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USC Engineer

A Journal for Alumni & Friends
USC Viterbi School of Engineering

Let There Be Light

A Revolution in BioMed Imaging

Small and Deadly

Searching for Air Pollution Solutions

Digital Reunion

Reuniting the Parthenon and its Art

A Proper Name

Viterbis Name School of Engineering

Spring/Summer 2004

One man's algorithm changed the way the world communicates.

One couple's generosity has the potential to do even more.

Andrew J. Viterbi:

- Inventor of the Viterbi Algorithm, the basis of all of today's cell phone communications
- The co-founder of Qualcomm
- Co-developer of CDMA cell phone technology
- Member of the National Academy of Engineering, the National Academy of Sciences and the American Academy of Arts and Sciences
- Recipient of the Shannon Award, the Marconi Foundation Award, the Christopher Columbus Award and the IEEE Alexander Graham Bell Medal
- USC Engineering Alumnus, Ph.D., 1962

The USC Viterbi School of Engineering:

- Ranked #8 in the country (#4 among private universities) by *U.S. News & World Report*
- Faculty includes 23 members of the National Academy of Engineering, three winners of the Shannon Award and one co-winner of the 2003 Turing Award
- One of only four universities nationwide to have two active National Science Foundation Engineering Research Centers
- Awarded the first Research Center of Excellence by the Department of Homeland Security
- Consistently ranked in the top three nationally in research funding per tenure-track faculty
- Distance Education Network (DEN) is a national leader in the field of e-learning, educating more than 800 graduate engineering students at corporations across the U.S.

Presenting The University of Southern California's Andrew and Erna Viterbi School of Engineering.

More than 40 years ago, we believed in Andrew Viterbi and granted him a Ph.D. Today, he clearly believes in us. He and his wife of nearly 45 years have offered us their name and the largest naming gift for any school of engineering in the country. With the invention of the Viterbi Algorithm, Andrew J. Viterbi made it possible for hundreds of millions of cell phone users to communicate simultaneously, without interference. With this generous gift, he further elevates the status of this proud institution, known from this day forward as USC's Andrew and Erna Viterbi School of Engineering. While we already boast an array of the best faculty in the world, this extraordinary gift will help us attract even more of engineering's best and brightest scholars, educators and students. Their energy, diversity, creativity and commitment will further USC's rich history of innovation, creating a future destined for even greater marvels of human achievement.

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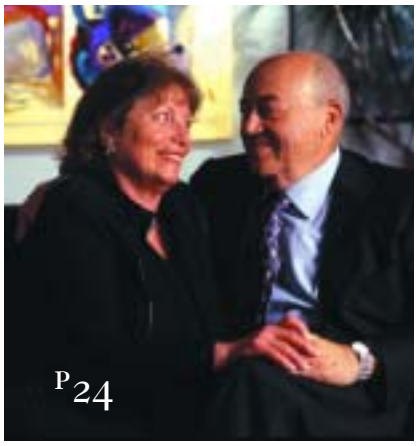
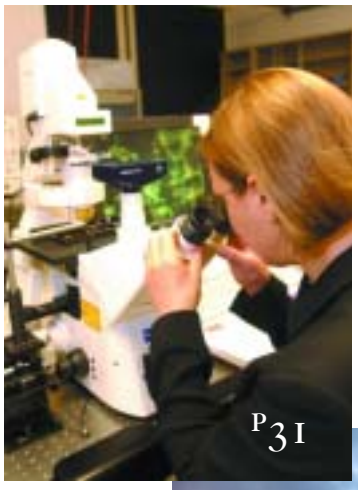
www.usc.edu/dept/engineering

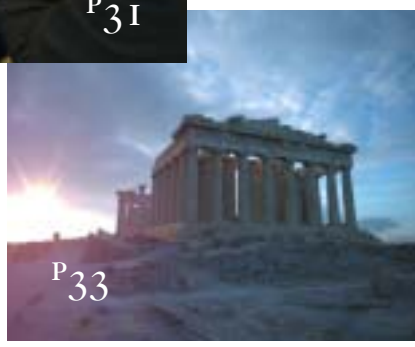
The University of Southern California's Andrew and Erna Viterbi School of Engineering

features



departments





This year's steel bridge entry was once again an innovative design...
see Concrete & Steel for more

Cover and Viterbi photos by Michelle A. H. Smith

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USC UNIVERSITY OF SOUTHERN CALIFORNIA
Viterbi School of Engineering
Distance Education Network (DEN)

Spring Brings New Things

It is spring and the USC campus is once again a riot of colorful blossoms. But along with flowers, spring has brought our School some very good news that you will find in this issue of *USC Engineer*.

We are now the USC Viterbi School of Engineering, thanks to the largest naming gift ever given to an existing American engineering school. Andrew (Ph.D. EE '62) and Erna Viterbi's $52 million gift nearly doubled our endowment fund and places us near the halfway mark of our $300 million fundraising initiative goal. Our School will be forever associated with one of the great engineers of our times, a giant in both the academic and entrepreneurial worlds. Furthermore, Andy Viterbi has joined our faculty!

However, to focus solely on the Viterbi's philanthropy would be to miss the larger picture of their investment in USC and the Viterbi School of Engineering. The importance of professional engineers to society may be greater today than any other time in history. In our daily lives, we constantly come in contact with and experience the benefits of the great intellect, vision and imagination of exceptional engineers. Andrew and Erna Viterbi's gift will not only enrich engineering at USC, but will also ultimately improve life around the world.

Shortly after the announcement of their gift and shortly before *USC Engineer* went to press, *U.S. News & World Report* published their annual rankings of graduate engineering schools. The Viterbi School now ranks sixth in a tie with Caltech. This is a gain of two spots from last year and it reflects the increasing quality of both our graduate students, particularly Ph.D. students, and of our faculty. We graduated more than 100 Ph.D. students in the past year.

The third piece of significant news covered in this issue concerns another new partnership, this one with the Indian Institute of Technology (IIT) Kharagpur. I traveled to India with USC Senior Vice President Alan Kreditor and on March 23, we signed a letter of intent with the Director of IIT Kharagpur S. K. Dube and Professor Kalyan Chakravarti, who is dean of the institute's Gupta School of Management. This partnership was facilitated by Vinod Gupta for whom the management school is named.

The IIT Kharagpur is the subcontinent's top engineering school and India is an important source of graduate students for our School. For many years, USC has been one of the top destinations for international students from all over the world.

The quality of the graduate students who come to the School from India is exceptional and in recent years Associate Dean Margery Berti, usually accompanied by one of our Indian faculty, has traveled to India to recruit these highly desirable students. The new partnership with IIT Kharagpur can only help her efforts.

So, as flowers bloom on campus, nowhere is the bloom of spring brighter than at the newly named USC Viterbi School of Engineering.

C. L. Max Nikias
Dean
USC Viterbi School of Engineering

Nikias photo by Max S. Gerber

EDITOR'S NOTE

The Trojan spirit at the USC Viterbi School of Engineering has never been more alive. This magazine celebrates Trojan spirits everywhere, from those found in our research labs, pushing the boundaries of reality toward the stuff that dreams are made of, to the undeniable strength of our alumni, whose profiles in this issue continue to demonstrate the vitality of Engineering's Trojan Family.

Our magazine also continues to celebrate the lives of Trojans who have become "Trojans in spirit," so to speak. The following excerpt is from a eulogy given at the celebration of the life of Robert Arrington (MBA '62, MSEE '66), one of our School's most dedicated alumni whose profile is on page 46 of this issue. It describes better than I could what the Trojan spirit is made of.

