delighted to help support the pursuit of quality students for the department of civil engineering," Chilingar said in ceremonies held over lunch at the California Club in Los Angeles on March 12.

"You have become the role model for all other faculty to follow," said Dean C. L. Max Nikias in accepting the gift. "I am very grateful, and thank you on behalf of all of the civil engineering students who will benefit from this scholarship fund."

In more than a half-century of academic achievement, Chilingar has published more than 50 books and hundreds of articles in the fields of geology, petroleum engineering and environmental engineering. He earned his bachelor's and master's degrees in petroleum engineering and a Ph.D. in geology at USC, and has been a pioneer in the concept of interdisciplinary study.

His greatest contribution to the petroleum industry is a means of identifying oil-rich rock by analyzing the ratio of calcium/magnesium in core samples.

# USC'S BIONIC NEURON

## In this case, size does matter

*by Gia Scafidi*

Gerald Loeb's BION, developed at USC's Alfred E. Mann Institute for Biomedical Engineering (USC-AMI), is the size of two grains of rice. That makes the muscle stimulator small enough to be injected into the newly paralyzed or weakened muscles of stroke and arthritis patients. Loeb, a professor of biomedical engineering, sometimes jokingly compares the device to those tummy-tightening belts advertised on late-night TV, except that the stimulation delivered by the BION—short for bionic neuron—is precisely applied within the muscle itself.

"The BION allows us to take precise control of muscles," says Loeb, who is also director of the university's Medical Device Development Facility. "It links the nervous system to the outside world, where a control system orchestrates muscle coordination."

Encased in a protective glass capsule with electrodes on each end, the BION is accepted by the body in much the same way as other implanted devices, such as pacemakers and bone screws. The device receives command signals from an external transmission coil. The flat rubber coil, which a patient places over the affected area, causes the BION to produce electrical stimulation pulses that activate adjacent neurons. The precisely placed BION enables targeted muscles to be strengthened and retrained through the patient's individualized exercise regimen.

"The coil is hooked into a small box programmed with individualized exercises and can send up to 3,000 commands per second to the BION," Loeb explains. "We can tailor the therapy to the needs of the patient, strengthening the muscles, protecting the joints and helping the patient relearn to use a paralyzed limb." The coil and its programming supersede commands the brain would normally send through the nervous system to the muscles.

BIONs are built on USC's University Park Campus in a facility in the Denney Research Center. They have recently begun clinical trials in the U.S. after initial success in Canada and Europe.

"Patients are overwhelmed right after a stroke," explains Anne Dupont, the clinical trials manager. "They've just gone from being perfectly normal one day to being paralyzed the next. But when they start using the BION regularly, they really like the therapy. Not only do patients realize they are helping themselves, but they also enjoy the practicality of the BION because they can perform the therapy at home rather than in a hospital."

Strokes occur when a part of the brain becomes starved of oxygen; they can result in the paralysis of many muscles in the face, arms and legs. Research has shown the brain has great capacity to recover and relearn, but muscles often remain weak. Therapy with BIONs strengthens weak muscles by allowing a patient to exercise them daily.

"If approved by the Food and Drug Administration and manufactured commercially, BION technology could eventually be used for many different medical problems and disabilities resulting from muscle paralysis," Loeb says. Already under way is research to determine if BIONs can stimulate the muscles that operate the tongue and open the airways of those suffering from sleep apnea, a condition in which one's breathing stops during sleep. Additional research involves using the BION to enhance muscle tone and flexibility in stroke patients unable to open their hands, and in assisting stroke patients who have regained partial movement in their legs to once again master the act of walking. New versions of the technology that could facilitate movements such as reaching and grasping are under development at the Mann Institute.

With the present technology still in its early stages of clinical research, however, only a small number of patients who meet very specific criteria currently can benefit from BIONs. "The investigational phase requires intensive monitoring of each patient," Loeb says. "It will be some time before we can implant the BION into people who do not meet the set criteria of these trials."

Loeb advises stroke and arthritis patients always to take advantage of the best treatment available to them today and not to wait for promising experimental treatments to become available. "Sooner or later this technology will be available from a physician, but it could be years from now. The worst thing anyone could do is to let current treatment pass them by because they believe something better might come along one day," he says.

As USC Engineer went to press, the BION faced a major hurdle. The U.S. clinical trials were being conducted at Rancho Los Amigos National Rehabilitation Center, which the Los Angeles County Board of Supervisors had slated for closure due to budget constraints. Loeb was scrambling to find a way to ensure the trials could move forward.

*Gerald Loeb holding the BION.*

The first clinical trials of the device began three years ago in Italy and Canada. The trials were expanded through a five-year, $5.3 million grant from the National Institutes of Health.

"Two of the three local trials of the BION were supposed to be based at Rancho Los Amigos—one trial was actually under way," Loeb says. "We have a subcontract for these trials with Rancho's separate research corporation, the Los Amigos Research and Education Institute." As a private foundation worked to save Rancho Los Amigos, Loeb expressed hope that the research institute would survive or that the clinical trials could resume at facilities treating patients formerly treated at Rancho Los Amigos.

"The closure of a clinical facility doesn't mean that people will stop having strokes," he says.

Loeb photo by USC News Service

# Choong Hoon Cho Dies

## *Father of Y.H. Cho, USC Trustee and School of Engineering Friend*


Choong Hoon Cho, who built a huge Korean transportation empire and was the father of Y.H. Cho, member of the USC Board of Trustees and the School of Engineering's Board of Councilors, died November 17 in South Korea of old age. Cho, 82, had been in declining health in recent years.

Cho was one of a generation of leaders of conglomerates, called chaebols, credited with South Korea's miraculous economic rise that began in the 1960s. Unlike other chaebol leaders, who spread their efforts over a diversified range of economic activities, Cho concentrated on the transportation sector. He often said that while you could drop many lines into the water, you didn't necessarily catch more fish that way.

He began in 1945 with a single truck in the South Korean port city of Incheon and lost most of his fledgling trucking company in the Korean War. But he also won U.S. military contracts to transport ammunition and other supplies. He received more contracts during the Vietnam War.

His son Y.H. recalls how the yard around their family home in Incheon was full of trucks and trailers. Cho ran his business from a downstairs office while his family lived upstairs.

Trained as a marine engineer, Cho was a creative entrepreneur with a reputation for honesty, hard work and applying innovative technology. He was the first to operate inter-city bus lines in Korea and the first to establish an LPG distribution station. When he entered the shipping business, he built his own ships, creating Korea's first container ship systems, and built a private container port. He called his company Hanjin, which literally means "moving Korea forward".

When the government privatized Korean Airlines in 1969, it asked Cho to take over the struggling airline, which then had only four turboprop aircraft. He modernized it and turned it into one of the world's largest airlines with one of the youngest fleets of modern jet aircraft. Korean Air is the world's second largest air cargo carrier and Korea's flagship carrier.

Today the Hanjin Group, a vast conglomerate with assets valued at more than $20 billion, is the sixth largest company in Korea. Hanjin includes trucking, shipping, travel, transportation and bus companies, and it remains the parent of Korean Air.

Cho also strongly believed in the value of education. He took over and invested in Incheon's Inha University when it foundered, becoming chairman of its board of trustees, a post now occupied by his son Y.H. Cho.

Cho is survived by his wife, Kim Jung Il; four sons, Yang Ho (known as Y.H.), Nam Ho, Soo Ho and Jung Ho; and a daughter, Hyun Sook.

# FACULTY HONORS & AWARDS

*Left to right are the School of Engineering's award winners from USC's Convocation held March 11, Alan Willner, Peter Will, Wei-Min Shen and Lloyd Welch.*

Four School of Engineering faculty were among those honored at the Academic Honors Convocation ceremony held at USC on March 11.

**Lloyd Welch**, professor emeritus in electrical engineering and member of the National Academy of Engineering, was one of two retired faculty members chosen to receive the **2003 Faculty Lifetime Achievement Award**. Welch, who recently received the **2003 Claude E. Shannon Award**, has had a 40-year-plus research career in the area of digital communications, coding theory and signal processing. He helped develop the Baum-Welch algorithm for detecting and predicting the behavior of hidden Markov models. "Always ready to help students and colleagues, he is known for his modesty and concern for others, and often helps in their research without seeking any credit for himself," said USC President Steven B. Sample.

**Alan Willner**, professor of electrical engineering, associate director of the USC Center for Photonic Technology and associate director for student affairs at the Integrated Media Systems Center, received the **USC Associates Award for Excellence in Teaching**. Willner has been the top-rated professor on student evaluations in the department of electrical engineering-systems each of the 10 years he has taught at USC. He received the **1999 TRW/USC School of Engineering Excellence in Teaching Award** and numerous others. In the past six years, his students have received three of the annual Best Paper Awards from his department.

Convocation photo by Irene Fertik

# NSF Approves Renewal of IMSC

The National Science Foundation (NSF) has renewed funding for the School's Integrated Media Systems Center (IMSC) for a final five-year contract as its sole Engineering Research Center (ERC) for multimedia and Internet research.

NSF support for IMSC will continue until 2007, completing the maximum 11-year period provided under the ERC program. The NSF selected the School's proposal for IMSC in 1996 out of a total of 117 that were submitted.

"We are very pleased that NSF has approved the IMSC renewal for the full term of the ERC program, thereby affirming our successes over the past six years and our plans for the future," says IMSC Director Ulrich Neumann. "We have received tremendously positive feedback from NSF and our industry program members on the center's contributions to advancing the multimedia and Internet research fields."

Last year, IMSC demonstrated breakthrough technology called Remote Media Immersion (RMI) for streaming high-definition digital video and multichannel audio across the Internet. The synchronized video and audio is rendered on a big screen and multiple speaker sound system. IMSC demonstrated RMI again for the NSF site review team in June. In October, IMSC used RMI to stream a New World Symphony concert coast-to-coast for 500 top Internet researchers who saw it on a 30-foot theater screen in USC's Bing Theater.

"This is one way people will use the Internet in the near future," says Neumann. "They'll be able to experience a movie or a concert in their own living rooms whenever they want. The picture and the sound will rival that found in today's best theaters."

*IMSC Director Ulrich Neumann*

IMSC has developed unique technologies such as 3D face and body modeling and animation, streaming media servers, speech and face expression analysis, Immersivision™ panoramic video technology, and immersive audio. The center is breaking new ground in haptics (touch-related) technologies, data compression and wireless communications. Its integrated research approach is progressing toward "immersipresence," a future where the current 2D world of computers, television and film will transform into 3D immersive environments in living rooms—or anywhere.

IMSC has nearly 40 faculty investigators and an annual operating budget of approximately $10 million. The center's industry program members include Boeing Co., Eastman Kodak, FX Palo Alto, Hewlett-Packard, IBM, Intel, Lockheed Martin, Microsoft, NCR, TRW and smaller entrepreneurial companies. IMSC also partners with the National Aeronautics and Space Administration (NASA), including NASA's Jet Propulsion Laboratory and the Defense Advanced Research Projects Agency.

*More details about IMSC are available at http://imsc.usc.edu/.*

## FACULTY HONORS & AWARDS

"A winner of prestigious research awards, Professor Willner balances his teaching with directing a vibrant research group," said Sample.

Two Information Sciences Institute researchers, **Peter Will** and **Wei-Min Shen**, received **Phi Kappa Phi Faculty Recognition Awards** for their published research on self-reconfigurable robots. Shen, a project leader and director of the Polymorphic Robotics Laboratory, created the hormone software concept used in the machines, while Will, a research professor of industrial and systems engineering and materials science, invented the system and hardware. The internationally recognized robots are able to reconfigure themselves into insect or snake-like forms and can penetrate small places.

Assistant Professor **Tzung Hsiai** of the School's biomedical engineering department has received a **Career Development Award** from the National Institute of Health for his project entitled "Microsensors to Study Endothelial Cell Dynamics." Hsiai is developing and applying micro- and nano-systems to address fundamental cardiovascular pathways that lead to acute coronary syndrome (heart attack). The NIH award of $514,350 over five years, is termed a **Clinical Scientist Development Award** and is aimed at young investigators with a health professional doctoral degree who are committed to a career in fundamental biomedical research.

**Shrikanth Narayanan**, assistant professor of electrical engineering and linguistics has received an **NSF Career Award** of $500,000 over five years to pursue studies of modeling and optimizing user-centric mixed-initiative spoken dialog systems. He is working in the Integrated Media Systems Center and the computer science department.

University Professor **Sol Golomb** has been named to the **Board of Governors** and the **Academic Committee** of the **Board of Technion**, at the Israel Institute of Technology. The initial appointment is for two years.

Senior Computer Scientist **Jerry R. Hobbs** received an **honorary degree** from the University of Uppsala in Sweden on January 24, only three months after joining the USC School of Engineering's Information Sciences Institute.

# Legendary Leaders The School of Engineering's Partnership with Hewlett-Packard

*by Meredith Goodwin*

The origin of international powerhouse Hewlett-Packard Company—a single product, manufactured in a garage by a pair of visionary young electrical engineers—sounds like an entrepreneurial fairy tale. Add the merger between HP and Compaq, a company whose first product was designed on a napkin in a pie shop, and the story grows to almost mythic proportions.

For more than six decades, the Hewlett-Packard legend has fueled the dreams and ambitions of young engineering students. One of them was Harry W. "Webb" McKinney (BSEE '68, MSEE '69), who joined HP as a sales engineer straight from his studies at USC. Today, McKinney is a member of HP's executive team.

*Harry W. "Webb" McKinney*

As executive vice president for merger integration and organizational effectiveness, McKinney leads HP's ongoing merger integration and global citizenship efforts, as well as the company's organizational effectiveness and governance initiatives. He played a pivotal role in the 2002 merger between HP and Compaq, co-heading the team whose responsibilities included planning and leading the integration of HP's and Compaq's systems, processes and people.

However, he still finds time to serve on the School of Engineering's Board of Councilors. "I'm a strong supporter of education," he explains, "and I enjoy being part of a team that strives to educate and develop the men and women who will soon enter into the work environment."

McKinney actively supports HP's longtime commitment to the School's student retention and diversity programs. "HP is one of the most active members of the Center for Engineering Diversity, which provides professional development for under-represented engineering students," says Janene White, the center's director. "HP's representatives help students develop important career skills such as writing effective cover letters and preparing for job interviews. The company also provides scholarships and equipment for our students and participates in our Summer Bridge program, helping freshmen prepare for the challenges of college life."

"We view a diverse workforce as a compelling business need," says Patricia McCarthy, who manages HP's University Relations Department. "Our customers encompass all demographics, and we try to ensure that our employees and business divisions reflect this diversity. We find that diversity and retention programs are extremely effective in encouraging students to complete their degrees.

"We also put a lot of effort into providing summer internships, as well as offering year-round research opportunities for the School's undergraduates," McCarthy adds. "We know that creating opportunities for students to develop personal relationships with HP mentors is an excellent way for students to see the end result of the rigorous and challenging course of study they've chosen."

McKinney underscores the importance of a supportive educational experience. "USC provided a superb education that helped to build a strong foundation for my career at HP," he says. "The challenging environment and experienced faculty at USC instilled life-long values in me that I believe are true today. As an alumnus of the USC Engineering program, I felt it was important to give back to the institution that helped shape me and my career at HP."

"Webb is the nicest guy on the planet," McCarthy says. "HP was started by men who lived through the Depression and knew the value of a person's word. They infused HP's corporate culture with their sense of personal values and respect. Webb's entire career has been with HP, and he truly embodies these values."

The successful USC Engineering-HP partnership also extends into the research arena. HP is a member of the Scientific Advisory Board of the Integrated Media Systems Center (IMSC), and helped to design the School's graduate Creative Technologies Program. It also supports a number of innovative faculty research projects with research grants and equipment.

"There's a wonderful match between researchers at the School and HP's Industrial Research Labs," McCarthy says. "They both share a five- to 20-year time horizon for technology research and development, rather than the zero- to five-year time frame of the rest of the company."

Recently, HP provided IMSC with a face detection and recognition library to support Professor Jay Kuo's research on audiovisual-based speaker identification for movie content analysis. The project attempts to identify specific speakers in a film or video through audio and/or video cues. Another research project the company supports involves speech recognition technology that would enable an individual to access the Internet by speaking into a wristwatch. HP also is supporting IMSC Director Ulrich Neumann's efforts to add eye-tracking capabilities to videoconferencing.

"Clearly, the HP 'mystique' is as strong today as ever," says Dean C. L. Max Nikias. "We are truly grateful for the insight and leadership that Webb McKinney brings to the School of Engineering, and to HP and Pat McCarthy for their exceptional level of support for the School, its students, faculty and research."

# Faculty Profile: Paul Ronney

## *Out of the Ashes, Hope*

When the space shuttle Columbia and its astronauts were lost February 1, a great deal of scientific data also disappeared. However, the crew left behind a foundation of research that could benefit life on earth. Among the many experiments was one developed by the School's Paul Ronney.

Ronney, professor of aerospace and mechanical engineering in the School of Engineering, has been examining the dynamics of combustion and igniting lean mixtures of fuel, oxygen and inert gases. Conducting his experiment, Columbia's astronauts set records for the weakest and leanest flames ever burned on earth or in space.

Their miniature balls of flame could lead to more fuel-efficient car engines, a better understanding of gas explosions in confined spaces such as underground mines, and improved methods for spacecraft fire safety assurance.

Ronney, first discovered these tiny flame balls nearly 20 years ago, is now on a mission made more personal since the Columbia disaster. His data incomplete, he is driven by the loss of the astronauts, and by the memory of their courage and commitment, to extract as many conclusions as possible from the information he has.

Called "Structure of Flame Balls at Low Lewis-number," or SOFBALL, the project is based on weakly burning flames in mixtures of either hydrogen-oxygen-inert gas or methane-oxygen-inert gas. The Columbia crew produced 55 flame balls in all, naming 33 of them. "Kelly" was the longest-burning flame, at 81 minutes. The weakest flame they burned produced half a watt of thermal power, which is exceedingly weak: a single birthday-cake candle produces about 50 watts of thermal power.

"What we're doing is building up a knowledge base about how weak flames burn. We've known for a long time that if we could burn weaker mixtures in our car engines, we could get better fuel efficiency and lower pollutant formation," Ronney says. "We can use these flame balls to provide data on weak combustion that will help us develop better models of combustion, which then can be applied to car engines."