Annette Blain
Director, Alumni Relations

"As many of you know, Bob Arrington was a Trojan. Now, some of you might be wondering what a 'Trojan' is. Trojans are doctors, lawyers, architects, actors, directors, corporate executives, teachers and even Naval Captains.

So what makes a person a Trojan? Well, Trojans come from a school out west in South-Central Los Angeles called the University of Southern California. They are educated like so many other college students today. However, something unique happens during their time in school that forges individuals into Trojans.

I don't believe that making a Trojan has anything to do with IQ or intelligence since USC has been making Trojans long before it became one of the top schools in the country. Rather it is more concerning the heart, or a feeling deep inside, like a torch burning. And it is not necessarily forged on the gridiron. But, I do know that the flame can begin to smolder the first time you are at a game, down 23 to nothing and you yell 'Fight On'!

'Fight On!' Down 23 to nothing, and you look around and no one is leaving? Now there are schools… where people would be leaving in droves at this point in the game. But at SC you learn whether on the football field or the gridiron of life, that the battle has not ended until the last man goes down. You see, Trojans are never quitters.

Now that was Bob, a Trojan… He was a warrior and commander… He exemplified the Trojan Spirit and his help, participation and dedication to USC is what made the Trojan Family… so unique. As we all know, when you go to USC you become a Trojan for life, certainly Bob epitomized this fact. So, 'Fight On and Win for Old SC, Fight On to Victory, Fight On!'"

—by James Jester, (BS BIOL '72, Ph.D. '78), *January 30, 2004*

USC VITERBI SCHOOL OF ENGINEERING

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USC Engineer is published twice a year for alumni and friends of the Viterbi School of Engineering at the University of Southern California.

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

Mission to Arabic: It's Not Your Father's Language Lab

To teach soldiers basic Arabic quickly, USC computer scientists are developing a system that merges artificial intelligence with computer game techniques.

The Rapid Tactical Language Training System created by the USC Viterbi School of Engineering's Center for Research in Technology for Education (CARTE), tests soldier students with videogame missions into animated virtual environments where the students have to successfully phrase questions and understand answers in Arabic to pass.

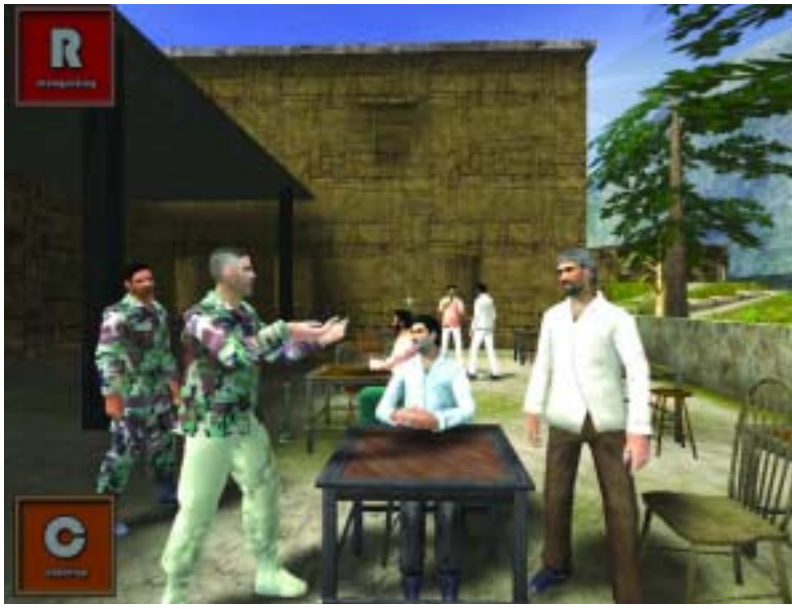
Special Forces troopers will be using the 80-hour system now being completed at CARTE's headquarters at the Information Sciences Institute (ISI).

"Most adults find it extremely difficult to acquire even a rudimentary knowledge of a language, particularly in a short time," says CARTE Director W. Lewis Johnson. "We're trying to build an improved model of instruction, one that can be closely tailored to both the needs and the abilities of each individual student."

Cadets studying Arabic at the U.S. Military Academy at West Point offered suggestions on the system after trying an early version of the system in October 2003. December trials at Ft. Bragg by enlisted personnel were encouraging and led to further guidance on making the material accessible.

Johnson leads a six-person CARTE team that is spearheading the effort. The Defense Advanced Projects Agency (DARPA) and the Office of Naval Research are funding the work. The Rapid Tactical Language Training System is one of several instructional programs in a DARPA initiative aimed at developing a heterogeneous set of active learning tools.

Part of the system, the "Mission Skill Builder," resembles an intensive version of the language laboratory programs that have been in use for generations, in which students imitate and practice words and phrases pronounced by native speakers.



A meeting at a cafe. If the student's Arabic is understandable and polite, the information needed will be forthcoming. If it is garbled, or rude, he will be ridiculed or even threatened by the figure sitting at the table.

"While it's similar to drill-and-practice language programs that have been in use for some time, the Skill Builder incorporates some important innovations," Johnson elaborates.

These include:

- speech recognition technology tailored for language learner speech, that is able to evaluate learner speech and detect common errors
- pedagogical agent technology that provides the learner with tailored feedback on their performance
- a learner model that dynamically keeps track of what aspects of the language the learner has mastered and what areas the learner is deficient in.

Along with linguistic skills, this section of the program also instructs students in non-linguistic cultural matters of importance in communication. "People don't just communicate with words," says Johnson.

"In face-to-face conversation, nonverbal behavior such as gesture, posture, gaze, head movements and facial expression play an important role in coordinating a successful exchange," explains ISI research scientist Hannes Hogni Vilhjalmsson, a specialist in modeling human non-verbal communication. "Wrong interpretation of nonverbal cues or the wrong nonverbal responses can lead to serious misunderstanding and escalate hostility. Since these cues can depend on culture, it is important to include all of these behaviors when teaching conversation skills in a foreign language."

Vilhjalmsson says "by exposing learners to

continued on page 8

In the News

USC Viterbi School of Engineering projects and faculty continue to generate headlines and here are some of the highlights…

The $52 million naming gift from **ANDREW (Ph.D. EE '62) AND ERNA VITERBI** announced on March 2 received worldwide attention through the ***Associated Press*** and ***Reuters*** wire services and stories in the ***Los Angeles Times***, ***San Diego Union-Tribune***, ***Jerusalem Post***, the ***Jewish Journal***, ***Science***, the ***Chronicle of Higher Education***, ***Philanthropy Digest***, ***National Public Radio*** and radio station ***KFWB***.

BEHROKH KHOSHNEVIS, professor of industrial and systems engineering, has two projects receiving worldwide media attention. Contour crafting, his technology that could someday build custom houses in 24 hours, was featured in a special report on ***NBC*** Nightly News, as well as press coverage in the ***New York Times***, ***New Scientist*** and ***Der Spiegel***. His wrinkle on rapid prototyping technology that makes possible desktop "printing" of complex 3-D plastic and metal objects was covered in ***BusinessWeek***, ***Space Daily*** and many others. *See story on Khoshnevis' 3-D printer on page 22.*

In February, **TOM VERNIER**, a doctoral student and engineering manager at ISI, was in ***New Scientist***, ***Der Spiegel*** and the ***BBC*** with a collaborative project to tweak cells with nanopulses of electrical energy. *See story on nanopulsing on page 11.*

The ***Los Angeles Daily News*** quoted civil and environmental engineer **CONSTANTINOS SIOUTAS** in a story on the dangers of ultrafine air pollution particles. "The broad public needs to be banged on the head and know that the air you breathe will kill you." *See story on air pollution on page 32.*

Late in February ISI's **CRAIG KNOBLOCK** and his software that automatically extracts information from travel web sites and telephone books was featured in an ***Associated Press*** story that appeared in the ***New York Times*** and many other places.