Ronney lost about 50 percent of the data obtained on the last Columbia flight, but the researchers were able to downlink much to the ground. In 1997, another Columbia mission carried a successful flame-ball experiment, which means that altogether, 75 percent of the data is in hand.

"Since science was the main objective of this flight, perhaps the crew would have been pleased to know that SOFBALL did get much of its science," he says.

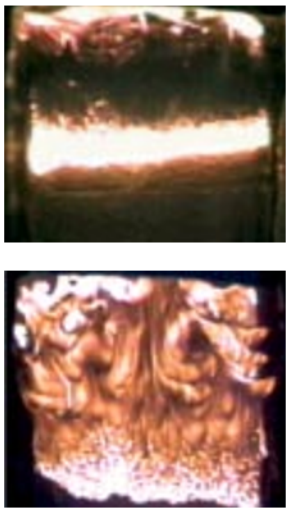
There were some unexpected results in the Columbia experiment.

One of the flame balls drifted in the combustion chamber much more than expected, and other flame balls, mainly those with methane mixtures, moved in a corkscrew pattern. The biggest surprise came in the final test, which was supposed to last 25 minutes. That test produced nine flame balls and, as expected, they extinguished one by one until only Kelly was left. Kelly continued to burn in the middle of the combustion chamber until it finally had to be extinguished.

"We never intended a third flight for this project," Ronney says. "We'll review the data that we have, build on that and try to address the surprises we came across."

Ronney had trained to be an alternate crewmember on the1997 flight that carried the first SOFBALL experiment. He initially did low-gravity research in graduate school, where he began thinking about conducting the experiments in space. Now he has become a strong advocate of continuing the manned space program and scientific research in space.

"This particular program was running for five years before the Challenger disaster occurred. Until Columbia, it had been 17 years without another accident," he says. "Two disasters in over 100 flights is terrible, but historically, it's impressive. Think of the first 100 outriggers headed out of Polynesia for Hawaii (which they didn't even know existed). I'm sure that at least two boats were lost there, too. In the history of exploration, we've come so far and we're doing so much better than our predecessors."



*Images of flames spreading over solid fuel beds at microgravity (top) and earth gravity (bottom). This flame research is aimed at developing better methods of assessing fire safety in orbiting spacecraft as well as understanding mechanisms of fire spread in buildings at earth gravity.*

*See Ronney's personal perspective on the Columbia on page 48.*

Ronney photo by Irene Fertik

## KEY ADDITIONS TO THE BOARD OF COUNCILORS

**EDGAR S. BROWER** (BSISE '59) recently retired as chairman of the board, president, and CEO of Newport Beach-based Pacific Scientific Company, where he had worked since 1985. Prior to joining Pacifica Scientific, Brower spent eight years in various senior management positions with the Allied Corporation. Previously, Brower held directorships at Omega Environmental, the M.C. Gill Company, Pro Computer Sciences, Ceracon Drilling Products, and Metal Alloys. Key government positions included United States Assistant Postmaster General from 1972 to 1976, during which time he guided the design and implementation of the nation's $1 billion automated mail handling system. The system allowed the postal service to handle increased volumes of mail with 80,000 fewer people. He served in the U.S. Army from 1950 to 1954, rising to the rank of first lieutenant. In 1989 he received the Outstanding Alumnus Award from the University of Southern California.

**LEO CHU** is an entrepreneur who has made a significant imprint in textiles, women's apparel, and Las Vegas-style casinos. He first developed his family's textile firm in Hong Kong before emigrating to the U.S., where he and his wife started California Ivy, a women's apparel company that they eventually sold to a Fortune 500 company. He now owns and operates Hollywood Park Casino and Crystal Park Casino Hotel in the Los Angeles area. Chu is a graduate of Hong Kong Polytechnic.

**DAVID M. DICARLO** (Ph.D EE '79) is vice president of engineering at Northrop Grumman Space Technology. He is responsible for all engineering activities and processes within Space Technology, as well as microelectronics process development and fabrication.

Prior to joining Northrup Grumman, DiCarlo served as vice president and general manager of the electronics and technology division at TRW Space & Electronics. He has also served as vice president and executive director for Broadband Wireless in TRW Ventures, and vice president and director for the TRW Center for Automotive Technology, which transfers TRW aerospace and information technology to the company's automotive products. He has an extensive background in program management, including the management of a major defense payload project.

**HESTER GILL** is vice president of the Merwyn C. Gill Foundation. Born in the Orange Free State, Republic of South Africa, Gill completed her business degree at the University of South Africa. After holding increasingly responsible positions in South African firms, and completing courses and tests to become a public accountant, she joined Price Waterhouse and immigrated to Vancouver, Canada. Following a subsequent move to the United States, she married USC alumnus M.C. Gill (BSCHE '37). As part of her responsibilities with the foundation, Gill works with a range of charities.

# SPACE SCHOOL

*continued from page 9*

of the 1960s. He further evolved this concept for his final project, and intends to submit it as a proposal to NASA and Boeing.

Richardson's thinking meshed well with the concept behind the Synthesis Studio. His presentation placed the life boat in historic context, while the design elaborated on known technologies. It filled an obvious need for the International Space Station, and his concept was simple enough to be cost-effective.

Panelist Tony Freeman, a JPL program manager, pointed out that life boats for sailing ships hardly changed over 200 years because they worked so well, so the proven concept of a reentry capsule could evolve and adapt to our needs for an equally long period.

Bill Haynes, whose career started in a World War II B-29 and included the winning design for NASA's 1970s Skylab program, was another regular panelist. He liked the fact that Richardson's life boat had windows, so a pilot could bring it safely to earth by dead reckoning if all else failed.

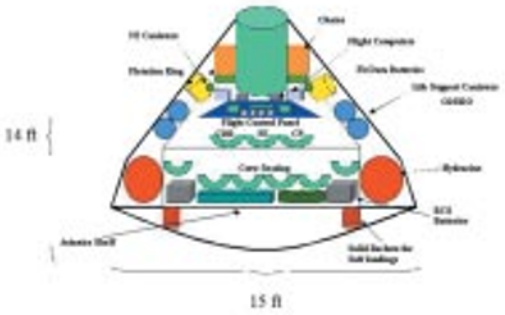
Another evolutionary proposal came from Dan Rowan, another Boeing employee. He elaborated on the space shuttle program and its known costs in his proposal for an earth-orbiting "trash truck," which could be based at the International Space Station. This orbiting ship would collect and repair disabled satellites.

Other student projects included a lunar-based space telescope array, an interplanetary "cruise ship," methods for turning the moon's surface into the solar system's largest billboard, a lunar resort constructed within hollowed-out extinct lava tubes beneath the moon's surface and a reality television show set on the International Space Station.

### WHERE DO THEY GO FROM HERE?

With students presenting this wide array of concepts, it's reasonable to ask Thangavelu if many students become working space architects. "No, not many at all," he says. "It is a challenging pursuit, one that forces us to imagine beyond what has already been defined. It's easier to live and work within the bounds of what most people already understand.

"As I said before, the conflict between what's possible and what's daydreaming is necessary," explains Thangavelu. "But only a few can stand to live at the center of such conflict for a long period of time."




*Bryan Richardson, a Boeing manager and naval aviator, has evolved the proven concept of the reentry capsule into a "life boat" for the International Space Station.*

## The Lord Foundation—Visionary Partners

*by Meredith Goodwin*

This nation's leading universities have built their reputations on outstanding research and innovation, in a large part, thanks to partnerships they have forged with farsighted individuals and entrepreneurs. Perhaps the best example of this principle at work has been the Lord Foundation's long relationship with the USC School of Engineering. For many years, it has been a source of funding for some of the most innovative research and academic programs at the School.

*Top–Thomas Lord provided leadership for the Lord Corporation for more than five decades. Below–James W. Wright, current vice president of legal affairs and secretary.*

"The Lord/USC Engineering partnership has always sought innovative approaches to technology and education. Together, we continue to make important advancements that will benefit generations to come," says Dean C. L. Max Nikias. "The Lord Corporation has been a pioneer in its field for nearly 80 years." The Lord Corporation is a privately held company that is a global leader in designing and producing adhesives and coatings as well as vibration, noise and motion control products for the automotive and aerospace industries.

Lord's chairman, Thomas Lord, came from a pioneering background. His father, patent attorney Hugh Lord, founded the company in 1924 after being unable to find people who could successfully manufacture his numerous inventions. Eight years later, Charles and Anne Lindbergh switched to Lord mountings for the instrument panels on their historic flight to China because most of the instruments used during Lindbergh's famous 1927 trans-Atlantic flight failed due to excessive vibration. Hugh Lord held more than 100 patents when he died in 1952 at the age of 85. Tom Lord was promoted to general manager of the company in 1932, and was named president in 1946, overseeing the company's dramatic growth on both the domestic and international fronts. He became chairman of the board in 1968.

In the early 1970s, Lord began exploring ways to utilize the company's resources to advance research, education and health care in the United States. He asked the corporation's then-president, Donald M. Alstadt, a noted chemist and inventor who later succeeded Tom Lord as chairman of the board, to help identify institutions that fit Lord's philanthropic criteria: private, financially sound and decentralized, with graduate programs that could potentially be of interest to the corporation.

"We wanted to geographically decentralize our philanthropy," says Alstadt. "So we were looking at 10 to 15 schools with which we might partner. Jack Rebman, who was general manager of our Mechanical Products Division at that time, had previously worked at Lockheed, and he told me USC's programs were highly regarded on the West Coast."

Alstadt brought Tom Lord to USC and Lord liked what he saw. With Lord's gift of Class B stock, a highly successful three decade-long partnership between the two institutions was launched. In 1977, Lord formally established the Lord Foundation of California to support the USC schools of engineering and business. The foundation was set up as a "supporting organization" to foster interaction between the two institutions. This structure mandated that USC, as the fund recipient, would hold a majority of seats on the Board of Directors, with representatives of the Lord Corporation forming a minority.

"The Lord Foundation of California was the first of five philanthropic foundations that were formed by Thomas Lord," says James W. Wright, vice president of legal affairs and secretary of Lord Corporation. "I had the pleasure of working with USC in establishing the foundation and have been involved ever since. There is mutual respect in the relationship, with both parties learning from each other.

The foundation has funded an impressive range of programs at the School of Engineering—from "big-picture" projects such as the Distance Education Network, to research at the most minute level through the School's research of nanoscale structures. Other programs the foundation has supported recently include the Kaprielian Innovation Fund for graduate fellowships and interdisciplinary research. Today, it provides approximately $1.5 million in support annually, which is divided between the schools of engineering and business.

## Tsunami Researcher Saves Life at the Beach

*Costas Synolakis on a recent tsunami field study*

Remembering a 25-year-old CPR class, University of Southern California Civil Engineering Professor Costas Synolakis helped save the life of a heart attack victim on a Santa Monica beach.

Synolakis, who lives in Venice, was jogging on the bike path near the point where Pico Blvd meets the beach, shortly after 9 a.m. on March 19, when he came upon a man in his sixties who had collapsed. The man had no pulse and was struggling to breathe. As Synolakis started cardio-pulmonary resuscitation (CPR), a woman who was a nurse also stopped to aid the victim.

"She did chest compressions and I did mouth-to-mouth. I had to pull his tongue out to clear the airway, " said Synolakis. The two performed CPR for several minutes until lifeguards arrived with a defibrillator. They continued the CPR while lifeguards rendered a series of three electric shocks. On the third shock, the victim's heart began working and he started to breathe.

"This guy was as close to dead as you can be. He was so lucky to live," said Angus Alexander, lifeguard captain with the L.A. County Fire Dept. "I've been involved in 17 other CPR incidents and this is the first time the victim lived."

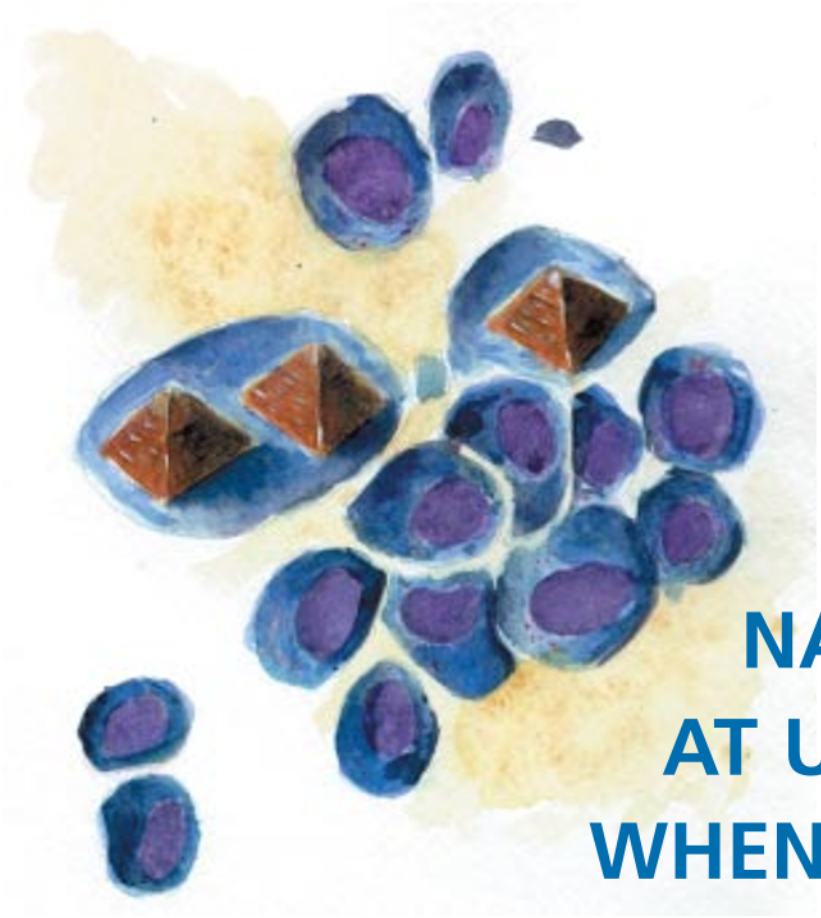
He said the actions by Synolakis and the nurse kept oxygenated blood flowing to the victim's brain and maintained his heart in a "shockable" condition.

"It is very tough to do CPR on a complete stranger," said Alexander. "It's psychologically, physically and emotionally demanding. We're very glad that Dr. Synolakis and the nurse weren't just bystanders."

Alexander had previously assisted Synolakis on some tsunami research projects and the two were also acquainted through the L.A. County Tsunami Task Force. Synolakis is a well-known tsunami research.

Synolakis said he learned CPR when he took a SCUBA diving course at Caltech when he was a student 25 years ago and that he had never taken a refresher course.

"It is amazing how quickly things come back when you need to remember," he said. "When I heard that the guy lived, I was just ecstatic. I couldn't have been happier."



# NANOTECHNOLOGY AT USC ENGINEERING: WHEN LESS IS MORE

*Tiny Research with Big Results*

## Big Things in the Small, Small World of Nanotechnology

## The School of Engineering Stakes Out Its Niche

Steve Martin said, "Let's get small." The USC School of Engineering says: "Let's get nano." That's nano, as in nanotechnology.

Nanotechnology involves structures and tools small enough to fit inside single living cells, man-made creations the size of single molecules or even atoms. Several USC Engineering labs have been working on nanotechnology for almost a decade.

Such molecule-sized computing devices would need almost no external power, since electricity would flow through transistors one electron at time. (Today's Pentium chip moves about a billion electrons to express one bit [a one or a zero] of data.) Nanoscale devices could attain unparalleled levels of sensitivity, perhaps to the point of finding a single molecule of a target substance.

The USC effort is intensifying and focusing on a specific "nanoarena," a critical intersection where materials science, biology and information technology meet. Scientists including Chongwu Zhou, Anupam Madhukar, Leonard Adleman, Ted Berger, John Granacki, Eun Sok Kim, Dan Dapkus, Paul Ronney, Tzung Hsiai and Ari Requicha are working on exceedingly small devices that may lead to applications as varied as internal drug-delivery systems or biological monitors, microscopic full-fledged computers, ultra-sensitive sensors and mini-motors. Researchers talk passionately about "smart regulated bio-implant systems," "genetically engineered peptides as bio-compatible coatings for prosthetic surfaces" and "templates for quantum dot and wire devices."

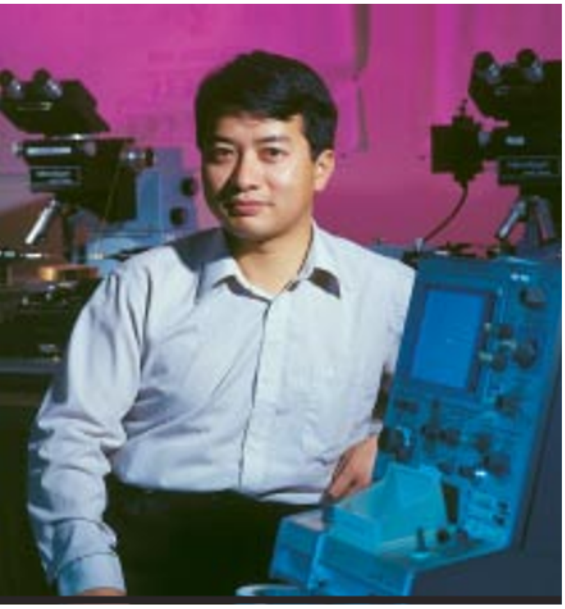
The territory being staked out builds on existing strengths in the School and other parts of USC. An entire floor of the new Ronald Tutor Hall will be devoted to nanotechnology (and micro) research.

"We have expertise, momentum and enthusiasm, and we have a plan to exploit a specific niche where we believe we can do big things in nanotechnology," says Dean C. L. Max Nikias. "That's why we are going to build these new laboratories in Ronald Tutor Hall." *See story on Tutor Hall on page 47.*

## MOLECULAR ELECTRONICS

To realize their most ambitious dreams, nano-engineers need new structures such as the remarkable ones coming out of Chongwu Zhou's laboratory. Zhou, an assistant professor of electrical engineering, is a recent arrival from China by way of the University of Science and Technology of China, Yale and Stanford. Youthful and energetic, he is pursuing three separate lines of research that are attracting considerable attention.