SHRIKANTH NARAYANAN, a computer scientist and linguist working in the Integrated Media Systems Center, caught the fancy of many media outlets with a software program that can detect anger in frustrated people stuck in automated telephone answering systems. The first story was in the February ***MIT Technology Review***. Subsequent stories appeared during February and March in or on ***Wired.com*** in both English and Spanish; the ***Sunday Glasgow Herald***; ***MSNBC***'s "Countdown with Keith Olbermann;" the ***Canadian Broadcasting Corp.***, which was heard on ***KPCC*** locally; ***94 KJY*** in Providence, Rhode Island; "Le Show" on ***NPR***; ***Smemoranda*** (an Italian Newspaper); ***Focus*** (Munich, Germany); the ***Financial Times*** (London) and ***BBC*** Radio. *See story on language simulator on page 15.*

In the special double issue, the Year Ahead 2004, ***U.S. News & World Report*** named neuroscientist **ROBERTA DIAZ BRINTON** as one of four "Best Minds;" In the magazine's story, her collaboration with biomedical engineer husband **THEODORE BERGER** to develop an implantable memory chip received prominent play.

The February issue of ***IEEE Spectrum*** listed the IMSC multimedia degree programs in the top 10 list of best programs for students studying Hollywood technology. The February issue of ***ASEE Prism*** carried a long story about the School's second Engineering Research Center, the Biomimetic MicroElectronic Systems (BMES), quoting Dean **C. L. MAX NIKIAS** and many of the center's researchers.

ALBERT "SKIP" RIZZO, a clinical psychologist from the IMSC, was featured in a ***New York Times*** article about the growing use of virtual reality for therapy.

On Nov. 25, the Department of Homeland Security announced that it had selected USC for its first Center of Excellence at a press conference held on campus. Media covering the announcement included the ***L.A. Times***, the ***San Jose Mercury News***, ***Sing Tao Daily***, the ***International Herald Tribune***, ***Congressional Quarterly***, the ***Chronicle of Higher Education***, ***La Opinion***, ***Associated Press***, ***KABC-TV***, ***KNBC-TV***, ***KTLA-TV***, ***KTTV-TV*** and radio stations ***KNX***, ***KFWB*** and ***KFI***. The ***New York Times*** took note of the new center in December. Another spate of stories appeared in January including stories on the ***Associated Press*** wire, in the ***Contra Costa Times***, the ***Torrance Daily Breeze*** and ***KNBC-TV***. On Jan. 25, ***L.A. Times*** business columnist James Flanigan wrote about the economic impact of homeland security in Southern California, prominently mentioning the 350 students who had signed up for the School's new cyber-security class. **RANDOLPH HALL**, senior associate dean for research, was interviewed Jan. 26 on ***CNNfn*** about the homeland security center.

The ***L.A. Times*** ran a major story on Dec. 14 about ChevronTexaco's $5 million commitment to the USC Viterbi School of Engineering to develop new oilfield technologies. The story explored the partnerships between academic institutions and corporations quoting Dean **C. L. MAX NIKIAS**: "We listen to industry and we react to what their needs are."

A late November expo held by the Cinema-Television and Engineering schools to announce plans to offer minors in video game creation attracted considerable media attention including stories on ***Wired.com*** and ***Hollywood Reporter***. ***CNN Headline News*** conducted a live 5-minute interview that was repeated half a dozen times with **ANTHONY BORQUEZ**, director of the Information Technology Program.

In November, civil engineer and safety expert **NAJM MESHKATI** warned in the ***L.A. Times*** that Southern California rail lines were becoming "killing fields" and that experts needed to determine why so many people were dying in level grade crossing accidents. The same month, in another ***L.A. Times*** story he defended an Iranian American scholar from UC Berkeley who had been arrested in Iran. Also in November, Meshkati was in a ***Christian Science Monitor*** story about Iran's secret uranium enrichment program expressing his hope that "longer-term cooperation" between European foreign ministers and Iran would include better nuclear safety technology. He was prominently quoted in a story in the British newspaper, the ***Guardian***, about the threat of nuclear accidents in Iran.

The ***San Francisco Chronicle***, ***CNET*** and several other media covered a $5.46 million grant made in November to the School and UC-Berkeley from the National Science Foundation and Department of Homeland Security to build a cyberwar test bed.

An ***Associated Press*** story in December about projects to roboticize the Segway scooter featured computer scientist **GUARAV SUKHATME** and was widely printed around the nation.

The Fichtner Principle **Faculty OpEd**

by James E. Moore

James E. Moore

The Fichtner Principle, attributed to Professor Paula Fichtner, former chair of the history department at the City University of New York's Brooklyn College, holds that first-class academic departments hire first-class professors, and that second-class departments hire third-class professors. Quality faculties seek out scholarly colleagues, while mediocre faculties want to avoid confronting their own mediocrity. The Fichtner Principle explains why and how the USC Viterbi School of Engineering has been able to hire such a prominent array of excellent new faculty members.

The University of Southern California subscribes to the concept of faculty governance. The term loosely and imprecisely describes the collective impact of the faculty's various service activities, including the faculty's responsibilities in personnel decisions. The most important and rewarding faculty responsibilities are, of course, teaching and advising students; but the context in which the faculty makes its most lasting and important contribution to the intellectual culture of the institution is in the appointment, promotion, and tenuring of academic personnel.

Excellent leadership of the sort provided by Dean Nikias is a necessary condition for the continued ascent of the USC Viterbi School of Engineering, but neither the benefits of this leadership, the high quality of our students, nor the advice and goodwill of our friends and donors are sufficient to ensure the School's continued progress. At first-tier research institutions such as USC, it is the responsibility of the faculty to identify, recruit, and evaluate new additions to their ranks. Leadership from the dean's office is instrumental in helping the faculty to sift and compare priorities. However, it is the collective, considered judgment of the faculty that determines who, from among many prospective candidates, the Dean and the Provost will ultimately consider for appointment to the USC Viterbi School of Engineering faculty.

The School has always been very strong, particularly so now and in the last quarter of the 20th century; but in recent years the School has been able to recruit scholars and scientists of astonishing quality. As a faculty, we have become proficient at identifying the very best minds in our various disciplines. We are particularly good at the difficult task of identifying promising scholars early in their careers. However, it is time to consider whether and how we might do even better.

The School's eight academic departments provide a convenient mechanism for organizing resources, accounting for expenses, mounting degree programs, and connecting the faculty to research sponsors and the various engineering professions. Faculty members typically form their closest collegial and collaborative associations within their departments.

The opportunity to form these working relationships is of great intellectual value, but departmental boundaries also constrain faculty perspectives and activities in subtle ways. In particular, we tend to recruit new colleagues almost entirely in terms of our respective departments' degree programs and research areas. We too infrequently pursue or advocate interdepartmental or interschool hires. Instead, we consistently try to recruit new, multidisciplinary colleagues into an institutional environment that remains organized in fundamentally disciplinary terms.