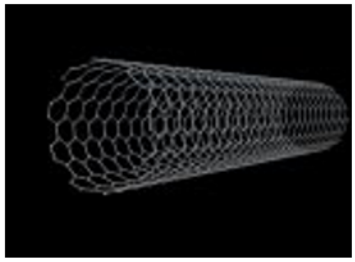
The first is an ingenious way to create a new kind of computer memory with molecules of a plastic called PPV. Most plastics are polymers with molecules composed of long chains of many units. Zhou works with oligomers—molecules of just two or three of the PPV units that can receive or give up electrons in the controllable way needed for memory. He has devised a clever method to suspend these individual molecules, which are about 1.5 nanometers in length, between ultra-fine metal wires. He used palladium in his first version and gold in the new model, which he is working on now. Wires attached to the "top" of the molecule run in one direction; those attached to the "bottom" are at right angles to those on top.



ASSISTANT PROFESSOR CHONGWU ZHOU

Zhou has demonstrated that such a grid is able to read and write data. His first working model held a modest 64 bits, but the new version will hold more than 1,000. The system is so compact that more than 10 billion units could be packed into a single square centimeter.

Zhou is also at work on a new kind of transistor based on carbon nanotubes. Ordinary carbon atoms are linked together in a sheet that rolls up tight to form a cylinder, two nanometers or less in diameter. Many researchers are investigating carbon nanotubes because they are phenomenally strong for their size. Zhou, however, is interested in the electronic possibilities. Carbon in nanotubes can function the same way its periodic-table cousin silicon does in electronic devices. Solid-state devices made from silicon are "doped" with small quantities of active materials such as germanium to create electronic properties. Using novel doping techniques, Zhou assembles structures of doped and undoped nanotubes that function as transistors that are far smaller and consume much less power than their silicon brethren. Zhou's group already has demonstrated one working nanotube electronic device, an integrated logic inverter.



*Nanotube*

The plastic memory and carbon nanotube transistors have attracted interest, but Zhou's third research focus, nanowires, is perhaps the most interesting of all. He is working with ultra-thin (10 nanometers in diameter) strands made from two different semiconductor compounds. The gallium nitride nanowires have been made before, but he is making them with unprecedented control over their diameter, location and orientation. His indium oxide nanowire is a brand-new material. A paper announcing the synthesis appeared in Advanced Materials in January, and Zhou believes the nanowires could lead to extraordinarily sensitive chemical and biosensors.

Currently, thin films of the two substances are able to detect the presence of ammonia and other such toxic gasses. But nanowires would be more sensitive because they expose more surface area while being much smaller. Zhou says a multitude of wires sensitive to different substances in a single device would constitute a "laboratory on a chip," a vision others are also pursuing around the world.

However, a lab on a chip is not the only possibility for the nanowires. They can also sense light.

"These devices don't have to be completely electronic," Zhou says. "I'm looking at wires that can accept input in the form of light (optical switching) and also do the reverse."

Since they can both sense and emit light, the nanowires could be nanoscale structures functioning as light-emitting diodes (LEDs), and possibly even as laser LEDs.

Is this all? Zhou smiles behind the neat stacks of new research papers fresh off the press on his desk. You get the idea he has barely begun.

## DNA COMPUTING

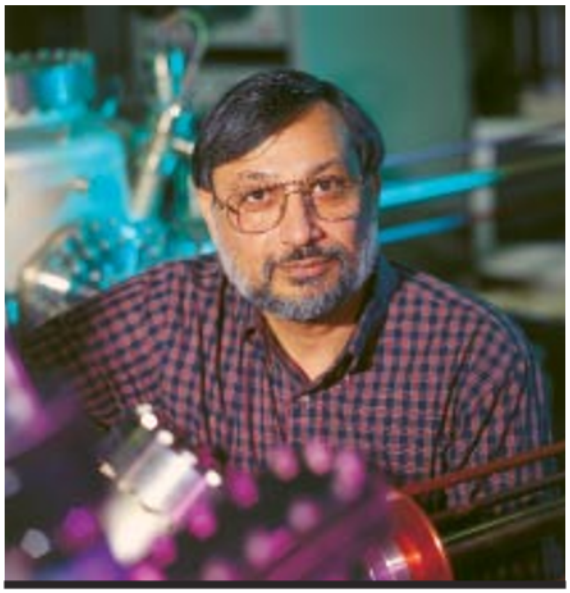
Along with Zhou's nanoscale, molecule-sized computer components, another more basic development is unfolding. Leonard Adleman, the Henry Salvatori Professor of Computer Science, has turned DNA molecules into a computer. A computer scientist, biologist and member of the National Academy of Engineering, Adleman first used DNA to solve a simple computing problem in 1994. Employing laboratory techniques to find and read DNA molecules that represented alternate solutions to a problem, he made the billions of DNA molecules in a test tube act as a massively parallel computer.

This classic experiment captured worldwide attention. It is cited in many texts and sparked whole conferences on DNA computing. Backed by USC's extensive expertise in molecular biology, Adleman has continued to pursue DNA computing and last year made another breakthrough that rippled around the world when his paper was published in the journal Science.

Adleman's first paper involved what he calls a "toy problem," one so

Illustration by Scott Holmes and Zhou photo by Michelle A. H. Smith

simple that almost anyone could solve it in a few minutes using pencil and paper. Last year's experiment, however, showed that DNA computing could solve a mathematical problem with more than a million possible solutions, far too complex for anyone to calculate without a computer.



PROFESSOR ANUPAM MADHUKAR

Despite his success, Adleman believes existing DNA computing technology is too error-prone to compete against conventional computers. Nevertheless, the fact that something as pervasive in biological systems as DNA can work as a computer raises intriguing possibilities. "It's possible that we could use DNA computers to control chemical and biological systems in a way that's analogous to the way we use electronic computers to control electrical and mechanical systems," Adleman says. In fact, he is not the only computer researcher at USC who has found inspiration in the human body.

## BIOLOGICAL INSPIRATION

Ted Berger, professor of biomedical engineering, has been working to build a brain prosthetic device for many years that could take over brain functions lost through injury or disease. By bombarding live brain slices from rats with a huge range of electrical impulses and studying the signals that emerge, Berger has been able to model larger and larger groups of neurons.

John Granacki, director of the Advanced Systems Division at the Information Sciences Institute, has fabricated computer circuits that mimic Berger's neuron models. Armand Tanguay, professor of electrical engineering, has designed a precisely shaped photonics array to connect to the hippocampus of the brain. Berger's team is preparing to test the neural prosthetic device on live rat brain slices. But their single biggest remaining challenge is to attach the man-made hardware to the wetware of the brain. The challenge fits neatly into the USC nanotechnology niche of "smart regulated bio-implant systems," and Berger has begun exploring a possible nanotech solution to the remaining hurdle.

Meanwhile, Berger's research has spun off a neuron-based speech recognition system that is better than the human ear; it is under commercial development. He and Granacki have received grants from the National Science Foundation and others to develop a next-generation computer chip based on how neurons compute.

## QUANTUM DOTS

Some of the School's longest-running research in nanotechnology involves photonics, an area of strength for almost two decades. In the late 1980s, Anupam Madhukar's work with semiconductors began to suggest a novel approach to making smaller devices, such as lasers and transistors, than are possible with standard silicon technology.

Madhukar, the Kenneth T. Norris Professor of Engineering and professor of materials science and physics, deposited a layer only a few molecules thick of the semiconductor indium arsenide onto a thick gallium arsenide layer. A seven- percent difference in the spacing between the atoms of the two materials resulted in the formation of tiny crystalline pyramids called quantum dots. The pyramids are about seven nanometers high and 20 nanometers in diameter at the base.

"Because of the strain induced by the difference in spacing of the atoms, the indium arsenide buckles and creates the pyramidal bumps," Madhukar explains. "Nature's own elastic forces form them spontaneously."

Quantum dots contain 10,000 to a million atoms arranged "epitaxially," i.e., in a defect-free relationship to the underlying semiconductor surface atoms. They offer new electronic properties not present in either much larger or much smaller collections of atoms. Devices such as lasers, detectors and transistors based upon them require a fraction of the power of standard silicon devices. Since publication of dot breakthroughs in *Science and Physics Today*, introducing and utilizing the concept of "surface stress engineering," Madhukar has continued to develop this class of quantum dot technology under a USC-led $5 million multi-institution federal grant.

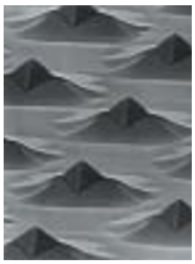
Madhukar's group has found dots that detect the presence of certain wavelengths of infrared radiation. Properly configured, quantum dots could work as the senses and the brains of new machines. He has been trying to attach his quantum dot detectors to biological molecules and cells to create what might be termed smart, biochemical sensors.

More recently, his interests have expanded to another class of quantum dots, nearly spherical semiconductor, metal or ceramic nanoparticles with diameters from two to 50 nanometers suspended in a solution. As the lead lab in another concurrent

SOME OF ANUPAM MADHUKAR'S POST DOCTORAL RESEARCHERS.

$5 billion multi-university grant under the National Nanotechnology Initiative, his group is examining ways of utilizing engineered proteins to direct the assembly of the "colloidal" quantum dots into usable device structures.

"Exploiting the best features of both classes of quantum dots, epitaxial and colloidal, in integrated architectures will potentially revolutionize the emerging field of nanotechnology as applied to life sciences, biomedicine, biomedical prostheses and information sensing, processing and computing technologies," says Madhukar. Inside the body, he notes, "Chemical signals of all kinds are constantly being passed" from cells to their environments and other cells. Molecules in cells in the pancreas, for example, detect how much sugar is in the blood and can send a signal that triggers the release of insulin to metabolize the sugar.



*Quantum dots*

Madhukar envisions drug delivery systems controlled by quantum dots that could do somewhat the same thing. He has begun work to integrate quantum dots with a designed protein matrix. "Imagine a drug delivery system that brings just the right amount of a medicine to the precise part of the body where it is needed," he says.

Turning this and other goals into reality requires the computing muscle to crunch the enormous calculations needed to predict and mold the various structures. "It is becoming possible to do computer modeling on this scale," Madhukar says. "There is a natural marriage between high-performance computing and nanotechnology."

Last year a research team specializing in the kind of quantum modeling needed by nanotechnologists relocated to USC from Louisiana State University. Priya Vashishta, Rajiv Kalia and Aiirchiro Nakano, who had collaborated with Madhukar previously, all received joint appointments in the School of Engineering and the College of Letters, Arts and Sciences. The new Center for High Performance Computing and Communications, partly run by the School's

Madhukar photos by Michelle A. H. Smith and ant photo by Adam Cohen

## NANO'S BIG BROTHER MICRO: IT'S STILL A SMALL, SMALL WORLD

**This 12-layer chain was made with electrochemical fabrication (EFAB) technology developed at the School. The chain is 290 microns wide directly under an ant's head and each layer is approximately seven microns thick. EFAB facilitates mass production of complex micro-electromechanicalsystems, or MEMS, devices. The picture was taken by EFAB inventor Adam Cohen with a scanning electron microscope and has been colorized.**

Along with pioneering research in the ultra-small realm of nanotechnology, USC Engineering researchers have long worked in the thousand-times larger microtechnology domain. Micro may be nano's big brother, but it is still a very small place. A micron is one millionth of a meter, or a thousandth of a millimeter. The challenges and the potential benefits of micro research are just as great as those of nanotechnology. School of Engineering researchers have been crafting a wide variety of micro devices, from brain implants to cure diseases such as Parkinson's to moving assembly lines that would fit on the head of a pin. USC's micro researchers will be joining their nano colleagues in laboratories in the new Ronald Tutor Hall.

A longstanding area of research interest at the School has been micro-electromechanical systems, or MEMS. At the School's Information Sciences Institute, robotics expert Peter Will, who collaborates with nanoscale researchers Ari Requicha and Anupam Madhukar, has gained recognition for MEMS research involving tiny electromagnetic fingers, or cilia, that can manipulate or move items too small and delicate for human hands. His work was described in a 1998 cover story in Discover. Because of Will, ISI has become the location for a major MEMS resource, an online clearinghouse.

THE CHALLENGES AND THE POTENTIAL BENEFITS OF MICRO RESEARCH ARE JUST AS GREAT AS THOSE OF NANOTECHNOLOGY.

ISI is also the birthplace of Electrochemical Fabrication, or EFAB, a new MEMS technology that has successfully made the transition to the commercial world. Adam Cohen, who invented EFAB while a project leader at ISI, is now chairman and executive vice president of MEMGen, a Burbank company

*continued on page 22*

Information Sciences Institute, has a 570-node (soon to expand to more than 1,000 nodes) Linux parallel supercomputer, one of the largest of its kind in academia.

PROFESSOR P. DANIEL DAPKUS

## UNIFORM QUANTUM DOT ARRAYS

Researchers lead by P. Daniel Dapkus, William M. Keck Professor of Engineering, Electrical Engineering and Materials Science, are perfecting new methods to control the size, shape and spacing of quantum dots. "Controlling those parameters provides you with the maximum benefit from semiconductors," Dapkus says. "The atom-like properties of these nanostructures improve many of the device characteristics and provide new functionality not achieved in any other way."

Before depositing the layer of gallium arsenide or indium arsenide semiconductor, Dapkus applies a film of polymeric material that "self-assembles" into a pattern of nanospheres. The pattern forms because the film is a copolymer, two different long-chain organic molecules that tend to avoid one another. The copolymers allow a wafer to be patterned with processes that are similar to the standard photoresist patterning used in the semiconductor industry. The resultant quantum dots have unprecedented uniformity, with a diameter of 20 nanometers and ordered placement on 40-nanometer centers. This approach of using organic materials to pattern wafers on a nanometer dimension is an important new paradigm emerging in a field termed nanophotonics.

"We are working to control both the light and the electronics of photonic devices at the smallest possible physical scale," Dapkus says.

## SILVER AND GOLD

In the 1980s, scientists discovered that the sharp silicon tip of the newly invented scanning probe microscope not only produced images revealing individual atoms and molecules, but would sometimes move them. A team led by Ari Requicha, professor of computer science and director of the Laboratory of Molecular Robotics, has been steadily improving the precision with which his team can move ever-smaller materials. Among them are colloidal gold and silver balls as small as two nanometers in diameter on a mica slab, and string-like organic molecules called dithiols that tether the balls together. They can chemically link the particles to form assemblies, and they can make nanowires by depositing metals on strings of carefully positioned balls.

With $1.5 million from the NSF, Requicha and several other researchers are working to create tiny nano-robots to monitor potentially dangerous microorganisms in the ocean. *(See "Lilliputians*

## NANO'S BIG BROTHER MICRO *continued from page 21*

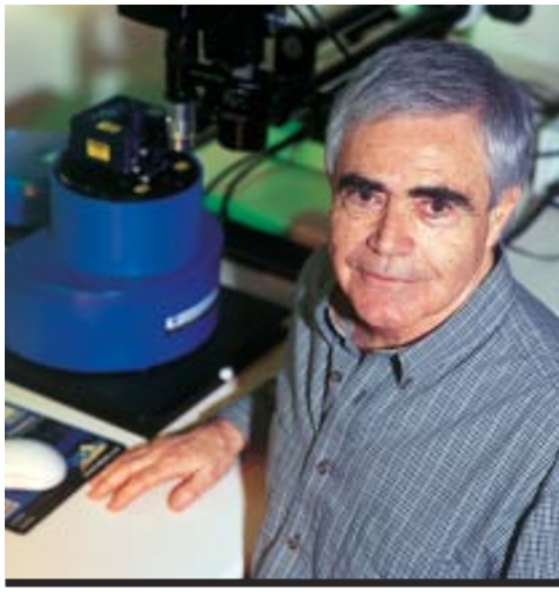
revolutionizing the production of micromachines and microscale devices. EFAB works by depositing successive, very thin layers in precise computer-controlled patterns to build up tiny but fully 3-D microscale items.

Cohen and MEMGen are collaborating with Paul Ronney, professor of aerospace and mechanical engineering, to create a unique micro-machine. Ronney, who is an expert on combustion (See faculty profile, page XX), hopes to use EFAB to produce a minute MEMS generator, a micro-engine burning hydrocarbon fuel to generate power through thermoelectric materials, substances that produce electricity when heated. Ronney's design has no moving parts and he has tested the concept successfully on the macro scale. Next, he hopes to make a micro version using the EFAB technology.

Two other School faculty are at work on other species of MEMS. In biomedical engineering, Tzung K. Hsiai is developing MEMS sensors that will report on the environment inside blood vessels to give an unprecedented, real-time detailed picture of how disease—particularly coronary disease—progresses.

In electrical engineering, Eun Sok Kim, head of the MEMS Group, is developing applications for the moving microscale membranes that his group has learned to fabricate. The membranes have strong sections that move or stand up in cantilever structures when they are energized by sounds or other fluid waves. The movement can be monitored very accurately so that the membranes act as sensors. They could become a tiny but rugged microphone array requiring very low power. Or, the membranes themselves can vibrate to generate sounds or fluid waves. Kim is exploring one possible application using a "laboratory on a chip" for biomedical uses. Membranes coated with piezoelectric films would generate focused acoustic waves to mix liquids—for example, blood with a reagent—for instant analysis. The devices also might serve as microscale fluidic drivers for such things as pumps, liquid-droplet ejectors or micro-propellers

"Beyond gains in basic scientific understanding," Nikias says, "our research is aimed at creating devices and making advances that can fulfill longstanding needs in medicine and information technology."



PROFESSOR ARI REQUICHA

*of Troy" in the Spring/Summer 2002 USC Engineer.)* This project spans nanotechnology, robotics, computer science and marine biology. It is centered on the development of ultra-small robotic sensors and software systems to control them.

Requicha says it will be possible to build nanoscale devices with electrical and mechanical components so that the devices could propel themselves, send and receive electronic signals and even compute. While a single nanoscale device would have minuscule computing power and capability, the idea is to have vast numbers of them operating in concert. This will require considerable advances in the areas of nanotechnology, robotics and computer networking. It will be at least a decade, he estimates, before any nanoscale robots are deployed in the ocean. But along the way, he predicts, the project will spin off technology in marine biology and other areas.

"Suppose we put 15-nanometer particles on a grid with 100-nanometer spacing, which we can routinely do in our lab today. If we interpret the presence of a particle as a binary one and its absence as a zero, we have a scheme to store data," he says. "The bit density is 10 gigabytes per square centimeter, which means we have data storage that is 100 times better than today's compact disks. And it could be even greater with smaller particles and spacing."

Creation and manipulation of nanoscale materials involve controlling biological, chemical and physical processes with great precision and sophistication. The School's ability to do this will improve when the new, specially designed laboratories in the new Tutor building facilitate the work. It will improve further when top faculty are recruited to work in USC's special nanotechnology niche.

"Beyond gains in basic scientific understanding," Nikias says, "our research is aimed at creating devices and making advances that can fulfill longstanding needs in medicine and information technology."

Dapkus and Requicha photos by Michelle A. H. Smith

of atomized liquid jets. Another application the researchers envision is that the membrane cantilevers could precisely position microscale mirrors or capacitors, which would be tuned to the exact capacitance desired.

USC Engineering's strong photonics program, centered on the large cleanroom in the Keck Photonics Laboratory, has steadily been making smaller and smaller photonics devices. P. Daniel Dapkus, whose work with "quantum dots" is described in the nanotechnology story, has scored other breakthroughs as well. In 1998, he created arrays of Vertical Cavity Surface Emitting Lasers (VCSELs) that were unprecedented in their small dimensions. He succeeded in packing 1,000 or more of the devices into a square millimeter and has used newer technology to shrink them still further. Working with Dapkus as part of the MicroPhonic Devices group is another electrical engineer, John D. O'Brien, who has designed some of the smallest lasers ever made. O'Brien and the group have produced a variation of the VCSEL, called a photonic crystal defect laser, which at 0.5 microns in diameter grazes into the nanotechnology realm in a new field termed "nanophotonics."

**Artist's rendering of interior of the new Ronald Tutor Hall**

CLASS OF 2002/2003

# The Brightest & the Best

*by Dan Gordon*

TOP STUDENTS CHALLENGE THE SCHOOL

After admitting the brightest freshman class in its history — with the highest average SAT score on campus at 1366 — the USC School of Engineering is reinvigorating its undergraduate curriculum. The School is considering measures that will give students greater flexibility to take minors outside of engineering, more hands-on instruction and a better sense from the start of what it means to be an engineer, among other goals.

"These are very talented kids," says Yannis Yortsos, senior associate dean for academic affairs. "The challenge is to keep them engaged."

The Undergraduate Curriculum Revision Task Force, consisting of senior administrators, faculty representatives from each department and student representatives, met throughout the 2001-02 academic year before submitting recommendations to Dean C. L. Max Nikias last summer. Jerry Mendel, professor of electrical engineering and director of the School's Academic Program Revision chaired the task force. The school and its departments are currently setting priorities and determining how best to implement these recommendations.

Left: Entering class of 2002/2003 at the new student barbecue this past fall.

Among the changes being considered:

- Reducing the number of required courses so that students can make more choices in their programs, including being able to complete a minor outside of engineering;
- Adding a new biology course for engineers;
- Radically restructuring introductory courses to give freshmen more hands-on experience;
- Enhancing instructional laboratories and developing methods of instruction that depart from the traditional lecture format;
- Working with the math and physics departments in the College of Letters, Arts and Sciences to develop curricula that are more relevant to engineering students;
- Developing freshman "academies" – cohorts of students who would take required courses together and meet regularly for one-unit seminars, led by each academy's faculty mentor, on topics such as ethics, contemporary engineering and technology.

Freshman Aaron Pipkin, a Presidential Scholarship awardee majoring in electrical engineering, loves music; he was drawn to USC, in part, by the opportunity to combine electrical engineering with courses in music recording. His freshman colleague, Pamela Fox, has been programming computers since the sixth grade, but hasn't neglected other interests. The Trustee Scholar and Merit Research Award recipient chose to enroll at the School not only because she was attracted to computer science, but also for the wide array of opportunities across the campus. "Sometimes I don't even consider myself an engineer because I have so many other interests," says Fox, who is weighing minors in fine arts and Spanish.

One of the major purposes in revising the curriculum is to free up units so that students such as Fox and Pipkin can pursue any of USC's more than 100 minors as a way to enrich their education, add value to their degree and gain

"These kids enter the university with the sense that engineering is about getting together, designing something, building it, tearing it apart," says Yates. "They come in and it's mostly lectures for the first two years. We need to capture their attention early so that they don't begin to question whether they're in the right place."

Yannis Yortsos, senior associate dean for academic affairs

Louise Yates, associate dean for student affairs and admissions

Jerry Mendel, professor of electrical engineering and director of the School's Academic Program Revision

experience from the interdisciplinary collaborations that are increasingly important in the engineering profession. "The way our curriculum is currently structured, students have very little room for anything other than engineering coursework," says Louise Yates, associate dean for student affairs and admissions, and a member of the task force. "Our brightest students tend to be the ones who want more – they want to learn a foreign language or do a minor in international relations to understand world affairs, for example. So our departments are looking at which courses are absolutely necessary and which can be offered as electives rather than requirements."

The School is also reviewing its own offerings of minors in an effort to replace those not attracting students with more appealing new ones. Only three of the eight existing engineering minors have consistently drawn well: Interactive Multimedia, Multimedia and Creative Technologies, and Web Technology and Applications. New minors have been proposed in bioinformatics, artificial intelligence, bioengineering, engineering management, technology for non-engineers and computer science for non-computer scientists.

While departments are looking to reduce requirements to give students more flexibility, they are also making room for a new required course in engineering biology. "In the future, more and more industrial activity will be in the area of bioengineering," says task force member Yortsos, who is developing the course. "The departments agree on the need for a course that addresses modern biology in the context of engineering applications."

Additional efforts are focused on revising the sequence and content of required courses in math and physics, which are taught in the College of Letters, Arts and Sciences. "We need to work with the math and physics departments to establish a better connection between what our students are learning there and the engineering coursework they're taking here," says Yortsos, who has initiated such discussions.

But the School is also intent on revising its own introductory courses, mindful that today's students respond better to action-oriented, hands-on experiences than to the traditional lecture format. Departments are being encouraged to stress laboratory experience, information technology, interaction and problem-solving modalities, as well as to use "out-of-the-box" thinking to restructure introductory courses so that they are more appealing and convey a clearer concept of what it means to be an engineer.

"These kids enter the university with the sense that engineering is about getting together, designing something, building it, tearing it apart," says Yates. "They come in and it's mostly lectures for the first two years. We need to capture their attention early so that they don't begin to question whether they're in the right place."

"Students today are very sophisticated," adds Yortsos. "They want to see real-world applications – how what they're learning fits into the big picture."

Sam Bagwell chose USC over other engineering schools because of its strength and flexibility. "I didn't want to become a number, another face in a crowd," he says. As a freshman, he has already enjoyed personal attention through his participation in the MERIT research program, working in a signal-processing laboratory with Antonio Ortega, associate professor of electrical engineering. Nick Danziger enrolled with the intent of majoring in engineering and minoring in business. In his first year, he has already built an autonomous LEGO robot and served as drumline cymbal player in the USC Trojan Marching Band; he is also interested in speaking to visiting high school seniors and helping with recruitment as a member of the Engineering Student Council.

Their interests and pursuits illustrate the niche that has helped USC's engineering school attract such a high-caliber freshman class: the ability to offer a broader, more well-rounded education than a more specialized campus such as Caltech, while providing more personal attention than can be afforded at larger campuses such as those in the University of California system.

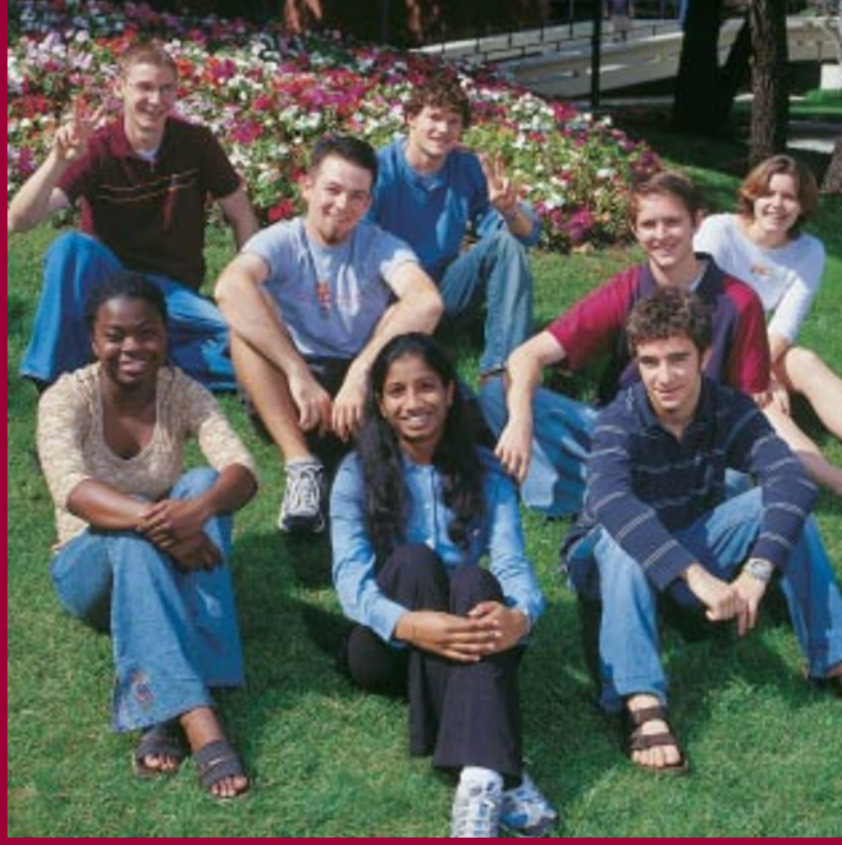
"Our students want to learn about more than just engineering," says Yates. "They're very service-oriented."

Yates also believes that, while today's students are better prepared academically than ever before, many have little notion of what engineering is about. "They don't realize that engineering gives you a skill set, a way to think about problems and look at things analytically that can open up so many career possibilities," she says. "They have this sense that all engineers sit around in cubicles, never talking to anybody else other than engineers." With that in mind, the school is piloting a program this spring to bring in working engineers to discuss their careers. "This will help our students gain exposure to how fun and exciting

*continued on page 28*

Yortsos and Yates photos by John Livzey and freshman photos by Michelle A. H. Smith

# Freshman Profiles



## Sarah Williams

Sarah Williams, computer science major with a 1450 SAT score, left the Bahamas and her family to face the double challenge of adjusting to collegiate life and to foreign customs. "I didn't want to do the typical thing Caribbean people do. I think they're scared of the West Coast. There are so many things you don't know about—housing, roommates, classes, professors, classmates. I was always wondering, 'Am I doing this right?' My first semester was really hard."

Originally from Guyana in South America, Williams has learned about more than just American culture. At Parkside International Residential College, she lives with students from around the world. "My roommate and I are such a good match. She's from Hong Kong, which opened the door for Chinese culture. Neither of us could pop home for a weekend. We were both pining for home." Williams' multicultural explorations led her to a French course. "The French class was great—I had so much fun."

Adjusting to culture and academics was hard, but Computer Science 101 proved an adventure. "You start off loving CS and all fired up about programming. Then you get the assignments. After all the debugging you wonder if this is really what you want to do." She has decided that it is. "There are so many options with my degree, and I'm still discovering new interests within computer science." Attracted to the School's multimedia program, she currently works in a network research lab through the Merit Research Program. "I really like my adviser, Farnoush Banaeia-Kashani, at the lab. He has a unique gift to break things down to a level a freshman can understand. Any time I have a question, he answers it perfectly."

Though homesick, Williams describes the difference between her first and second semesters as "stark." She feels more at home at USC now, and touts the diversity. "When USC says it's multicultural, they're not joking. I'm just so grateful that I've gotten a chance to get out and meet people from all over the world."

## Kellen Sick

"At the end of junior year, I wanted to stay on the East Coast—but the more I thought about it, USC Swimming is a top-five program in the country, Engineering is the second biggest school here and they specifically had aerospace engineering. Ever since I've been little, I've wanted to be a fighter pilot; past that, I can probably use my aerospace degree to design aircraft. My (high school) GPA was over a 4.0. I talk to my parents every now and then and hear how the weather's been for them—it's been snowing, and here it's 65 degrees and sunny. I can't argue with that; it's just another day in paradise, I guess.

"I swim the 100 butterfly and the 50 or 100 freestyle, mainly sprint stuff, and occasionally the 200 freestyle or 200 butterfly. Practice is usually twice a day, six days a week—it adds up to about 25 hours of practice (a week) or so. In terms of people in the dorms, when they hear 'aerospace engineer,' they think, 'Oh wow, that's rocket scientist stuff.' Any kind of degree that has 'engineer' attached to it, they think, 'Oh man, you must be smart.' It doesn't necessarily take someone overly smart; it takes someone dedicated to putting the time in.

"The feeling I got here is that professors are concerned about whether students are learning—'not am I just doing my job to get by, but am I actually teaching these students'. I've met with (Dean) Louise (Yates) quite a bit, for counseling and advice; whenever I have a question, even a really small one, I was never brushed off; someone can address it."

Kellen Sick is from Virginia Beach, Va.

Some of this year's freshman class. Pictured left to right: (bottom row) Sarah Williams, Sumati Bavisettey, Fima Macheret; (middle row) Nick Danziger, Sam Bagwell; (top row) Aaron Pipkin, Kellen Sick and Pamela Fox.

# Freshman Profiles

## Fima Macheret

In high school in Cincinnati, Fima Macheret, a 19-year-old chemical engineering major with an emphasis in biochemical engineering, grew to love science and math, especially calculus.

"I wanted to combine the two in a mathematical approach to science, which is engineering," he says. "My junior year, I got a brochure from USC, and I saw that they had a biochemical engineering emphasis. I didn't want to do straight BME or chemical engineering. So that's the first thing I found out about USC. You don't really hear that much about USC in the Midwest, which is a shame.

"When you come to college, there's nobody making you do work. You don't turn in homework on a daily basis, like in high school. The kids here want to help each other; the department wants to help you. My professors were really supportive. I've gone to a lot of teachers' office hours, especially my physics teacher, Professor Bickers. The workload is tough, but it's well worth it.

"The social life here is absolutely amazing. I work really hard. I study when I need to, I do my problem sets, but at the same time, I play hard. I see LA. I went on the Weekender. I try to do as much social stuff as I possibly can, because I'm from Ohio, and this is California!

"The Greek life here is awesome. I ended up joining a fraternity (ZBT), and it taught me to manage my work a lot more. You have fun with your fraternity brothers, but you also study with them, and it's a great experience.

"One of the things that makes the engineering school stand out is how much the engineering affairs office helps you. I can go in and get advisement, and they're so willing to help me—Dean Yates, Paul Ledesma, Monica de los Santos, Julie Phaneuf, Matt O'Pray, all of them. They hook you up with all the internships you ever need, and put you right on track."

## Aaron Pipkin

Aaron Pipkin was awarded the Presidential Scholarship upon entering USC to study electrical engineering.

"Ever since I was young, I've been surrounded by engineering. My father is an electrical engineer and my mother, civil. I've always been interested in computers; I took a number of computer courses when I was in high school, but wanted to know about what was inside them and how they really worked."

"My dad was steering me to attend UCLA. But the more we visited USC together, the more my mind changed. I came to the conclusion that USC really was the place for me. I'm very interested in music; one of the reasons I ended up at USC was the opportunity to take the minor in music recording, closely coupled to electrical engineering. I'm looking forward to beginning those courses; currently I'm taking the core engineering and general education requirements. My first semester has been pretty challenging: I took 19 units. It keeps me very busy, but I enjoy it. I've really enjoyed and gained from conversations with upperclassmen. They can offer a fresh perspective on professors and coursework that can help you make informed decisions."

Aaron particularly enjoys the opportunity for close faculty-student interactions. "I've got friends who ended up at Brown College, Berkeley, and UCLA. They say they're getting shuffled around in huge classes, taking mostly GEs, and becoming largely bored, seldom able to talk to their professors. I've gotten a lot of help from the offices in Olin Hall, too, in getting things accomplished and planning out my curriculum."

Freshman profiles by the staff of *Illumin,* a student website produced by the Engineering Writing Program under the direction of Steve Bucher."

## The Brightest & the Best *continued from page 26*

engineering can be," Yates explains.

The school also hopes that the creation of eight freshman academies, each with approximately 50 students, will improve retention. The first academy will be implemented on a pilot basis beginning this fall. "One of the things we felt was missing was the human equation," says Mendel. "This will help to develop a sense of community within the student cohorts."

The bottom line in all of the curricular changes, Mendel contends, is to live up to the expectations of a high-quality group of students. "If you have bright students as we do, it means you can raise the level at which you present the material," he says. "It means we can have important discussions and bring research and more advanced concepts into the classroom."

Yortsos believes the curricular changes will both capture the interest of the new students and give them the well-rounded education that will prepare them for a wide variety of careers, including leadership positions. "If you read the literature about engineering education and hear comments from employers, you know that there is a need to change things," he says. "We are confident that when we make the necessary changes, it will serve our students well."

# Building Custom-Designed Houses in 24 Hours

*Professor Berokh Khoshnevis*

USC School of Engineering researchers are at work on a fundamentally new construction technology for building houses and other structures, funded by a grant from the National Science Foundation.

"The goal is to be able to completely construct a one-story, 2,000-square-foot home on site in one day, without using human hands," says Berokh Khoshnevis, co-principal investigator on the project and a professor in the School's Daniel J. Epstein Department of Industrial and Systems Engineering.

The process, called "contour crafting," has already won two patents, attracted the interest of an internationally known architect and won a best paper award at an important recent robotics conference.

The NSF grant will support the scale-up of a system Khoshnevis has been working on for the past five years, since the idea came to him while smoothing plaster on his house. Contour crafting builds up shapes in layers by controlling the flow of liquid building materials with two movable, programmable, trowel-like tools deployed around a nozzle.