In the past two years, USC has paid substantial attention to this question, formalizing expectations with respect to joint appointments, and identifying procedures for allocating funds recovered from large, multi-investigator, multi-school research projects.

It may always be desirable for most faculty members to provide their contributions from the vantage point provided by a principal academic appointment in a specific department, but the intellectual and scholarly benefits that flow from additional appointments in related departments and schools are very substantial. These benefits include opportunities for faculty members to combine ideas, approaches, and methodologies from multiple disciplines, to form research partnerships with a wider array of colleagues, and to develop administrative knowledge of USC and its operations.

Such joint appointments should become the norm, not the exception. This shift will require a thoughtful dialogue within the School concerning how to define the academic rights and responsibilities of such dual or even plural academic citizens. In the past two years, USC has paid substantial attention to this question, formalizing expectations with respect to joint appointments, and identifying procedures for allocating funds recovered from large, multi-investigator, multi-school research projects. Most of the USC Viterbi School of Engineering faculty has yet to take full advantage of these arrangements. We should take the lead and go even further than these modest changes suggest. Doing so is a crucial next step in the intellectual development of the Viterbi School. The 21st century is off to a highly multidisciplinary start.

James E. Moore II, is chair of the Daniel J. Epstein Department of Industrial and Systems Engineering, a faculty member in the department of civil and environmental engineering, and USC's School of Policy, Planning and Development. He is the current chair of the USC Viterbi School's Committee on Faculty Appointments, Promotion and Tenure.

Moore photo by John Livzey

Mission to Arabic *continued from page 5*

Communication is not entirely spoken. The learning system teaches the meaning of gestures, which the student must also be able to understand.

Teaching the mission, the virtual instructor explains the geography of the place the student will go, and what must be done there.

realistic face-to-face situations and by training them to be culturally sensitive, we prepare them to become effective social players as well as speakers in the new language."

Points covered in culture training include:

- social skills necessary to build rapport with local people
- appropriate degrees of politeness to use in different social situations
- how to disagree with someone without offending
- how to respond to offers of hospitality.

Gesture training includes common Arabic gestures that a Westerner might misinterpret (for example, Arabs may roll their eyes to mean "no"), and American gestures (such as thumbs-up) that an Arab might misinterpret.

The examination or application part of the training system, the "Mission Practice Environment," is still more innovative. It is designed to give students an unscripted, unpredictable, and therefore challenging test of their mastery of these elements.

In this segment, students wearing earphones and microphones control a uniformed figure moving through a Lebanese village, complete with outdoor coffee bar. They meet animated Arabic speakers, who (thanks to artificial intelligence driven voice recognition programs) can carry on free-form conversations.

"These AI figures can understand what the students say, if it's said correctly — or won't, if it isn't. And they will respond appropriately," says Johnson.

In the exercise, after exchanging greetings, the student learns the names of locals, the name of the place, the identity of the local headman and the location of his house, and must follow these directions through the game interface to get there.

"In typical videogame fashion, the idea is to get to the next level," explains Johnson. "In this game, in order to get to the next level, the learner has to master the linguistic skills."

The program already has features to adapt it to each individual user, noting consistent errors or difficulties, which can be targeted for extensive or remedial practice.

So far, researchers have completed approximately seven hours of the program. The full program will have about 80 hours of instruction and introduce perhaps 500 carefully chosen words of the "Levantine" Arabic spoken in Lebanon to learners. If all goes as planned, the system may be deployed next year.

"We here in the Department of Foreign Languages are very excited about the Tactical Language Training System and the new capabilities that it can provide to military language learners, including our cadets," says Colonel Stephen LaRocca of the Department of Foreign Languages at West Point.

"This system allows learners to rehearse real-world tasks in the most realistic environment technology can provide," LaRocca continues. "It will be available wherever and whenever the learner is available, and activities can be repeated as often as the learner desires. It has the potential to greatly expand speaking opportunities in a meaningful, motivating context."

Working with CARTE on the project are the USC Integrated Media Systems Center; UCLA's Center for Research on Evaluation, Standards, and Student Testing; and the Micro Analysis & Design Inc. firm of Boulder, CO.

CARTE is headquartered at the Information Sciences Institute, which is part of the USC Viterbi School of Engineering. In addition to Johnson and Vilhjalmsson, the ISI researchers involved include Stacy Marsella, Catherine M. LaBore, Dimitra Papachristou, Carole Beal, Nicolaus Mote, Shumin Wu, Hartmut Neven, Ulf Hermjakob, Mei Si, Nadim Daher and Gladys Saroyan.

For more information see the Tactical Language Project home page: http://www.isi.edu/isd/carte/proj_tactlang/index.html

Ringed Revelation

Saturn, one of the most distinct planets in the solar system, may soon yield its secrets to Cassini, a spacecraft carrying an experiment co-designed by USC researchers.

The "Ultraviolet Imaging Spectrograph" (UVIS, for short) is a collaboration of the Jet Propulsion Laboratory in Pasadena and the University of Colorado at Boulder for NASA's Cassini-Huygens mission to Saturn.

The instrument is designed to examine Saturn's magnetosphere, which is the space around the planet controlled by its magnetic field. It will also look at the atmosphere of the ringed planet and its moons. The instrument is among 18 scientific devices onboard the Cassini orbiter and Huygens probe that will delve into the ringed planet's mysteries.

The Cassini Huygens mission is considered to be among the most ambitious and sophisticated efforts in planetary science exploration and it marks the USC Viterbi School of Engineering's first experience with an outer planet space program.

Saturn, with its icy rings, 31 known moons, and huge, complex magnetic environment, has fascinated scientists for centuries. Sometimes called the "Lord of the Rings," the planet and its largest moon, Titan, will be the focus of the Cassini mission, which is expected to reach the orbit of Saturn later this year.

The mission's observation phase officially began in December 2003 and the Cassini Spacecraft is scheduled to arrive at Saturn on July 1, 2004, at which time it will have been traveling in space for nearly seven years. It will remain in a Saturn orbit for four years, or possibly longer.

"It's a big relief to see this process begin," says Donald Shemansky, a UVIS co-investigator and professor of aerospace and mechanical engineering at USC. "We've waited 15 years for this opportunity to learn how Saturn's system evolved."

The spacecraft will release its Huygens probe on November 6, 2004. The probe will enter the atmosphere of Titan — the only known moon in the solar system with an atmosphere as dense as the Earth's — three weeks later. From there, the probe will sample the atmosphere and provide the first-ever photographs of the mysterious moon's surface. Because Titan and Earth share much of the same major atmospheric components — nitrogen and oxygen — the distant moon is thought to hold clues to how primitive Earth evolved into a life-bearing world.

The Saturn mission is expected to reveal new space discoveries and deepen scientists' understanding of phenomena in fields such as biology, atmospheric chemistry, physics, tectonics, volcanism and climatology.

"In the end, not only do we gain information about the evolution of Saturn's system," says Shemansky, who has worked on numerous space missions, including Mariner 10, Pioneer 10 and 11, Voyager 1 and 2 and Galileo. "We also learn specifics about Earth, the solar system as a whole and possibly how life formed on this planet."

Data collected by UVIS may provide pieces to this puzzle. It also may help scientists decipher the rate at which the moon's atmosphere is dissipating.