Khoshnevis has developed contour crafting machines to create smaller three-dimensional items in different shapes such as cubes and boxes, bowls or domes, cylinders, cones, cones coming out of boxes and rings or disks, which can be either geometrically regular or free-form. He has used materials including plaster, concrete, adobe, plastic and a paste of wood particles mixed with epoxy. Guided by computer programming based on CAD-CAM representations, the contour crafting nozzle-and-trowel system molds these materials into shape while they are still semi-liquid.

In order to perfect contour crafting programming and controls, Khoshnevis recently began working on the project at the School's Information Sciences Institute (ISI), a nationally recognized facility specializing in computer research.

Contour crafting is derived from an established technology called rapid prototyping. Rapid prototyping systems have similar computer-controlled head mechanisms that build up successive thin layers, usually of specialized or exotic materials, to create 3-D models, or prototypes. The prototypes then are used to make molds for casting or die-casting metal or plastic manufactured products.

*Contour crafting builds up shapes in layers by controlling the flow of liquid building materials with two movable, programmable, trowel-like tools deployed around a nozzle.*

The goal of contour crafting, by contrast, is not to make a prototype, but to create a finished product. The unique double trowels precisely control a flow of material from the nozzle and allow much cheaper and more durable materials to be applied in thicker layers.

Khoshnevis' contour crafting system has already made larger objects than other rapid prototyping systems. By making the nozzle still bigger and mounting it on a overhead gantry system, a six-cable "Robocrane" system or even on freestanding, wheeled robotic units, Khoshnevis believes contour crafting can erect building-sized structures, layer by layer. The NSF grant will give him the resources needed to test this theory.

In the first construction design he plans, the nozzle begins by creating a hollow wall outline about a foot wide, with each layer perhaps 6 inches high, through the entire footprint of the building, including external and internal walls.

On the next pass, the machine raises the hollow outline by another layer—while filling the hollow left after the first pass with more material. Repetition of the process creates a solid cement wall. The gantry system—an overhead beam mounted on two uprights, running on parallel rails—could create a succession of houses in a row, each programmed to have its own design. Speed is limited mainly by how fast each layer dries sufficiently to allow another to be put on top.

The system is flexible enough to handle additions to the basic scheme. For example, a robot arm can continually insert coils of steel rebar to make the wall stronger. Inserting hollow conduits, either vertical or horizontal, for wiring and plumbing will be easy, Khoshnevis claims.

Khoshnevis says the Pasadena-based California Institute of Earth Art and Architecture has offered a building site for a contour crafted adobe structure.

He acknowledges the scale-up of his

*continued on page 30*

Khoshnevis photo by Irene Fertik

## Building Custom–Designed Houses in 24 Hours *continued from page 29*

system will be a challenge. "We are talking about much larger machines, much greater volumes of material and working outdoors in less controllable environments." Still, while the practical problems are formidable, he says, "We have a working smaller-scale system, and there is no theoretical reason why a larger one won't work."

Houses or other buildings are not the only objects a contour crafting unit could construct. He believes it could just as easily build a road in a prepared bed, and more quickly than current road-building technology. And he believes it will work anywhere. In a recent paper, Khoshnevis proposed to use contour crafting to create structures on the moon.

Contour crafting already has attracted wide interest in the world of industrial design, construction and architecture. Venice, California-based architect Greg Lynn, who is part of United Architects, one of the six design teams that submitted proposals for rebuilding the World Trade Center, called the possibilities of the process "extraordinary for anyone in the design field. It offers a direct link between computer visualization and the real world."

Lynn, who drew international attention with his computer design architectural ideas at the 2000 Venice (Italy) Biennale of Architecture, has been developing a vision of what he calls "custom-designed, mass-produced houses, based on computer design tools" for years. Khoshnevis, after reading one of Lynn's articles on the subject, introduced himself and showed a video of the contour crafting process to Lynn's architectural group.

"Our response was, 'Here it is,' " Lynn recalls. "We knew it was inevitable that something like this was going to develop. We had been waiting for someone to take the initiative and do it."

The architect says the process not only held the potential of making building faster and freer for architects, but also opened new artistic vistas.

"Architects are now exploring a whole new family of shapes and forms. It's very difficult to realize these using conventional construction techniques. Aesthetically, there's a great potential to make things that have never been seen before," Lynn says.

Khoshnevis recently won a best paper prize for his paper setting forth the principles of house-scale contour crafting at the 19th International Symposium on Automation and Robotics in Construction, held in September 2002 in Washington, D.C.

Khoshnevis' co-investigator on the NSF grant is veteran robotics expert and National Academy of Engineering member George A. Bekey of the School's department of computer science. Another of ISI's internationally known robotics expert, Engleberger Prize winner Peter Will, also is collaborating with Khoshnevis.

Student Highlight

## MASTERS OF GOING FASTER

In a shed on the first floor of Parking Structure A, across from Olin Hall of Engineering at USC, sit a trio of dwarfish racecars painted in USC livery. Two are complete and still wear scars from campaigns of the past decade. The third racer is coming together as this issue of USC Engineer goes to press.

Thanks to generous funding provided by the late Dwight C. "Bill" Baum and his son, Dwight J. "Jim" Baum II, USC developed its first Formula SAE teams in the 1990s. The two decided to fund the racecar team when third-generation Trojan Dwight J. "Jim" Baum III (BSME '99) was an undergraduate.

"Programs like Formula SAE show there is light at the end of the tunnel for engineering students. It shows that being an engineer can be fun, not just solving problems every day in class," says the elder Jim Baum, who is business manager of Dwight C. Baum Investments in Pasadena.

The Society of Automotive Engineers sponsors the Formula SAE automotive engineering competition. Schools from around the world field single-seat "race cars" built to an exacting formula. Students are told to assume a manufacturing firm has engaged them to produce a prototype car for the non-professional weekend autocross market, also known as slalom racing. The firm is planning to produce four cars per day, and each should cost less than $25,000. Competing student teams attempt to design and fabricate a prototype that best meets these goals.

In slalom racing, cars race around orange traffic cones, usually set up in a parking lot or on a closed airfield. Speeds are relatively low and turns are extremely tight, with the emphasis on agility, balance and acceleration out of corners.

Entries are judged not only for on-track performance (many team members get a turn at the wheel), but also for the clarity of the team's business plan. The future engineers must manage an entire product development program with the same financial, quality, manufacturing, performance and design elements found in product development programs at car companies.

Winning Formula SAE team members are highly prized candidates for fast-track engineering and engineering management positions in the automotive industry. "In the business of automobiles, the innovators of the future are going to be the people who understand what it takes to build a vehicle and have experience in developing something unique," says Bob Lutz, General Motors vice chairman of product development and chairman of GM North America, in an interview with USC Engineer.

Will the USC team be successful at the competition in Detroit this May? USC is just returning to Formula SAE, and winning the Formula SAE laurels usually takes a multiyear effort, just like taking a Grand Prix racing team from midpack to the front of the grid, or revitalizing a car company. But don't be too surprised if, 30 years from now, one of our School's 2003 Formula SAE competitors is CEO or VP of advanced technology or head of motorsports at Ford, GM or DaimlerChrysler.

**The Team: Nathan Theiss (Engine Team Leader), Lawrence Lee, (Suspension Team Leader), Kevin Carney (Chassis Team Leader), Louis Flinn (Drivetrain Team Leader), Marc Bonifacio, Mike Boros, Chris Cheung, GarLun Chew, Robert Chung, Jim Danella, Chris Hutchinson, Vashte Johnson, Michael Losordo, Mike Mueller, Keith Nogueira, Gary Norris, Toufan Rahimpour, Kyle Sherk, Brad Tallon, Derek Thomas, Peter Zimmerman. Mechanical engineers Professor Paul Ronney, Associate Professor Dan Erwin and Materials Science Lab Manager Warren Haby provided support for the team.**

Racecar team photo by Irene Fertik

# Aircraft Accident Investigation

## LITTLE-KNOWN USC PROGRAM FINDS SUCCESS FOR HALF A CENTURY

Michael Barr is 5 foot 5_ inches tall, and that turned out to be important. By U.S. Navy standards, he is half an inch too short to fly, which is why Barr, a 1962 graduate of the Naval Academy in Annapolis, Md., opted to become a fighter pilot for the Air Force, where pilots are only required to be 5 foot 4 inches. In the Air Force, he flew F-100s and F-4s, and the F-4 is basically a Navy aircraft.

**Barr, one of the world's most respected aircraft accident investigation experts, is the director of the Aviation Safety Program in the USC School of Engineering.**

*Mike Barr is director of the School's Aviation Safety Program and a former Air Force fighter pilot.*

"It makes no sense at all," laughs Barr, who spent 23 "tall" years flying jet fighters for the Air Force and flew 137 combat missions in Vietnam. In the Air Force, he developed a reverence for safety, a knack for teaching and an almost mystical instinct for seeing why a multimillion-dollar aircraft had been accidentally turned into a heap of smoldering junk.

Barr, one of the world's most respected aircraft accident investigation experts, is the director of the Aviation Safety Program in the USC School of Engineering. This year he will retire from leading one of USC's most successful, least known and longest-running educational programs.

The classes are short, expensive and full. Almost none of the teachers have academic credentials, but the program sets the international standard by which other aviation programs are judged. Roughly 80 percent of all aircraft accident investigators in the United States, and about half of them in the world, have taken courses in this continuing-education program at the School of Engineering.

It began in 1952 after USC successfully bid on a contract to train Air Force accident investigators. Civilian courses began in 1956, while the Air Force courses at USC ceased in 1993. Barr went through the program in 1968 while he was still in the Air Force. When he retired from the military in 1985, he began working for USC, training Air Force accident investigators. He took over leadership of the program in 1993.

"Safety is always an issue in the aviation industry, so our courses are always full," says Barr, who in addition to directing the program is the lead instructor for the air safety management courses. "All of the major airlines and all of the regionals send people. We get students from the major aircraft and engine manufacturers. They come from government agencies like the Bureau of Land Management, NASA, Customs, the FBI, police departments, the Coast Guard—and we get tons of people from corporate flight departments."

All of the students are working professionals with several years of experience. Courses range in length from two to 10 days, and a student completing 200 hours of training receives a certificate in aviation safety. There are no plans to develop an aviation safety degree program, and courses are not offered to USC undergraduates.

"A student could complete all of the coursework, but with no real aviation experience he wouldn't be employable," Barr explains.

Aviation safety also goes on the road. "This year we have been to Hong Kong, Wright Patterson Air Force Base, Saab in Sweden, Mexico City and Trinidad," he says.

Barr finds instructors from the same set of people as the students, except they are more experienced and are actively working in the areas they teach.

"The two main accident investigation instructors are former NTSB (National Traffic Safety Board) accident investigators. My engine teacher is one of the lead investigators for General Electric engines. The human factors instructor is active with the Airline Pilots Association and he's also a pilot, a captain for U.S. Airways," Barr says.

These instructors, like Barr, continue to be active in accident investigations by working as consultants, usually for lawyers representing one of the many parties who have an interest in the investigation of an airplane crash. It would not be practical to use current NTSB investigators as instructors because those investigators can be called to accident scenes at any time.

The lone USC faculty member who teaches in the program is Najmedin Meshkati, associate professor of civil engineering, director of the School's continuing education programs and a safety expert. He teaches the human factors course covering the man-machine interface.

*continued on page 32*

Barr photo by Irene Fertik

**A typical class looks like a mini-United Nations. These are key people at an operational level who can make a real difference about safety in their airlines and in civil aviation."**

Meshkati, who teaches both undergraduates and graduates, says students in aviation safety are the toughest to teach because they are so professional and demanding.

"You must develop credibility with them, and they can be very critical in their evaluations," he says. "A typical class looks like a mini-United Nations. These are key people at an operational level who can make a real difference about safety in their airlines and in civil aviation."

Every day, Barr spends at least an hour on the Internet reviewing current accident investigations and exploring new accident prevention programs. He has become one of the media's most widely quoted aviation experts after airplane accidents, and he often works as an adviser for news organizations.

When the Concorde crashed in Paris in July 2000, Barr was the first to come up with the theory that the crash had been caused by a penetration of the fuel tank. He was advising a TV network at the time and called them just as they were about to go on the air with what Barr knew would be an inaccurate story.

What really happened? "A plane in front of the Concorde shed a piece of metal, which blew the tire on the Concorde," he says. "A piece of the tire hit the fuel tank with such force that it caused a shock wave that ruptured the tank. Then the hot parts of the tire ignited the fuel."

Barr is able to speak in soundbites for the media, using vivid metaphors to describe the challenge of an aircraft accident investigation: "It's like tossing a 1,000-piece jigsaw puzzle off the top of a 10-story building and then trying to find enough pieces to show you the picture."

The media began quoting him often following the TWA 800 accident in July 1996. All airplane crashes have high media visibility, a reality that all involved in the subsequent investigation must face.

"If good people don't give the media good information, they'll get bad information, or make it up. The media has a job to do and it is best to work with them. There are a certain group of people who appear after accidents on TV who are emotional and judgmental and who try to solve the accident in the first couple of hours," he says. There is a media course in the Aviation Safety Program where students learn how to handle the media without hurting their own company.

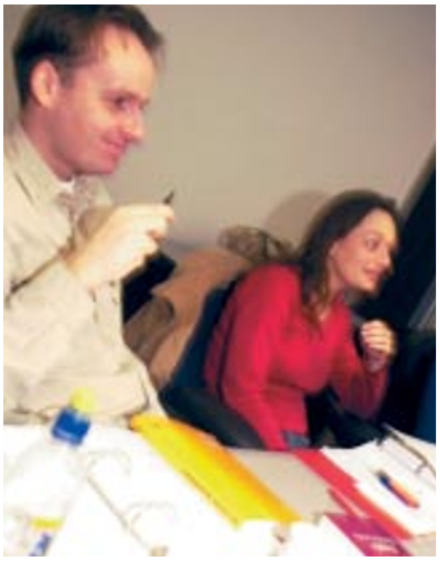
"The second reason I do interviews is that it really helps our program. I always insist that they put USC under my name. Once you appear on quality shows and newspapers, people put you in their Rolodex. It's good marketing."

Barr describes the TWA 800 accident as the most challenging aircraft disaster in his experience. The plane mysteriously exploded high over the ocean, 40 miles east of Long Island Sound. All ocean crashes pose the added burden of recovering wreckage from underwater. The investigators found as much of the plane as they could and re-assembled it. They found that the support beams around the center fuel tank were all bent outward, pointing to an explosion in the tank.

"If it had been a missile, some of those beams would have bent inward," Barr explains. "We don't know specifically what wire sparked the explosion, but it was in the fuel tank."

The lead NTSB investigator on that accident was Albert Dickinson, who will be replacing Barr as director of the USC program. Dickinson will go through the certificate program himself before taking over as director on August 1. Barr will reduce his workload in the program to half-time, continuing to teach all air safety management courses and doing his own unique brand of marketing for the program.

And the Aviation Safety Program, a mainstay at USC for more than half a century, will continue.



*Top and above: The School's Aviation Safety Program, which has trained aviation safety and crash investigators for more than a half century, has produced many if not most of the world's aviation crash investigators. In the past year, the program held seminars in Hong Kong, Sweden, Mexico, and Trinidad, in addition to its courses at USC.*

Student photos by Irene Fertik

# Sleepy Joe

## Michael Khoo Applies Engineering Tools to Sleep Apnea

*Professor Michael Khoo is a leader in sleep apnea research.*

In *The Posthumous Papers of the Pickwick Club*, published more than 150 years ago, Charles Dickens created a character named Joe, "a fat and red-faced boy, [often] in a state of somnolency," and constantly snoring. Dickens provided one of the earliest accurate descriptions of someone with severe obstructive sleep apnea syndrome (OSAS). Some of the most recent findings about this life-threatening condition come from Michael Khoo, professor of biomedical engineering at the USC School of Engineering.

"Imagine if throughout the night someone were to block your nose and mouth for 10 to 60 seconds every couple of minutes," Khoo says.

In a person with sleep apnea, he explains, that airflow blockage occurs when the pharynx (throat) collapses from the negative pressure caused by breathing in. Blood oxygen levels decrease, carbon dioxide levels increase and the individual makes greater efforts to draw a breath. But the stronger negative airway pressures heighten the collapse of the pharynx. It is like trying to breathe through a collapsed straw. The brain keeps signaling respiratory muscles to work harder, but no air gets into the lungs. Then the struggling subject briefly awakens and breathes. When sleep resumes, the apnea cycle repeats.

An estimated 18 million Americans suffer from sleep apnea. It is twice as common in African-Americans as in whites; oddly, the incidence in professional football players may be as high as 34 percent.

It should surprise no one that people with sleep apnea experience excessive daytime fatigue, frequently falling asleep. "Joe! Damn that boy. He's gone to sleep again," reads a line in Dickens' *Pickwick Club.* You would not want someone like Joe to be a long-distance truck driver or an airline pilot.

Other characters called Joe "young dropsy," a 19th-century term for people with swelling in the legs, a common symptom of congestive heart failure. Dickens was right on the mark. There is a link between sleep apnea and various forms of cardiovascular disease, including hypertension, stroke, coronary heart disease and congestive heart failure. The relationship between sleep apnea and cardiovascular disease is the primary focus of Khoo's research.

"During an apnea, blood oxygen concentrations can plunge to alarmingly low levels," says Khoo. Activity surges in the sympathetic nervous system, the network of nerves that mediate the "fight or flight" reflexes. Arousal from sleep further increases nerve activity, and blood pressure and heart rate rise as well. "We believe that long-term exposure to these repetitive surges leads the sympathetic nervous system to operate in a mode of permanent overdrive, which wreaks havoc on the cardiovascular system."

Physicians treat hypertensive sleep apnea patients with a mask-like medical device that administers continuous positive airway pressure (CPAP). The treatment lowers blood pressure, suggesting sleep apnea is the cause and not the consequence of high blood pressure.

Sleep apnea involves the dynamic interaction of three major physiological control systems—respiratory, cardiovascular and sleep regulation. Khoo is using mathematical modeling and control engineering to better understand that interaction.

"We developed a computer-controlled ventilator system that delivers a sequence of breaths with randomly modulated volumes. We then subjected normal and OSAS volunteers to this test protocol during wakefulness and different sleep states, at the same time recording measurements of respiration, heart rate and blood pressure," Khoo explains.

In the January 2003 issue of the *American Journal of Respiratory and Critical Care Medicine,* Khoo catalogued the dynamic characteristics of the major components responsible for regulating heart rate and blood pressure in sleep apnea patients and in a control group, during both wakefulness and sleep. This study, the first of its kind, was done at L.A. County/USC Medical Center in collaboration with physicians Ricardo Juarez and Ahmet Baydur.

In a previous study, conducted with physician Richard Berry of the Long Beach V.A. Medical Center, Khoo applied similar techniques to a group of sleep apnea patients receiving home CPAP therapy. "We found a substantial treatment-related improvement," Khoo says, "but only in those patients who, on average, used CPAP for at least three hours per night."

In another study, published in the February 2003 issue of *Sleep,* Khoo analyzed data recorded while the subjects were breathing spontaneously, without any external interventions. All were assessed using conventional noninvasive methods of cardiovascular function testing.

Khoo believes he has shown that a short, simple and noninvasive test can detect the harmful cardiovascular effects of sleep apnea and assess how well these effects are reduced during long-term treatment. Currently the severity of a patient's sleep apnea is assessed through a sleep study, allowing a physician to choose a suitable individual therapy. Usually, there is no follow-up to determine the treatment's effectiveness on cardiovascular function. "It is our hope," says Khoo, "that the future availability of a convenient and economical means of testing can fill this gap in the treatment of sleep apnea."

And poor creatures like sleepy Joe might see an end to their suffering.

Khoo photo by Irene Fertik

# Thomas O. Gephart, BSME '62

The Horatio Alger myth of the paperboy with gumption who builds an empire is exemplified by the life of Tom Gephart.

"I wanted a bike when I was a kid, bought with my own money—you know, independent money," laughs Gephart. "So I earned the cash with paper routes. When I was 16, I bought my own first car, a 1947 Pontiac convertible."

*Margie and Tom Gephart beside their 1929 Packard Opera Coupe, in the carriage house facility where the couple often hosts charity events.*

That same drive and energy gets Gephart out of bed at five a.m. to call investors in Europe. It keeps him running through the late afternoon and into the night, when he connects with investors in Asia. In between, he's staying in touch with managers at the more than 70 companies his venture capital firm, Ventana Capital Management LLC, has helped to build. "Our main emphases are in bio-pharmaceutical and very advanced high-tech communications and semiconductors, including wireless and detection technologies. We're also moving into MEMS and nanotech, and hope to see commercial realization within the near future."

Upon graduating from USC, Gephart worked at Hughes Aircraft just as the space program and defense were ramping up. He completed assignments quickly and well, but he wanted more. He had a knack for spotting clever ideas with commercial potential. Hughes sent the entrepreneurial dynamo back to USC for an MBA, but with only a few more courses to complete his degree, the ambitious Gephart left both Hughes and USC behind and branched out on his own.

## His First Company

"I was in a hurry to do things. A firm in Harrisburg, Pennsylvania, thought I could help them develop new products. That firm, AMP, is now the single largest company in the Tyco group, doing something like $5 billion a year. I brought them an idea that they didn't want to pursue. I asked if I could take it, and that's when I really started to do things on my own. I formed Interlink, built it up, then sold it."

That success led to the first iteration of Ventana, which began in 1974. The 1970s was a time when venture capital was scarce. Gephart's "angel group" began helping three or four companies a year get started.

"In the early days, we did things like wind farms with equipment from Denmark. We did a bit of everything, from defense-related industries to fairings for racing motorcycles," he says.

In the beginning, he did it mostly with his own money. By 1982, he knew he had to change if Ventana was going to compete in the high-stakes venture capital game. The Ventana Group mutated into Ventana Capital Management, which today works with investor and capital groups from across Europe, the Nordic Region, Asia and the U.S. It is Gephart's ability to work between start-ups and established firms that brings success. The start-ups have inventions, which he sees as the source of growth and wealth.

"We have a position with the big players so we can bring our small companies together with their money and their know-how. We're really involved as business builders and in the whole corporate structuring, not just providing finance. We see ourselves as integrators of capital with know-who and know-how."

His energy never seems to flag and he is always looking for opportunities. This spring, he plans to travel to New Delhi and Bangalore where Ventana has invested in a firm developing software for interactive television and broadband. He wants to see their facilities.

At times Gephart has linked a personal passion for high-performance cars with his business. His Orange County, California estate features a 15,000-square-foot carriage house and entertainment center where his collection of high-end finely crafted hot rods, and classic

*Gephart's flawless 1940 Ford Woodie, was created by Boyd Coddington, one of the world's leading builders of hot rods.*

and vintage Packard and Roll-Royces can be found. Most of his hot rods were built or at least partially built by Boyd Coddington, the Michelangelo of the hot rod world. Coddington cars meld the highest order of chopped, channeled, Frenched and slammed bodywork. They look like old-fashioned hot rods, but underneath they have the brakes, power steering, suspensions and sophisticated engines of the most modern performance and luxury cars.

Gephart has a flawless 1941 Ford Woodie wagon with a chop top, a 1941 Cadillac coupe, a 1929 Packard opera coupe, a 1949 Ford that any rebel with or without a cause would love, a perfect 1957 Chevy Bel Air and a 1961 Rolls-Royce Silver Cloud II. More than just a big garage, the carriage house also serves as a venue for the many charity events Gephart and his wife Margie host.

"All my cars have taken trophies, either at concours d'elegance competitions or at roadster shows. The black '34 Ford won the prestigious AMBR (America's Most Beautiful Roadster) and has turned heads for years. The '29 Packard opera coupe is a beautiful, eye-catching show piece. There is only a handful in this type of condition that still exist," he says. "The cars are all licensed. I drive them regularly. We took the dean to dinner in the '97 Rolls Silver Spur, which was a record-setting car at the largest gathering of Rolls Royces, and is listed in the Guinness Book of World Records."

Success also allows him to indulge other passions, such as collecting wines. He and his wife find time to roam the wine country in France, Spain and California's Napa Valley. Between them they have six children and nine grandchildren. You would think there would be no time left for the USC School of Engineering. But Gephart sees his role with the Board of Councilors as more than another passion and more than just love for his alma mater. He takes it seriously.

*continued on next page*

Gephart photos by Robert Peterson

# Elaine Masako Iba, MSEE '88

In her journey from science to softball to skeleton sleds, Elaine Masako Iba (MSEE '88) decided early on that "Carpe diem!" would be her lifelong motto. Now in her early 40s, Iba complements her cerebral engineering skills with competitive athletic talents that might make Annika Sorenstam (the Swedish golfer who will become the first woman in 45 years to play in a PGA tour event) blush. She holds two American track and field records, and was recently selected as a member of the USA Skeleton National Team.

Iba is a third-generation Japanese-American who grew up in Downey, California. "Ever since I can remember, I've been a Trojan fan," she says. "My father, Shozo Iba, received his BS in Biology and his MS in Microbiology in 1940 and 1941 from USC . He and his parents lived in a house on 36th Place near Normandie. When I was growing up and we'd drive into Los Angeles to see my grandmother, I'd always ask Dad if we could swing by USC to see the Tommy Trojan statue."

In the 1970s, the family held season tickets to USC football games, so Iba went to see Pat Haden, Anthony Davis and other Trojan greats play. Two of Iba's older sisters decided to attend USC: Nadine Iba received her bachelors and masters degrees in physical therapy, and Lynn Iba graduated from the School of Law.

Elaine Iba's route to a USC degree was more circuitous. She enrolled at California State University, Long Beach, where she enjoyed her classes in mathematics, physics and chemistry. A friend majoring in civil engineering steered her toward electrical engineering. Active in extracurricular activities, including Tau Beta Pi, Eta Kappa Nu, Mortar Board and Golden Key, Iba also was selected for the women's intercollegiate softball team, but stopped playing after she damaged her knee during a sorority football scrimmage.

Iba worked part-time as a student engineer at Hughes Aircraft Company, and was offered a full-time position when she graduated from CSULB with a BSEE in 1983. She eagerly seized the opportunity to apply for a Hughes fellowship that allowed her time off from work to attend USC engineering courses via a satellite link to the Hughes site in Fullerton. "I drove to USC to register and take tests, but the bulk of the courses were completed via satellite," she says. "This enabled me to get a quality education from a top-notch engineering university—while avoiding the commute from Orange County to Los Angeles."

Always looking for new challenges, Iba eventually left Hughes in 1996 to work for Silicon Systems Inc., which was purchased by Texas Instruments that same year. She also, at the age of 34, began competing in Masters track and field meets. "Participating in Masters track and field really opened doors for me," she says. "The pinnacle of my Masters experience was when I was invited to run an exhibition race at the 2000 U.S. Track & Field Olympic Trials. What an experience, to race in front of 20,000 spectators!"

While she was at the Olympic Trials, Iba noticed a flyer publicizing tryouts for a bobsled brakeman for the former USA Luge Olympian, Bonnie Warner. "I decided to go," Iba says, "because how many times do you get the opportunity to try out for a bobsled team?" Warner suggested that Iba's size made her more suitable for skeleton—a sport where athletes race face-first downhill at 80 miles an hour, on a three-foot-long sled, with their faces and toes mere inches above the ice.

*Elaine Iba with the tiny skeleton sled that carries her at speeds of up to 80 mph*

Once again, Iba decided to "seize the day." She flew to the Olympic Training Center at Lake Placid, New York even though she didn't know what a skeleton sled looked like. "I thought I'd regret it if I didn't go," she admits. After a brief training period, Iba placed fourteenth—not quite good enough to make the team, but enough to encourage her to keep trying.

Since those exhilarating days, Iba has suffered two serious blows: First, she lost her job when Texas Instruments closed its Tustin facility in 2001, and her father recently passed away after an unexpected illness, just as Iba was flying to Germany to compete in the Europa Cup.

But life must go on, and so Iba continues to look for work, while training and competing whenever she can. She placed eighth in the USA Skeleton National Team selection races last November, and 13th in the U.S. Championships this March. "My husband, Randy Messenger, has been wonderful in supporting all my activities," she says. "Now, I'd love to find an employer who'd allow me a flexible work schedule in the winter, and perhaps even help sponsor me!"

Who knows – with Elaine Iba's enthusiasm and talents, perhaps she will.

## Gephart *continued from page 34*

"Our company, Ventana, has successfully transferred highly advanced and experimental technologies out of universities and into commercial enterprises. University labs can be excellent incubators for technologies that can change the world," Gephart says. He believes there are technologies gestating in engineering labs at USC that are nearly ready for the great leap into the private sector, and he wants to help them make that leap.

"By generously sharing his wealth of knowledge about technology and commerce, Tom Gephart has already had a very positive impact on the School of Engineering," says Dean C. L. Max Nikias. "Together, I hope we can soon develop a program to move promising technologies out of USC and into the commercial sector." The dean knows if that anyone can help him do that, it's Tom Gephart.

# Farzad Naeim, MSCE '80, PhD CE '82

Farzad Naeim is vice president of John A. Martin & Associates of Los Angeles, one of the largest structural engineering firms in the country, and has served as technical director for analysis and design of numerous award-winning structures during the past decade.

One of his most colorful projects involved replicating the Eiffel Tower, at half-scale, for the Paris Hotel & Casino in Las Vegas.

Eiffel Tower II, as the project is known, received the Structural Engineering Association of California's (SEAOC) highest Award of Excellence in 1999, and the American Institute of Steel Constructors' (AISC) Engineering Award of Excellence in 2001.

The design and construction process involved complex technical and environmental issues, including the desert's extreme temperature changes, thermal stresses and the possibility of arson or terrorist attacks.

The 50-story re-creation of Gustav Eiffel's masterpiece utilized innovative welding and manufacturing technologies, creating an interior structure camouflaged with non-structural laces and more than 300,000 "fake" rivets, to mimic the tower's unique appearance. Plans for the 540-foot-high structure had to ensure that the elevator shaft was never more than one inch out of plumb, and that the tower would remain stable should one of its four legs be destroyed by fire. "One of the nicest things about the project was that I had the opportunity to visit the real tower in Paris a couple of times," says Naeim.

Naeim has directed other award-winning projects, including the seismic retrofitting of UCLA's Royce Hall, the Los Angeles Convention Center expansion, the California State University, Long Beach, University Events Center, and the Staples Center in Los Angeles—each of which received the SEAOC Superior Award of Excellence for structural engineering. Naeim currently is technical director for the dramatic design of the new Walt Disney Concert Hall in downtown Los Angeles, alongside fellow School of Engineering alumnus Vernon Gong (BSCE '84), who is the project's manager.

While working on the retrofit of Royce Hall, he proudly told his colleagues at UCLA, "See, you guys don't know what you're doing. It takes a USC engineer to fix your building!"

Naeim credits the training he received at USC Engineering for setting him on the path to success. His graduate adviser was Jim Anderson, professor of civil and environmental engineering, who became a father figure to Naeim. "I worked with Anderson on my dissertation, which dealt with modifying a computer program for creating complex structures," he says. "On my first day at Martin & Associates, they asked me to help with a computer program that had been giving them trouble for some time. In two days, I had it up and running."

Since then, Naeim has developed more than 45 software systems for earthquake engineering applications, and is a nationally recognized authority on the evaluation of design ground motion issues as they relate to the design of structural systems. He has performed seismic static and dynamic nonlinear analyses for such landmark structures as the Los Angeles City Hall and UCLA's Royce Hall and Knudsen Hall. He conducted investigations of the 1994 Northridge earthquake and the 1999 Taiwan earthquake, and edited the first and second editions of "The Seismic Design Handbook," used in all major U.S. universities.

Naeim calls his wife, Fariba, "the best thing that ever happened to me!" They have two children, daughter Mana, 12, and son Mahan, 7.

*Farzad at the base of Los Angeles City Hall after it was retrofitted with a complex base isolation system to enhance its earthquake safety. One of the isolators is apparent behind him. Farzad was the chair of the peer review committee for the project.*

## Alumni Relations Advisory Board

The Alumni Relations Advisory Board (formerly called the Dean's Circle Leadership Committee) is made up of alumni, friends and supporters of the School of Engineering. They have been instrumental over the past several months in helping to spearhead and create new activities and programs for alumni, including the future return of the Engineering Alumni Association. The School is grateful to them for their council, advice and commitment.

**Walter Babchuk**, BSCE '51
**Jack K. Bryant**, MSCE '60
**T. Page Eskridge**, BSEE '57
**Charles P. Flanagan**, BSCE '45
**Samuel H. Giesy**, BSISE '50
**Paul E. Iacono**, BSCE '44
**Roy Johnston**, BSCE '35
**Anthony D. Lazzaro**, BSISE '49
**Gerald J. Lopopolo**, BSEE '89
**John D. McConaghy** (Chair), BSME '66
**Gary D. McCormick**, BSCE '64
**C. Larry McMillan**, BSME '60
**Daniel R. Nelson**, MSEMT '89
**Loren C. Phillips**, BAPHIL '85
**Dena M. Scaffidi**, BSBMME-99
**Marvin S. Stone**, BSEE '62
**Timur Taluy**, BSEE '98
**Glenn R. Tanner**, BSME '77
**William C. Taylor**, BSISE '73

# SIGNS THAT YOU ARE A USC ENGINEER...

- You can type 70 words per minute but can't read your own handwriting.
- You sit backwards on the Disneyland rides to see how they do the special effects.
- You can calculate how many seconds the USC Fight Song is played per football game.
- The salespeople at Radio Shack can't answer any of your questions.
- You know what http:// stands for.

- You can predict Traveler's lap-time around the Coliseum based on his trajectory from the tunnel.
- You are at an air show and know how fast the skydivers are falling.
- You still own a slide rule, and you know how to use it.
- Your spouse hasn't the foggiest idea of what you do at work.

- You've calculated the average number of USC license plate frames you see on your daily commute.
- You see a good design and still have to change it.
- You actually understand the BCS statistics and formulas.

## And the number one sign that you are a USC Engineer...

- You are a member of the USC School of Engineering Dean's Circle!

**Help shape the future of USC Engineering** as a part of the Dean's Circle, the School's premier academic support group. Concurrent membership in the USC Associates, the University-wide academic support group, is automatic for annual Dean's Circle members. Matching corporate gifts count toward membership.

Please take a moment to send your support in the attached postage-paid reply envelope. If you have questions or need further information or assistance, please contact Lisa Van Ingen Pope at vaningen@usc.edu or 213/740-4879.

# snapshots

*USC School of Engineering Events*
*Winter 2002 & Spring 2003*

*Dean Nikias and the event's co-host Oliver Muoto (BSISE '92) in San Francisco.*

## San Francisco Weekender Reception

Over 70 alumni, parents, corporate representatives, and friends of the USC School of Engineering gathered at the Hyatt Regency San Francisco to celebrate the USC Weekender and to hear of the latest engineering achievements from Dean Nikias. Held on Friday, November 8, 2002, the event was co-hosted by local alumnus and entrepreneur, Oliver Muoto (BSISE '92), co-founder of Epicentric Inc. Immediately following the reception, the group joined hundreds of fellow Trojans in Union Square for the Spirit of Troy pep rally. The USC Trojans went on to trounce the Stanford Cardinals, 49-17, in Palo Alto, California.

*Bea McMillan, grandson Mark McMillan and son Bill McMillan (BSME '83) at the 2002 Homecoming celebration.*

## 2002 Homecoming

The School of Engineering 2002 Homecoming and Reunion Celebration was held on Saturday, November 16. Dean Nikias joined nearly 200 engineering alumni, family and friends for a home-style barbecue picnic on the south lawn of Doheny Library. A benefit drawing was held to support the Engineering Scholarship Fund that included a variety of USC Trojan prizes including School of Engineering hats, alumni license plates, t-shirts and stadium blankets, which came in handy on the brisk, fall day. The festivities continued at the Los Angeles Coliseum as the USC Trojans defeated the Arizona State Sun Devils 34-13.

*Niki Nikias, Charles B. Evans (BSEE '48) and Rose Marie Evans at the holiday dinner at Shutters in Santa Monica.*

## Holidays with the Dean

Dean Nikias, his wife Niki, and other School of Engineering officers, toasted the 2002 holiday season with alumni and friends at dinner parties in Newport Beach and Santa Monica.