Since the early 1600s, when Galileo Galilei first discovered Saturn's rings, the adorned planet has intrigued amateur and expert astronomers alike. Recognized by ancient cultures as a slow-moving point of bright yellow light in the sky, Saturn boasts 31 icy moons, hundreds of spectacular rings, a volume capable of holding more than 750 Earths, winds that rage at more than 1,100 miles per hour and a low-enough density that it could float in a gigantic ocean.

More intriguing to researchers, however, is the fact that the planet emits 87 percent more energy — or heat — than it absorbs from the sun. Unlike rocky Earth and massive Jupiter, scientists say the ringed planet should not have any heat left over from its original formation. It is believed that an internal source of heat is responsible, which instruments onboard the Cassini-Huygens spacecraft will examine.

"This entire mission has been a wonderful learning experience," says Janet Hallett, a USC aerospace engineering graduate student and member of Shemansky's team. Hallett, who has been interested in space and films like "Star Wars" for as long as she can remember, is expected to receive her doctoral degree this spring — based partly on her observations of Jupiter using the Cassini spacecraft.

An international enterprise, the Cassini-Huygens mission enlisted help from 17 nations, and more than 200 scientists from 16 countries will examine the data.

"There is no doubt that this will be a very exciting year for all of us," Shemansky says. "I'm definitely looking forward to it."

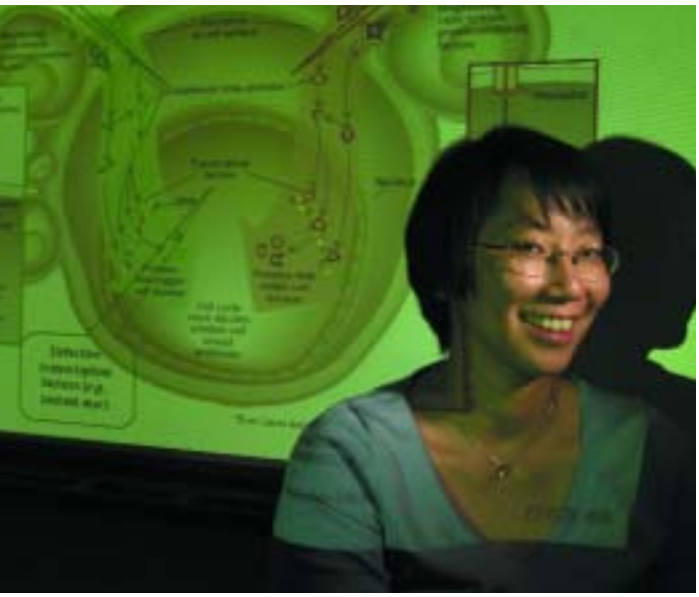
Saturn image courtesy of NASA/JPL

Biology Matters

ENGINEERING STUDENTS LEARN FUNDAMENTAL PRINCIPLES OF BIOLOGICAL SYSTEMS

Biology is increasingly critical to technological innovation. To better prepare tomorrow's engineers for the revolution in the biosciences, The USC Viterbi School of Engineering is introducing a new course — "Engineering Biology Matters" to the undergraduate curriculum.

"The progress we've made in biology, physics, chemistry and engineering has blurred all of the traditional boundaries between these fields," says Yannis Yortsos, senior associate dean for academic affairs, who helped to create the new undergraduate course. "We're seeing incredible breakthroughs in such areas as biomedical engineering, biotechnology, genomics, computational biology and information science. So we think it's important that our own undergraduates have a working knowledge of fundamental biology, regardless of whether they're in chemical engineering, civil engineering, computer science or electrical engineering."



Wee Ling Wong

Like USC, a handful of universities, including Stanford, MIT, Caltech and Cornell University, are responding with the first biological engineering courses ever to be offered.

"Whereas 20 years ago physics and mathematics were the pillars of engineering, we see that biology is playing an ever-important role," Yortsos says. "Biology has produced many discoveries and new technologies because researchers are looking at problems from the standpoint of how biological systems work, how cells work and how DNA works."

"Engineering Biology Matters" will incorporate this perspective and introduce a wide range of biology topics to undergraduate engineering students, says Wee Ling Wong, a molecular biologist who designed and is teaching the pilot course. Drawing on research under way in many USC laboratories, Wong is presenting topics ranging from tissue engineering to the development of biologically inspired robots, to environmental sensors and detectors.

"One of the most obvious applications of biological engineering is the Human Genome Project," she says. "Mountains of information are just waiting to be processed and interpreted, but computer engineers have to know the basics of biology in order to tackle these problems."

Wong holds a joint research faculty appointment in the Integrated Media Systems Center and the department of biomedical engineering. She believes many of the principles engineers learn in their undergraduate years will be useful in this course because engineers approach research problems from a holistic point of view.

"Biologists still take a reductionist's view in solving problems," Wong says. "They study the parts, but not the whole."

They can decipher genes and come up with a "parts list" of all the proteins in a gene, she says, but they still don't understand how all of those parts, or proteins, fit together to keep the genetic engine running.

In contrast, engineers focus on systems and processes — the integrated whole — rather than the individual parts of the system.

The USC Viterbi School's new biological engineering course has been three years in the making. Wong has been working with the school's curriculum committee task force and a faculty advisory committee made up of professors from other departments, in order to develop an interdisciplinary curriculum. Members of the faculty committee included Yortsos, David D'Argenio, professor of biomedical engineering, Ching-An Peng, professor of chemical engineering, and Laurent Itti, professor of computer science.

The course addresses a wide range of biological topics that are emerging in fields such as electrical, environmental, civil and chemical engineering, as well as information science and aerospace engineering. Lectures highlight some of the pioneering research that is under way in the School's new engineering research center on Biomimetic MicroElectronic Systems (BMES), where a team of engineers and scientists are attempting to fuse the "wetware" of neurons to silicon hardware in order to restore cognitive functioning in brain-damaged patients, sight to the blind and mobility to the paralyzed.

For the Spring 2004 semester, "Engineering Biology Matters" is a work in progress, or in a beta test phase, Wong says. She is refining course content as she goes along, soliciting feedback from students and "testing the waters."

"This is a live experiment in a way," Yortsos explains, "because biology is a huge field and it's very, very difficult to condense all of the applications into a 15-week course. We want to see how the process grows and where we can make changes to strengthen the curriculum so that we are giving students a solid foundation in biological principles."

If all goes well, "Engineering Biology Matters" should be fully incorporated into the undergraduate engineering curriculum in another year.

Wong photo by Max S. Gerber

Thomas Vernier

Cell Shocked

Ultra-short electric pulses promise to heal or kill unhealthy cells

A promising new technology using nano-pulsed electric fields to alter the "guts" of a cell may lead to improved methods of treating diseases such as cancer and leukemia, say researchers in the USC Viterbi School of Engineering.

The technology, called "electroperturbation," involves exposing cells to ultra-short electric pulses just tens of nanoseconds (tens of billionths of a second) in duration, says electrical engineer Thomas Vernier, a doctoral student and investigator on a collaborative project to develop the technology. An expert on semiconductors, he is also an engineering manager at the USC Viterbi School's Information Sciences Institute. Results of the work, supported primarily by the Air Force Office of Scientific Research with some additional funding from the Army Research Office, was reported at the national Nanotechnology 2004 conference held in Boston, Mass., in March.

The pulses are so brief and so intense that they pass virtually undetected through the outer membrane of a cell without damaging it, Vernier says. But these fast-rising pulses pack such a powerful punch to the intracellular structures that they can dramatically change its biochemical balance, or trigger the start of cell death, a process known as "apoptosis."

"In essence, we're delivering thousands of volts to the cell in mere nanosecond intervals," says Vernier. "These high-frequency pulses are so short that they pass right through the cytoplasmic membrane without altering its structure, but they jolt the cell's insides and, when delivered in strong enough doses, prompt the cell to self-destruct."

The pulses are so brief and so intense that they pass virtually undetected through the outer membrane of a cell without damaging it, Vernier says.

Still a fairly new application, nanosecond electric pulsing uses "Ultra-short Pulsed Systems Electroperturbation Technology," called UPSET. The technology has been in development at the USC Viterbi School's department of electrical engineering since 2001 says the project's principal investigator, Martin Gundersen, professor of electrical engineering. *See story on UPSET protege on page 18.*

Vernier and an interdisciplinary team of researchers from the department of electrical engineering, the department of cell and neurobiology at USC's Keck School of Medicine and the Biophotonics Laboratory at Cedars-Sinai Medical Center, have been testing the UPSET technology on leukemia cells by exposing the cells to high frequency electric fields.

The technique has advantages over conventional T-cell treatments, Vernier says. For starters, it is noninvasive and can be delivered remotely, without attaching contacts or probes directly to the cells. The hope is that nanoelectric pulsing may one day replace procedures such as surgical removal of tumors or toxic treatments such as chemotherapy.

Nanosecond pulsing is an improvement over an older technique called "electroporation," Vernier explains. Electroporation delivers longer duration electric pulses on the order of microseconds to milliseconds. The pulses punch holes in the cell's external membrane, but they can also inadvertently fry the cell.

Ultra-short electric pulses deliver shorter and higher frequency bursts of electricity, which do not puncture the cell's outer membrane or raise its temperature enough to damage the cell. Instead, Vernier says, the swift spike in voltage simply rearranges the cell's insides, such as its nucleus and mitochondria, without altering its outer shell.

Working in Gundersen's laboratory on the third floor of USC's Seaver Science Center, Vernier uses UPSET to study the biological mechanisms that trigger cell death. Healthy cells automatically self-destruct when they become unhealthy or when their numbers grow too large. Mutated cells, such as

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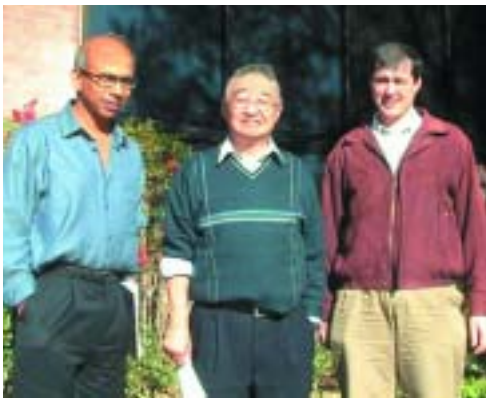
Vernier photo by Max S. Gerber

Cyber-Security and Privacy for Internet-based Grid Computing

The rapidly emerging and highly promising technology of Internet-based grid computing also presents daunting cyber-security challenges. The shared resources of large-scale computational grids make system insecurity and privacy violations significant obstacles that can hinder distributed supercomputing applications.

The National Science Foundation recently awarded a $2 million research grant to the USC Viterbi School of Engineering for a grid security project called GridSec. Kai Hwang, B. Clifford Neuman, Viktor Prasanna and colleagues have begun working on self-defense tools to automatically protect distributed computing resources from cyber attacks or malicious intrusions.



left to right: Professors of Electrical Engineering Systems, Viktor K. Prasanna and Kai Hwang, and B. Clifford Neuman, director of the Center for Computer Systems Security.

Hwang, professor of electrical engineering and computer science and the director of the Internet and Grid Computing Laboratory, leads the project.

The researchers will develop a new self-configuration security and privacy framework architecture for grid applications. Hwang and Neuman have begun building an automated intrusion response and management system to facilitate authentication, authorization and security for metacomputing grids and peer-to-peer web services.

The USC team is also developing a NetShield library with distributed micro firewalls and intrusion repelling software. The new security system adjusts itself dynamically with changing threat patterns and variations of network traffic conditions. The NetShield library is supported by special virtual private networks (VPN), built on top of the Globus security infrastructure developed at the USC Information Sciences Institute (ISI) jointly with the Argonne National Laboratory.

Dongho Kim and Tatyana Ryutov of ISI's Network Research Group are involved in policy management and access control in the project and currently six doctoral graduate students are working on the project. The USC team also collaborates with several world-class research teams including Professor Michel Cosnard of the University of Nice; Sophia Antipolis and the INRIA Institute in France; and Zhiwei Xu, who is the Vega Grid project leader at the Chinese Academy of Sciences in Beijing. Special benchmark experiments will be tested in these global sites against simulated terrorist attacks, grand thefts and privacy abuses during the next several years.

A fortified grid infrastructure will benefit many security-sensitive applications, such as digital government, electronic commerce, public safety, homeland defense, anti-terrorism activities and cyberspace crime control. GridSec will benefit all security-sensitive and network-based metacomputing applications. It offers protection to highly shared computer and network resources and promotes the acceptance of grid computing and services across international boundaries. The broader impacts are far reaching in science, education, business and governments in an era of growing demand for Internet, web and grid services.

(For additional details, visit the Project web site: http://GridSec.usc.edu)

Cell Shocked

continued from page 11

cancer cells, lose the capacity to self-destruct and, instead, begin to proliferate rapidly. So Vernier and his colleagues zap cells with different pulse exposures to see how the cells react.

After exposure, the cells are treated with membrane-staining dyes and imaged to identify internal changes. Vernier's team is also studying the effects of the technology on different types of cells.

"The more powerful nanosecond pulsing requires a very sophisticated solid state micropulse generator, a coaxial cable and special spark-gap switch, all of which we are designing and assembling at USC," Vernier says. "We are finding that UPSET allows us to deliver very concentrated, high field electrical pulses to cells without raising their temperatures and inadvertently destroying them."

Initial observations of the UPSET system have shown that the nanosecond pulses produce bursts of calcium inside cells within milliseconds after the pulse is delivered, Vernier says.

"This is important because calcium ions serve as regulatory messengers in a wide variety of processes across the physiological landscape of the cell," he says. "We are very interested in understanding how we might be able to use calcium ion releases to alter specific intracellular structures."

As the technology is refined, Vernier believes UPSET may become a more practical and more convenient tool for treating a variety of diseases. The technology is also likely to lead to other biologically inspired nanomachines that may one day be capable of coaxing unhealthy cells into healing or killing themselves.

USC Viterbi School of Engineering Ranks Sixth in 2004 *U.S. News & World Report*

THIRD AMONG PRIVATE SCHOOLS

The USC Viterbi School of Engineering rose to sixth place (tied with Caltech) in the *U.S. News & World Report* rankings of graduate schools for 2004, announced April 1.

Among private universities, only graduate engineering programs at Stanford and the Massachusetts Institute of Technology rank above the USC Viterbi School in the 2004 rankings.

Dean C. L. Max Nikias said that the forward momentum of the USC Viterbi School has been buoyed by the rise in the general reputation of USC under President Steven B. Sample — himself a member of the School's electrical engineering faculty and a member of the National Academy of Engineering.

"Steve Sample will go down in academic history as one of the great college presidents of our era," says Nikias. "He makes the work of all of his deans easier and more effective."

Additionally, Nikias stresses, "I cannot overestimate the importance of the major naming gift given this year by Erna and Andrew Viterbi, adding $52 million to our endowment, in addition to associating the School with one of the most renowned engineers of our time."