*Ann Stone (BSEDUC '63), Marvin S. Stone (BSEE '62, MSEE '65, PhD '69), William N. Rowley (BSME '55, MSME '64), Ruth Ann Rowley and Lisa Van Ingen Pope at the Santa Monica dinner.*

*Celebrating a continuing partnership, IMSC and Lockheed Martin.*

*Dean Nikias, Coach Pete Carroll and Ron Barnes (BS ACCT '76) at Papadakis Tavern.*


*Dean Nikias, Robert Keady and Seoung-Yong Hong at the first board meeting of the Pratt & Whitney Institute for Collaborative Engineering.*

## Lockheed Martin Winter Visit

On December 19, 2002, representatives from Lockheed Martin presented IMSC Director Ulrich Neumann with a check to support the research of the center and extend their membership in the IMSC Industry Affiliates Program. Pictured left to right are Cindy Campos, campus relations manager-west region, Lockheed Martin; IMSC Director Ulrich Neumann; and Gary L. Hafen, manager, Software Engineering Technology, Advanced Development Programs, Lockheed Martin.

## Papadakis Tavern: Alumni meet Coach Carroll

On Saturday, January 11, 2003, Dean Nikias hosted a small group of School of Engineering alumni at head coach Pete Carroll's football recruiting dinner at the Papadakis Tavern in San Pedro. John Papadakis, former USC football player (1968-72) offered his restaurant for Carroll, current team players and about thirty recruits and their families. This evening was one of a handful of recruiting events that lead to the Trojan's No. 1 collegiate recruiting class for the 2003-2004 season.

## Pratt & Whitney Institute for Collaborative Engineering Board Meeting

Representatives from Pratt & Whitney, Inha University, Korean Air and the USC School of Engineering met at the School for the first annual board meeting for the Pratt & Whitney Institute for Collaborative Engineering (PWICE) on January 29. The new institute will work on research and teaching missions, including distance education, for the benefit of all of the partners. Chaired by Robert Keady, vice president, Asia/Pacific, Large Commercial Engines at Pratt & Whitney, the board funded the institute's first research project, which will focus on technologies to enhance aircraft maintenance.

## David M. Wilson Associates Holiday Party

The David M. Wilson Associates, USC's civil/environmental engineering support group, gathered on December 22, 2002 for its annual holiday party. For the second consecutive year, the event was hosted by Ted (BSCE '43) and Ruth McConville at their home on Balboa Island in Newport Beach, California. The yearly Christmas Boat & Light Parade around the bay draws thousands every year and was enjoyed by the over 50 alumni, friends and their families who were in attendance.

*Members of the David M. Wilson Associates celebrate the holiday season together.*

*Timur Taluy (BSEE '98) right, and Stephen Mosker (BAPOSC '97) at the Ventura alumni reception, "A Taste of USC".*

## A Taste of USC

On February 7, the School of Engineering and the USC Alumni Association co-hosted "A Taste of USC," an alumni reception in Ventura, California featuring remarks by Dean Nikias and a wine tasting of the first portfolio USC wine collection. The event was held at Top of the Harbor at the Holiday Inn in Ventura, which provided a stunning sunset-view over the Pacific. President of the USC Club of Ventura, Russ Doyle (BSBUAD '78) introduced Dean Nikias, who spoke about the School's recent accomplishments and collaborative research with other USC departments. Over 80 guests attended the event, which in addition to engineering alumni included USC alumni from several other schools.

*During his trip to San Diego, Dean Nikias met with Harold L. Potter (BEME '57) and his granddaughter Bridget Bristow for a lunch meeting.*

## San Diego Alumni Reception

President of the USC Club of San Diego and engineering alumnus Carl Sarrazolla (BSEE '84) helped to organize and co-host a successful alumni reception in San Diego on February 27. The event was held at the San Diego Historical Society Museum in conjunction with its exhibit "Filming San Diego: Hollywood's Backlot," which detailed the history of San Diego and the movies. To complement the exhibit, Dean Nikias presented remarks entitled "Time for a New Hollywood," which outlined the future of Hollywood in a digital era. President-Elect of the USC Alumni Association and USC Trustee Ann Hill introduced Dean Nikias and welcomed the 90 guests in attendance.


*Randolph Hall, senior associate dean for research, spoke about the National Science Foundation budget at the School of Engineering Research Retreat held March 7.*

## Research Summit

Randolph Hall, senior associate dean for research, lead the School's annual research retreat held on March 7 at the Omni Hotel in Los Angeles. This year's retreat, "Extending the Boundaries of Engineering," was highly interdisciplinary, with many scientists from industry, the Keck School of Medicine and the College of Letters, Arts and Sciences joining engineers from the Al Mann Institute, the Information Sciences Institute and other School departments. The summit featured panels focusing on bioengineering, information technology and security and homeland defense. Steve Laderman, research and development manager of Agilent's Molecular Diagnostics Department, was the luncheon speaker.

20th Annual Orange County Executive Briefing Series 2003

## Orange County Executive Briefing Series

As part of the 20th Annual Orange County Executive Briefing Series, the USC School of Engineering presented Dean C. L. Max Nikias and a panel of academic and corporate experts speaking on "Technologies Driving Economic Recovery: Biotech, Infotech and Nanotech." Over 80 guests gathered at The Pacific Club in Newport Beach, California on the evening of Wednesday, March 12. Panelists included Dr. Priya Vashishta, professor of materials science at the USC School of Engineering; Dr. Brian M. Pierce, executive director of electronics for Rockwell Scientific Company; Dr. Ulrich Neumann, director of the Integrated Media Systems Center at the USC School of Engineering; Scott Shoults (BSEE '88), director of engineering, MRRBU, at Cisco Systems Inc.; Dr. David Z. D'Argenio, professor and Dwight C. and Hildegarde E. Baum Chair of biomedical engineering at the USC School of Engineering; and David W. Chonette (MSME '60, ENGME '64), general partner with Brentwood Venture Capital and adviser with Versant Ventures. The event was sponsored in part by Raining Data Corporation of Irvine, California.

# MARK YOUR CALENDAR!

Scheduled Events for Spring and Summer 2003

*Please call External Relations at the School of Engineering at 213/740-2502 for more information about these and additional future events. This list does not include all events scheduled.*

## Society of Hispanic Engineers-Mentoring Day
**April 18, 2003**
Time and Location TBA

## 25th Annual Engineering Awards Luncheon
**Honoring distinguished alumni and featuring special guest speaker, Steve Forbes**
**April 25, 2003**
11:00 am Reception
12:00 pm Luncheon and Program
Millennium Biltmore Hotel
Downtown Los Angeles

## Trojan Founders Circle Luncheon
**April 29, 2003**
11:00 am
Town and Gown
USC Campus

## Staff Recognition Luncheon
**April 30, 2003**
12:00 pm
Town and Gown
USC Campus

## Ronald Tutor Hall
**Ground Breaking Celebration**
**May 5, 2003**
11:00 am Reception
11:30 am Groundbreaking
South of Olin Hall *(future building site)*
USC Campus

## Student Recognition Program
**Acknowledging student leaders and graduating seniors**
**May 5, 2003**
Time TBA
Upstairs Commons
USC Campus

## W.V.T. Rusch Engineering Honors Program Senior Luncheon
**Honors program for graduating seniors**
**May 15, 2003**
11:00 am to 12:30 pm
Garden Court, Upstairs Commons
USC Campus

## USC Baccalaureate Ceremony
**May 15, 2003**
5:00 pm
Bovard Auditorium
USC Campus

## 2003 Commencement
**May 16, 2003**
9:00 am University Ceremony
Alumni Memorial Park
USC Campus

## 2003 School of Engineering Commencement Ceremony
**May 16, 2003**
10:30 am Undergraduate Ceremony
2:30 pm Graduate Ceremony
Archimedes Plaza
USC Campus
*Receptions will immediately follow the ceremonies*

## 6th Annual Conference on Teaching, Learning, & Technology
**"Transforming the Curricula for Today's Students"**
**May 19 - 20, 2003**
8:30 am to 4:30 pm
Davidson Executive Conference Center
USC Campus
*For more info go to www.usc.edu/tlt2003 or call 213/821 1336*

## School of Engineering Board of Councilors Retreat
**June 8, 2003**
5:00 pm
Private Home

## Dean's Circle Annual Dinner
**May 2003**
Date and time TBA

## Dean's Circle Hollywood Bowl Night
**July 2003**
Date and time TBA

*If you would like to work with the Alumni Relations office at the School of Engineering to help organize an alumni reception in your area, please contact our office at 213/740-2502.*

USC SCHOOL OF ENGINEERING

# Y. H. Cho
# A Celebration of Life and Engineering

*Cho and his wife Myong Hee enjoy the evening's program.*

*Cho's children, Heather, Emily and Walter help to honor their father.*

On January 29 at the Regent Beverly Wilshire Hotel in Beverly Hills, California, the School of Engineering honored Yang Ho "Y.H." Cho for his role in creating the new Pratt & Whitney Institute for Collaborative Engineering. Approximately 300 guests, including corporate executives from Pratt & Whitney and Korean Air, members of the local Korean community, the Cho family and senior administration, faculty and students from USC and Korea's Inha University attended the event.

"Y.H. is a great bridge builder and he is the person most responsible for the creation of this new institute," said Dean C. L. Max Nikias. "The institute is a bold partnership between Pratt & Whitney, Korean Air, Inha University and the USC School of Engineering. It will help us build an engine of discovery and supply new ideas that will enable each of us in the partnership to leapfrog our competitors."

Cho is the chairman of Korean Air, and a member of the USC Board of Trustees and of the School of Engineering's Board of Councilors. He also chairs Inha University's Board of Trustees.

*Y.H. Cho receives an honorary gift from USC President Steven B. Sample.*

USC President Steven B. Sample said the institute, which exemplifies USC's strong commitment to international research and teaching, would forge another bridge between Southern California — the American gateway to the Pacific Rim — and Inha University.

"Y.H. Cho exemplifies the very essence of what it means to be an engineer and a leader for engineering education in the 21st century," said Sample, adding, "What a great alliance of academe and industry!"

Bob Leduc, executive vice president and chief operating officer of Pratt & Whitney, said the institute was a mutually beneficial collaboration for international research and teaching that would develop new technology, particularly information technology, and would foster closer ties between Pratt & Whitney and one of its long time customers, Korean Air.

"This is a tremendous example of synergy among leading institutions in industry and education and I'm thrilled to be part of it," said Leduc. "Creative as always, Y.H. has managed to tie all of these interests together. This will pay big dividends, not just for the companies and universities involved, but for the American and Korean peoples."

In addition to the remarks, the audience was treated to a video about the new institute and the activities surrounding the signing of the memo of understanding in Korea on June 10, 2002.

Accompanying Cho to the dinner were his wife Myong Hee, and three children, Emily (Hyun-Ah), Heather (Hyun-Min) and Walter (Won-Tae). Another video was presented for the Cho family, this one a short emotional tribute to Choong Hoon Cho, father of Y.H., and a legendary Korean transportation pioneer who died last November.

"As you can tell, I'm a big fan of USC's School of Engineering," said Y.H. Cho. "Engineering sets us up with basic disciplines. It teaches linear, logical thinking. That's a big advantage in the business world.

"I am also a big fan of our new Pratt & Whitney Institute and what it can do for our schools, businesses and countries. The sharing of educational talents and resources can make this a better world and can form the basis of successful alliances."

## Board of Councilors News

School of Engineering BoC member **Alexis Livanos** joined Northrop Grumman as vice president of program operations on February 17, 2003. Mr. Livanos will report to the president of Electronic Systems. Livanos will also be assigned to oversee all development programs at the Navigation Systems Division. He will serve as a member of the Sector Policy, Leadership and Executive Councils. Before joining Northrop Grumman. Livanos served as the executive vice president for Boeing Satellite Systems, where he provided strategic direction for Boeing's research and development efforts. He also supervised all technology-related activities within Boeing Satellite Systems.

# Alumni news & notes

*Winter and Spring 2003*

## 1957

**Richard K. Smyth** (MSEE, PhD EE '63) recently returned to California after spending sixteen years in Malaga, Spain, where he wrote books and software on options trading.

## 1969

**Claude Harding McMillin** (MSISE, ENGIE '72) retired from Hughes Aircraft Company Missile Division in 1981, and then returned for a time to do consulting engineering work on computer cost models. Claude now lives on the island of Kauai in Hawaii.

## 1972

**Harvey Gobas** (BSCE, MSENV '75) is currently serving as president of the Los Angeles Section of the American Society of Civil Engineers (ASCE). This is ASCE's largest section, serving over 7,000 assigned members in nine California cities. Harvey was also recently elected vice president of the Southern California Chapter of the American Public Works Association. Harvey organized the "Summit on Los Angeles County Infrastructure" which was held on March 12 at the USC campus. Over 200 people attended the Summit.

**E.P. Hamilton III** (BSEE, MSEE '74), professional engineer, lives in Pflugerville, Texas, and is president of E.P. Hamilton and Associates, Incorporated.

## 1977

**Michael Alderete** (BSME) is currently a mechanical packaging engineer at DRS Technologies, Sensors and Targeting in Anaheim, California.

## 1978

**Kenneth W. Mei** (BSCH) is the measurement consultant for refining, supply, and distribution with Saudi Aramco in Damman, Saudi Arabia. Before joining Saudi Aramco, Kenneth provided technical consultation to clients within the Chevron Corporation and its subsidiaries worldwide.

## 1979

**Cyrous Adami** (MSCE, PhD '82), professional engineer, was recently appointed the building commissioner for the Board of Building Appeals for the City of Manhattan Beach, California. In August 2002, he received a certificate of recognition from the city council of Manhattan Beach. Cyrous' third son, Sean Amir, was born in May 2002.

## 1980

**Paul L. Livio** (MSEE) has decided to pursue teaching and is currently studying toward a teaching credential.

**Morad Madjlessikupai** (BSME) is chairman of Kerman Motor Company in Tehran, Iran.

**Hiram Willis** (BSEE '77) is Smart Chip Technologies' new president and chief executive officer. Smart Chip Technologies is a pioneer in the high-growth smart card and smart device market.

Willis is an internationally respected technology executive, who is both an INC 500 President (#401) and New York Fortune 50 president (#13), and brings 23 years of successful business, financial, and marketing expertise to SCTN.

Smart Chip Technologies (www.sctn.com) is a software technology company with a "gateway" patent and smart card loyalty system for banks, credit card issuers, retailers, and OEMs. Willis has joined SCTN to spearhead financial and market growth opportunities.

"As the new CEO, I look forward to implementing SCTN's compelling financial and marketing strategies targeted at building the share price and value," he says.

Willis holds an AMBA and MBA in finance from the P.F. Drucker Graduate School of Management at Claremont Graduate University. When at USC, in addition to his busy schedule as an engineering student, Willis was the editor of this magazine's predecessor from 1975-77, the popular *USC Engineering* newsletter.

Willis lives in California's Silicon Valley with his wife Carol and his three children, twins Kyle and Kellan, 18, and daughter Ariel-Tyler, 13.

## Alumni in the News

*Mortgage Originator* magazine selected **Joe Siau** (BSISE '86) to represent the U.S. lending industry as the most successful loan officer in September 2002. Candidates had to personally close at least 120 loans and $10 million in volume over a twelve-month period. Joe Siau closed 148 loans with a dollar volume exceeding $25 million from June 2001 to June 2002.

Siau paid his way through engineering school at USC by selling books and bibles door-to-door. He made 30 sales presentations per day, six days a week. "As I look back, that was one of several pivotal moments toward my career success," says Siau. "It taught me to be 100 percent service-minded and to focus on the customer."

After graduating with a degree in industrial and systems engineering, Siau worked in his family's importing business. Before becoming an originator, he worked for the Department of Defense, served on a credit union mergers and acquisitions team, sold real estate, prepared taxes, and was an engineer and manager for IBM and Hewlett-Packard.

### 1982

**Marco A. Papa** (MS, PhD CSCI '88) is the deputy director at the Superior Court of California and manager of the Case Management Systems Application Group. He is responsible for management, systems development and maintenance of all case management systems (such as criminal, civil, juvenile, traffic, etc.) for the Los Angeles Superior Court.

### 1985

**David C. Miller** (MSSM) recently joined NCI Information Systems Inc. as the director of Air Force business development. NCI Information Systems Inc. is one of the fastest growing information technology organizations in the U.S.

**Dean Tateyama** (BSEE) lives in Escondido, California and is an infrastructure technologist for San Diego Gas and Electric.

### 1989

**Eric L. Tanezaki** (BSME) is a patent attorney and was recently named a principal of Stetina, Brunda, Garred & Brucker, P.C., which is an intellectual property law firm in Aliso Viejo, California.

### 1990

**Mark Harold Russell** (MSEE) is a senior management specialist for the Boeing Company in Anaheim, California.

### 1992

**Chrisann Travlos** (MSEE) married Michael Torrelli on December 8, 2002.

**Keno Wai-Ki Yeung** (BSEE) is the senior staff design engineer at Broadcom Corporation in Sunnyvale, California. His daughter Emily was born on April 10, 2002.

### 1995

**Shamus Russell Carr** (BSBME) and Elisabeth Montgomery Dial were married on March 1, 2003 at St. David's Episcopal Church in Wayne, Pennsylvania.

**Phit Simahawong** (MSEMT) lives in Bangkok, Thailand, and is a department manager for Merck Limited.

**Alex Soriano** (BSBME) will be graduating this spring from the MBA program at the University of Michigan. After graduation, he will be a product manager for Guidant Corporation's Cardiac Rhythm Management Division.

### 1996

**Joe A. Tellez** (BSISE, MSSAE '99) was promoted to software project manager of Sempra Energy in August 2002. He has been an adjunct professor for the University of Phoenix since March 2002. Joe married Danielle Ybarra in December 2002.

### 2000

**Brianne Gibson** (BSENE) lives in Redondo Beach, California and is an assistant engineer for Waterstone Environmental.

Sangram Jadhav (MSCSCI) lives in Jersey City, New Jersey, and is a consultant for Deloitte Consulting in New York City.

### 2001

**Trina Henry** (BSCSCI) lives in Encino, California and is a business and development assistant for the Center for Early Education.