Nikias pointed to numerous signs of the School's rise, including the number of National Academy of Engineering member affiliates (23, the fourth highest total among private universities); and the numerous "Young Investigator" awards won by junior faculty, in addition to such major honors as the Turing Prize, the top honor in computer science.

"We have improved dramatically and done so with great speed. Only six years ago we were number 16," says Nikias. "This is a tribute to the outstanding quality of our faculty and students." (The USC Viterbi School ranked eighth in both the 2002 and 2003 rankings.)

THE TOP 10

1. M.I.T.
2. Stanford
3. UC-Berkeley
4. U of Illinois
5. Georgia Tech
6. **USC VITERBI SCHOOL OF ENGINEERING**

   Caltech (tied)
8. Purdue

   Michigan (tied)
10. Cornell

(UC San Diego ranked 13; UCLA ranked 16)

In 2003, Nikias notes, the USC Viterbi School scored other notable successes: the award of two major research centers, the Department of Homeland Security's first Research Center of Excellence (joint award with the USC School of Policy, Planning and Development); and the Biomimetic MicroElectronic Systems Center (joint award with the Keck School of Medicine at USC) established by the National Research Foundation, both won despite formidable competition from numerous other schools.

2003 also saw the announcement of new and highly significant partnerships with major corporations, including Pratt & Whitney and ChevronTexaco. "And on the same day of the announcement of the rankings," Nikias says, "the USC Viterbi School also announced a partnership with one of the premier engineering schools in India, the Indian Institute of Technology Kharagpur.

As it did last year, USC led the nation's engineering schools in research funding per tenured faculty member. Total research funding for the USC Viterbi School is now more than $135 million. Only 10 years ago, the figure was less than half that — $58 million.

USC now enrolls 1,878 undergraduates and 3,325 graduate students. In 2003 it awarded 512 B.S. degrees, 850 M.S. degrees, and 109 Ph.Ds.

Of the M.S. degrees, 99 were earned through the School's inventive Distance Education Network (DEN), which enrolls hundreds of students at corporations across the country including Boeing, Qualcomm, United Technologies Corporation, Intel, Aerospace Corporation, Raytheon, Ericsson, SAIC, Northrop-Grumman and Lockheed Martin.

"I believe all faculty, students, and staff of the USC Viterbi School can be proud of how far we have come in such a short time," the dean concludes.

George Chilingar
Engineer, Teacher, Diplomat

George Chilingar and friends at his dinner celebration.

When it comes time to write the history of the USC Viterbi School of Engineering, it will be hard to ignore George Chilingar (BSPE '49, MSPE '50, Ph.D. GEOL '56).

At a banquet held last November to honor him, Dean C. L. Max Nikias noted that for half of the time that it has existed, "the engineering school has been graced with the stylish presence of George Chilingar." Chilingar (AKA Chilingarian) is an extraordinary petroleum engineer, pioneering interdisciplinary researcher, beloved teacher and far ranging world diplomat. The banquet marked his 75th birthday and he was also honored for his 50 years of service, almost all of it spent at USC.

In addition to a host of USC colleagues, luminaries who attended the banquet included L.A. County Supervisor Michael Antonovich, Sheriff Lee Baca, Charles Reynolds, chancellor of Pepperdine University, John Mork (BSPE '70), president and CEO of Energy Corporation of America, several local judges, a large number of officers of Armenian, Iranian, Russian and Thai academic societies and government officials from those and other countries.

"I was very touched that so many people still remember me," said Chilingar, who has met a lot of people. Most regard the gregarious academic as one of the more generous and memorable people they have met. Chilingar is quick to pick up checks and often presents fine Armenian rugs to friends, adding "Persians learned how to make rugs from Armenians."

Iraj Ershaghi (MSEE '68, Ph.D. '72), professor of chemical engineering and director of USC's Petroleum Engineering Program, said every student studying petroleum engineering at USC for the last 40 years has taken a course from Chilingar. Among those students are the petroleum ministers of Saudi Arabia, Kuwait and Thailand.

Another of those students is John Mork who credited Chilingar with changing his life. When Mork was a USC undergraduate, Chilingar gave him a copy of one of his books with the inscription, "to my best student." At the time, Mork confessed that he was hardly anyone's idea of a "best student" but he took Chilingar's words to heart.

"From that moment on, I tried to be that best student," Mork said. "George changed my life."

Chilingar was born in Tbilisi in Georgia. His mother was Russian and his Armenian father was an Iranian citizen who was the personal physician to the Shah of Iran. Chilingar completed his high school education in Tehran before coming to America. He received a bachelor's and master's degree in petroleum engineering and a Ph.D. in geology, all from USC. Upon completing his studies, he spent four years in the U.S. Air Force and was chief of the Petroleum and Chemicals Laboratory at Wright Patterson Air Force Base near Dayton, Ohio. Then he returned to USC as a member of the faculty.

"He originated the standard means for identifying previously undiscovered oil-rich rock by analyzing the ratio of calcium/magnesium in core samples," said Nikias. "He radically changed estimates of global energy resources. It is no accident that one of the major oil fields in the Middle East is named the 'Chilingar Field.'"

One colleague describes Chilingar as "the Google of petroleum geology." Chilingar has written more than 50 books and 500 articles spanning the fields of geology, petroleum and environmental engineering. Many of the books have been translated into Russian and Chinese. And he has by no means retired from academic pursuits. He continues to write books and articles. Current interests include the possibility of using gas migration as a means of earthquake prediction and global warming.

Chilingar was the first American petroleum geologist elected to the Russian Academy of Sciences. The nations of Iran, Saudi Arabia, Thailand, Taiwan, El Salvador, Russia and the country of Honduras, which appointed him Honorary Consul of Honduras 20 years ago in Los Angeles, have all honored him. He also established a translation service for the Los Angeles County Sheriff.

"George has written more books than most people have read," said Solomon Golomb, university professor and professor of electrical engineering. "He has more trophies in his home than Heritage Hall and he speaks more languages than anyone I know. I met George when I was lost on my first day on the USC campus forty years ago. He personally escorted me to the building I was going to."

Chilingar was not sure how many languages in which he could legitimately claim fluency, but there are at least nine. Ever the diplomat, he has, all of his life, moved comfortably through many exceedingly different cultures charming everyone.

Ershaghi related that when Iraq overran Kuwait during the First Gulf War, Chilingar stepped in to financially and emotionally support Kuwaiti engineering students who had suddenly been cut off from their family support systems.

"His office is like a United Nations," said Ershaghi. Like Golomb, Ershaghi met Chilingar when he was lost on his first day at USC as a newly arrived graduate student. Chilingar not only oriented Ershaghi but also persuaded him to study petroleum engineering instead of geology, which had been his intent. "I was his student, then his colleague and now I'm his boss, though I'm not really sure what our relationship is!"

Chilingar's generosity continued last year when he endowed a scholarship fund with a $100,000 gift for students in the department of civil and environmental engineering. When the November banquet was announced, he offered to match any contributions made to the fund and as a result, it grew by another $31,900.

The banquet ended with a parade of representatives delivering more medals, plaques and proclamations honoring him, after which an emotional Chilingar finally addressed the crowd.

"Dean Max Nikias is the best dean we've ever had. Carter Wellford (professor and chair of civil and environmental engineering) is a guiding light. My students all become my dear friends upon graduation," he said. "I was very lucky in my life and I think God Almighty blessed me."