### Staff News

**Annette Blain** (BFATHAC '94), director of alumni relations in the engineering office of External Relations and editor of *USC Engineer,* along with her husband Marc Blain and daughters Margaux and Ella, celebrate the birth of their son Joseph Philip on March 22, 2003.

This edition of class notes includes updates received between October 2002 and March 2003.

**Our Apologies:** From November '02 to March '03 there was a technical error with our on-line update form. If you tried to update your contact information or send a class note during that period, we apologize for the inconvenience and hope you will visit our site again and re-submit your information.

Please keep us informed of your personal and professional progress, as well as changes in your contact information by visiting www.usc.edu/engineering and clicking on Alumni. Or by writing to the Alumni Relations Office at the USC School of Engineering, Olin Hall 300, Los Angeles, California 90089-1454

# Alumni Recognition

**Joseph W. Niesen** (PhD EE '96) has recently been named a Boeing Associate Technical Fellow in recognition of his "technical contributions and his capability to expand those contributions to the greater Boeing community." An indicator of the significance of being a Boeing Fellow is that for Niesen's Southwest Region, Fellows constitute less than 3% of the entire technical community. Niesen's reclassification as an Associate Technical Fellow took place in January and he was honored with a recognition award in March.

Niesen attended USC from 1991 to 1996 on a TRW Doctoral Fellowship. His course work was focused in communication systems, and he performed his doctoral work under Dr. Irving Reed in the Communication Science Institute in the electrical engineering systems area at USC.

As an Associate Technical Fellow, his technical specialty is wireless communication systems. "This award was enabled by the strong theoretical foundations in communication systems given to me by the distinguished faculty in EE Systems CSI and SIPI at USC," says Niesen.

President George W. Bush recently honored **Robert M. Gray** (PhD EE '69) with a 2002 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring. This award recognizes organizations and "individuals who have demonstrated a commitment to mentoring students and exciting America's youth about science, mathematics and engineering" by providing encouragement and guidance to traditionally underrepresented students. The annual award is administered by the National Science Foundation. Gray was one of ten outstanding individuals who received a $10,000 grant and a Presidential commemorative certificate during a ceremony in Washington, D.C. on March 18.

In April, the USC School of Engineering will honor Gray with its Distinguished Alumnus Award in Academia, at the School's 25th annual awards luncheon. He has received numerous awards throughout his career, including a Centennial Medal and Third Millennium Medal from the IEEE. He has also served on the Board of Governors of the IEEE's Information Theory Society and its Signal Processing Society.

At USC, Gray worked with Professor Robert Scholtz in the area of Shannon information theory, and spent two summers working at Jet Propulsion Laboratory (JPL). Upon receiving his PhD, Gray accepted a position at Stanford University, where he is currently professor and vice chair of the department of electrical engineering.

On January 22, DataLogic International Inc. announced that it had appointed **Moe Z. Win** (MSEE '89, PhD EE '98) to its board of advisers. He will act as a consultant for the company in the medical/healthcare and technologies-related areas. DataLogic is a professional service company dedicated to solving its clients' business problems with technology-based solutions.

Win received his MS degree from USC in electrical engineering and as a Presidential Fellow, he received both an MS degree in applied mathematics and a PhD degree in electrical engineering.

In 1987, Win performed research on digital communications and optical systems for NASA space exploration missions at the Jet Propulsion Laboratory (JPL), California Institute of Technology. From 1994 to 1997, he was a research assistant with the Communication Sciences Institute at USC, where he played a key role in the successful creation of the Ultra-Wideband Radio Laboratory. Since 2002, he has been with the Laboratory for Information and Decision Systems (LIDS), Massachusetts Institute of Technology, where he holds the Charles Stark Draper Chair.

## In Memoriam

**Richard Douglas Chamorro** (BSPHYS '51) recently passed away. Richard taught at the School of Engineering for many years. He is survived by his wife Teresa, three children, Douglas, Cydney, and Adam, and two grandchildren.

**Milton Wickers Davis Jr.**, 79, of Sea Pines passed away on Monday, March 3, at Hilton Head Regional Medical Center in Hilton Head Island, South Carolina. Milton was a distinguished professor emeritus of chemical engineering at USC, when he retired in 1988. He served as a chief engineering officer in the Navy during World War II and earned thirteen Battle Stars. He is survived by his wife Harriett Powers Davis, two sons, Shelley and Primrose, and four grandchildren.

**Harvey Duncan** (BSEE '48, MSEE '57) of Minden, Nevada passed away on January 26, 2003. He is survived by his wife Sophie, four children, and eleven grandchildren.

**Jerauld Richard Gentry** (MAOM '70) passed away on March 3, 2003 at Inova Alexandria Hospital in Alexandria, Virginia at age 67. Jerauld was a retired Air Force colonel and decorated Vietnam War veteran. He is survived by his wife Anne Rogers, two sons, Jeffrey and Alan, and three grandchildren.

**Donald Hess** (MSCHE '56) passed away on March 5, 2003 at age 71. He is survived by his wife Elizabeth, six children, and nine grandchildren.

**Byron G. Johnson** (MSSM '84) passed away on October 17, 2002 at his home in Gainesville, Virginia at age 55. Byron was a retired Air Force lieutenant colonel and former civilian Pentagon consultant. He is survived by his wife Gail, two children, Matt Johnson and Jennifer Higginbotham, and five siblings.

**James Eric Maass** (BSCH '66) passed away on March 14, 2003 at Rex Hospital in Raleigh, North Carolina at age 60. He is survived by his wife Barbara, three children, Jeffrey Maass, Julie Solovavy, and Elana Mesmer, and two grandchildren.

**Donald Lee Matson** (BSCHE '54, MSCHE '58) passed away on October 22, 2002, in Boston, Massachusetts. Don worked for Mobil Oil for 34 years, retiring in 1988. Don is survived by his wife Iona.

**James L. McMillen** (BSISE '48) passed away on August 28, 2002. He is survived by his wife Jodelle.

**Donald E. Nagy** (MSCE '59) passed away on February 28, 2003. He is survived by his wife Loraine.

**Herman Siegel** (BSISE '61) passed away on January 15, 2003 at age 76. He was a Reserve with the Los Angeles County Sheriff Department for 33 years, performing patrol, detective, and specialist duties. He rose to the rank of Captain and was in command of a specialist reserve company. He was preceded in death by his wife Rosalyn, and is survived by two daughters, Karen Mitchell and Jody Winslow, sons-in-law Ken Mitchell and Robert Winslow, and grandchildren Rachel and Andrew.

**James Ray Stevens** (MSAE '59), a 45-year resident of Palos Verdes, California passed away on January 4, 2003. He was a nationally respected aeronautical engineer who made major contributions to the T-38, F-5 and F/A-18 fighters, and the B-2 bomber. He is survived by his wife of 49 years, Lovena, three sons Tobin, Malcolm and Donald, daughter-in-law Bharti and three grandchildren.

**William Hollingdale Taylor** (BSME '49) recently passed away at age 79. He served during World War II, becoming a POW during the Battle of the Bulge in Germany. He spent his career in the aerospace industry, largely working on space shuttle ground support. He is survived by his wife Myra Joan.

**George Bernard Tuck** (BSME '57) passed away on March 4, 2003. He worked with the Army Corps of Engineers to preserve the beachfront and helped save many Orange County, California homes. He is survived by his brother Edward Tuck and sisters-in-law Pamela, Jennifer Tuck and Stephanie Tuck.

**Greg Woods** (BSME '65) passed away at age 59 on November 21, 2002 at Silbey Memorial Hospital in Washington, D.C. Greg was a retired chief operating officer for the Education Department's Office of Federal Student Aid. He is survived by his wife Lee, three children, Brian Woods, Denise Schultz and Kristen Martinez, and six grandchildren.

## In Memoriam

**Frank J. Lockhart**, professor emeritus of chemical engineering and former chair of the chemical engineering department at USC, passed away on December 12 from complications of hearth disease and diabetes. He was 86.

A resident of Harbor City, California, Lockhart was a member of the USC faculty from 1946 until his retirement in 1987, and he chaired the department of chemical engineering from 1956 to 1969.

Between 1965 and1972, Lockhart was responsible for the engineering and technology training of the nation's first air pollution control officers at the USC Air Pollution Control Institute. This program was triggered by the passage of the Clean Air Act in 1963, and Lockhart worked with the schools of Public Administration, Engineering and USC's Allan Hancock Foundation to create the institute.

"Frank Lockhart had a long and very distinguished academic career at USC, but through his efforts in air pollution control, he made life better for all of us," says Yannis Yortsos, senior associate dean for academic affairs at the School of Engineering, and a professor of chemical engineering.

From 1954 to 1973, Lockhart was a member of the Southern California Advisory Committee to Selective Service System on Scientific, Engineering and Specialized Personnel. In 1968, he received the Distinguished Faculty Award from the School of Engineering and the Engineering Alumni Association for his pollution control activities, his embrace of the cooperative efforts among various schools and his work with the selective service advisory committee. He was also cited for his "deep personal concern for undergraduate and graduate students alike."

Lockhart's family has informed USC that in his will he made a gift to start an emergency loan fund for engineering students. The School's office of financial aid will establish an endowment in his name.

He was named a fellow of the American Institute of Chemical Engineering in 1978, and in 1980 he received the Excellence in Teaching Award from the USC Associates.

Before coming to USC, Lockhart worked as a chemical engineer at Humble Oil and Refining Co., Union Oil Co. and Fluor Corp. He received a bachelor's and master's degree in chemical engineering from the University of Texas, and a Ph.D. in chemical engineering from the University of Michigan. He was a registered professional engineer in California and he served as a consultant to a number of oil companies and engineering contractors.

Lockhart is survived by his daughter, Sandra McGrath of Long Beach, California; five grandchildren, Erin Bernau, Karen Heavin, Steven Heavin, Pamela Richards and Cheryl Zavatsky; and nine great-grandchildren.

# Ronald Tutor Hall Construction Begins

## *New Donors Can Lend Their Names*

On May 5, the School of Engineering will hold groundbreaking ceremonies for the new Ronald Tutor Hall. This eagerly anticipated building is a central component of the School's plan to become one of the nation's elite engineering schools. Tutor Hall has been designed to foster collaborative, leading-edge research and to provide a rich educational environment for undergraduate students, two goals that are critical for ensuring the School's academic excellence and success.

The 103,000 square-foot, six-floor building will be located in the heart of the School of Engineering, just south of Olin Hall. Construction is scheduled to be complete by December 2004, with occupancy in time for spring semester 2005, according to Associate Dean, Sue Lewis, project manager for the hall.

The new building will house research laboratories in three rapidly evolving fields that the School has identified as key research initiatives for the coming decade: biomedical technology, information technology and nanotechnology *(see story on nanotechnology on page 18)* Dramatic advances in these fields are expected to significantly improve human health and welfare, and the School is committed to increasing faculty representation and research in each of them. Because these technologies will not evolve in isolation from each other, but will overlap and interact, often in unanticipated ways, Tutor Hall will bring faculty from many disciplines together in one location, encouraging maximum synergy and creativity.

The new building will also feature a student lounge and courtyard café, where students and faculty can congregate to exchange ideas, study and socialize. Tutor Hall is envisioned as a home for Engineering's undergraduate students. It will provide three instructional laboratories, a student lounge, centralized offices for the Undergraduate Student Affairs, the Engineering Mentoring Program, the Center for Engineering Diversity, Women in Engineering and the student tutoring program, as well as space for student organizations, meetings and undergraduate advising.

Much of the School's success depends on the quality of its research and the ability of its faculty to attract research funding in a competitive environment, explains Dean C. L. Max Nikias. "Academic excellence starts and ends with scholarly faculty and research. Outstanding faculty leads to cutting-edge research, which attracts more research funding, which in turn attracts high-quality students. This leads to preferential recruitment of our graduates in the marketplace, augmenting the School's reputation and encouraging stakeholders to increase their support for the School. This, of course, is what enables us to improve our facilities and infrastructure, thus enticing first-rank faculty to USC."

Ronald N. Tutor, who is a USC Trustee and president and CEO of Tutor-Saliba Corp., pledged $10 million to name the new building. In addition, the late San Marino investment banker Dwight C. "Bill" Baum gave $2.5 million to name the student lounge and café. Funding for the building's construction has been finalized, and donors now have an opportunity to support the programs and research that will be housed in the new building.

This phase of the Tutor Hall project is extremely important to the School's future success. For this reason, the School of Engineering plans to recognize gifts in support of student programs, research conducted in the hall, undergraduate scholarships or endowments in these areas.

"We are very excited to be starting construction on Ronald Tutor Hall," says Christopher Stoy, CEO of External Relations. "This new building sets the stage for significant advances in the School's ability to recruit and retain high-quality faculty and students. We hope that the School's alumni and friends will want to support this exciting endeavor."

*For information about making a gift to support Tutor Hall programs or research, please contact the Office of External Relations at 213/821-2400.*

### Supporting the School of Engineering: Gift Annuities

Many people have Certificates of Deposit that are earning disappointing returns at the bank, or money that used to be invested, and is now idling in the money market. And, if you plan to someday leave a remembrance to the School of Engineering in your Will, consider guaranteeing the gift today and at the same time improving your returns. Its possible with a Gift Annuity from USC. Consider the following example:

Linda, age 75, plans to donate a maturing $10,000 Certificate of Deposit. Since she needs continuing income, Linda decides to use the cash for a one-life Charitable Gift Annuity that the university will issue at the suggested rate of 6.7 percent.

Although Linda's annuity rate is 6.7 percent, her actual earnings will be higher for several reasons. First, because Linda itemizes income tax deductions, she earns a federal income tax charitable gift deduction of $4,414. With a marginal income tax rate of 30 percent, the tax savings of $1,324 will reduce the net cost of the gift to $8,675. Her annual annuity income of $670 will mean an effective rate of return of 7.7 percent.

The second advantage she will enjoy is that for the next 12.4 years, more than half of every dollar she receives will be considered a return of her investment on her annuity contract and will not be subject to tax. To earn as much after-tax, in a fully taxable investment, Linda would have to earn better than 8.9 percent.

Third, when Linda passes on, the money will go to create student scholarships at the School of Engineering, and that is a return that cannot be measured.

If you are considering a planned gift to the USC School of Engineering, please contact Sam Martinuzzi, director of planned giving, at 213/740-1214.

# Comments on the loss of Columbia, *February 1, 2003*

*by Paul Ronney*

*I've* gotten a lot of phone calls and emails today from friends and colleagues around the world offering their condolences on my loss. At first this struck me as being odd, since what I lost is trivial and meaningless compared to what others have lost today. When such tragedies occur, people not directly involved feel helpless do to anything substantive, so they want to at least offer condolences to someone. For many people, I am more closely linked to the tragedy than anyone else they know, so I suppose it makes sense that I would be a target for condolences.

I found out about the Columbia tragedy early this morning, about half an hour after it happened. One of my associates had been monitoring the landing and called my home.

*Researcher Paul Ronney, was backup astronaut for two previous Columbia flights involving his experiments.*

When I first heard about the loss of Columbia, I wanted to know, could anyone have survived? Where were they in the descent? I quickly turned on the TV and learned that contact was lost at about 200,000 feet and Mach 17. I knew from my astronaut training that there are no escape options at those conditions — you have to ride the vehicle no matter what its condition is.

I had met all of the crew. Four of the seven (Mike Anderson, Dave Brown, Kalpana Chawla "KC" and Ilan Ramon) conducted at least one test run on my experiment, called "Structure Of Flame Balls At Low Lewis-number," or "SOFBALL." I had met these four many times during the course of training. Even though KC was the only one of the four with a Ph.D. scientific background, all of them seemed really excited about my experiment. They asked me lots of questions about the science behind SOFBALL. They didn't just learn how to do the experiment, they worked very hard on the development of the crew procedures to minimize the chance of mistakes and extract every possible bit of data. I was especially pleased to see how Ilan, an Israeli military pilot with no scientific background, attacked the training with a vengeance. He was determined to be an active and valued crewmember, even though he was on the flight largely because President Clinton had promised Israel that NASA would fly an Israeli astronaut. Mike Anderson was one of the nicest people I ever met. Even if you're a confident, self-assured person, after five minutes of talking to Mike you walked away feeling better about yourself.

Even the other three crew members (Rick Husband, William McCool, Laurel Clark) played an important role in SOFBALL because it required a special Shuttle flight mode called "free drift" in order to minimize gravity disturbances. That mode had to be set up by these crew members in coordination with the crew members actually performing the experiment.

I think the crew liked the SOFBALL experiment in part because the flame balls have "personalities." In fact, after a few tests Dave Brown started naming the flame balls. Ilan Ramon even named one "Paul Ronney". It turned out to be a weak and wimpy flame ball that lasted only a few minutes. Through a bizarre set of circumstances that occurred during a test Mike was conducting, "Kelly" turned out to be the longest-burning flame at 81 minutes.

The SOFBALL experiment had flown in 1997 on two shuttle missions, which also used the Columbia orbiter. I was the backup astronaut for those missions. I spent over a year going through all of the space flight training (in case either of the two scientists on the flight got sick or injured), but I didn't fly. At some point during the mission it occurred to me, "What if the mission doesn't come back? The press will ask me a lot of questions since I'm the nearest thing to a survivor." I figured one question would be, "You wanted to be on this mission, do you still want to go into space?" I would have answered, "If space flight is your passion, it's like auto racing or mountain climbing. There are risks, but you know that going in and you accept them. Yes, I want to go on the next flight to finish the job my friends started." While I wasn't a backup astronaut for this flight (the one that just crashed), I had really wanted to be on it, and if I had an opportunity to fly on the next shuttle flight, I'd want to accept.

When I look at the notebook of graphs and the stack of CD-ROMs we produced from the downlinked data, I really start to feel guilty about what happened. After all, SOFBALL was one of the most crew-intensive experiments on the flight. They were flying largely to do my experiment. That notebook and those CD-ROMs are their legacy.

I feel privileged to have known the crew and I will miss them very much. Actually, the fact that they're gone hasn't sunken in yet. I'm still looking forward to talking with Mike after the mission about "Kelly."

*See story on Ronney's SOFBALL research on page 15.*
*Go to http://carambola.usc.edu/research/SOFBALL2quickie.html if you'd like to find out more about "Kelly" and the rest of the SOFBALL experiments.*

Ronney photo by NASA

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