Shri Narayanan

"Say or press '1' if you want . . ."

Do you get frustrated trying to navigate through annoying automated phone answering systems?

Help is on the way from researchers at the USC Viterbi School of Engineering's Integrated Media Systems Center. They are developing a new software program that recognizes frustration in your voice and then takes action by providing a soothing computer response, or immediately transferring your call to a human operator, or some other appropriate action.

The system distinguishes irritated speech from normal speech with 85 percent accuracy, according to Shri Narayanan, associate professor of electrical engineering, computer science and linguistics. Narayanan says that companies can use his system to ensure that callers do not hang up out of frustration. A commercially viable system could be available in as soon as two years, he says. Researchers are honing the software's accuracy and adding response capabilities.

The system identifies frustration from such vocal features as pitch, energy, duration of speech sounds, word content and contextual information. The research team used some 1,400 real calls recorded at a call center to "teach" the system to recognize frustration.

"The underlying voice recognition technology we are developing for this application will be useful in many other areas, including automated training, education and games," Narayanan says.

Narayanan photo by Max S. Gerber

EYE-MOTION COMMOTION

As "windows to the soul," the eyes have a particularly important place in human communication. Researchers in computer graphics at the USC Viterbi School of Engineering's Integrated Media Systems Center (IMSC) have developed a more practical method to synthesize life-like and lively eye motions for computer-generated human representations — a key element in creating a convincing "virtual human."

"Very often, the way the eyes are perceived is what destroys the illusion in attempts to animate computer-generated humans," said Zhigang Deng, a doctoral student in computer science and member of the project team. He presented the findings on February 20 to a campus forum sponsored by the IMSC Student Council.

"As humans, we are especially sensitive to the appearance of the face, and on the face, the eyes are particularly important," he said.

The new method simulates the motion a human eye makes while gazing and blinking. The researchers believe the animations they have produced are as good or better than those produced by more complex methods, such as a custom statistical model developed specifically for eye movement. The IMSC method is based on texture synthesis, which uses measured patterns of eye movement and blinking to create similar patterns.

IMSC researchers are working to develop animated "virtual humans" for use in movies, computer gaming, advertising, education and psychological therapy. The "eye motion" results are being used in a broader effort to develop facial models for animation.

Deng is also creating animations based on speech synthesis with Shri Narayanan, associate professor of electrical engineering, computer science and linguistics. They have created an animated face that moves automatically in order to sing in a realistic manner, and have recently developed hair-modeling methods as well.

At the forum, another computer science doctoral student, Zhenyao Mo, described projects on face caricature and portrait rendering. In the first project, a computer analyzes a photo of a face and then makes a caricature based on a computer model. In the portrait-rendering project, a computer turns a photo of a face into an image that looks like a pen-drawn sketch.

The "eye motion" findings will be published in an upcoming issue of the Institute of Electrical and Electronics Engineers (IEEE) Computer Graphics and Applications. The paper, *"Automated Eye Motion using Texture Synthesis,"* was co-authored by Deng, IMSC Research Associate J.P. Lewis, and IMSC Director Ulrich Neumann. This paper was also presented at the Association for Computing Machinery's SIGGRAPH 2003 conference in San Diego.

For more information on IMSC's graphics research, visit http://imsc.usc.edu/research/project/facemodeling/index.html.
The Integrated Media Systems Center is the National Science Foundation's Engineering Research Center for multimedia and Internet research.

student works

Mars to Earth: Data Packages Travel

Special Delivery Courtesy of Sol Golomb

The data streaming from the *Mars Rovers* to earth came special delivery in concentrated communications packages directly based on research by University Professor Solomon Golomb. Golomb holds the Andrew and Erna Viterbi Chair in Communications in the USC Viterbi School of Engineering's department of electrical engineering.

The millions of miles between the red planet and earth-based antennas, and the limited power of the transmitters aboard Spirit and Opportunity rovers, means that every bit in the message has to count, says Golomb.

To accomplish this, the images and other information acquired by the vehicles is processed in onboard computers using coding techniques that enable the messages sent home to be far smaller and contain far fewer symbols than the original raw data.

One of the systems the *Rovers* use to do this is called the Low Complexity Lossless Compression for Images system, or LOCO-I, developed by a three-man team of engineers working at Hewlett-Packard Laboratories in Palo Alto.

The mathematical heart of LOCO-I is what is known as Golomb codes, building on mathematics published in 1966 by Golomb, who, at that time, had been at USC three years.

"The coding scheme I invented is called 'universal,'" Golomb says, "because it doesn't depend on knowing in advance the precise statistics of what will be encountered; and 'lossless,' because although it reduces the amount of data that has to be sent, it doesn't actually lose any of the information."

Golomb's name occurs more than 34 times in the original 2000 paper describing the LOCO-1. Gadiel Seroussi, a member of the H-P Team, reached out as the *Mars Landers*' messages came home to congratulate and recognize the communications system's intellectual grandfather. "Obviously, Golomb codes have had a very long reach," he wrote in an email message to Golomb.

The Mars images are not the first interplanetary milestone for Golomb. In 1961, a radar signal encoded using another

Solomon Golomb

Golomb-pioneered signal technology was bounced off Venus, and successfully detected by Golomb's team at Jet Propulsion Laboratory.

"Reliable communication over interplanetary distances has had a remarkable history," says Golomb. "Until about sixty years ago many people doubted that it was possible at all. By the time of the *Apollo* moon landings we could get radio signals to and from the Moon, about 250,000 miles away. Now we can get television pictures from a planet more than 100 million miles away."

Golomb photo by Max S. Gerber

FACULTY HONORS & AWARDS

UNIQUE WORK BY SPECIAL PEOPLE

An award won by **Elaine Chew** highlights a recent run of honors for faculty — and provides an example of the impressive breadth of research at the USC Viterbi School of Engineering.

Chew, an assistant professor in the Epstein Industrial and Systems Engineering Department and a researcher at the School's Integrated Media Systems Center, has earned a National Science Foundation (NSF) Career award, the premier grant for young faculty in engineering and the sciences.

Chew's creative work at the intersection of human-computer interaction and music performance is unique. Her research centers on two projects. The Expression Synthesis Project (ESP) creates a driving interface that makes expressive performance possible for non-expert musicians. The Collaborative Performance Assessment (CPA) creates analysis tools for evaluating musical synchronization in collaborative environments.

According to one reviewer, "The research is highly interdisciplinary, combining aspects of performing arts with computer science, operations research and networked digital media. The tools developed in this program will make the performing arts more accessible, and engage more people in the experience of making music."

Only two years after joining USC straight from graduate school at Cornell, **Bhaskar Krishnamachari**, of electrical engineering, computer science and the Information Sciences Institute (ISI), has won a NSF Career award. Despite his youth, the new assistant professor already has more than 60 book chapters, journal publications, conference papers, invited speeches and technical reports to his credit. He is also director of the Autonomous Networks Research Group at ISI.

His field is autonomous networks, particularly wireless sensor networks — ways to create and maintain self-governing "republics" of individual units who cooperate with each other to monitor an environment with minimal power and maximum coverage.

Such networks can provide — in the words of Krishnamachari's NSF award citation — "high resolution interfaces between the physical and virtual world." They have

DEN: No. 1 in Degree Diversity

The USC Viterbi School's Distance Education Network (DEN) continues to diversify and expand its e-learning graduate degree offerings to include four new degrees, including the first M.S. ever offered online in a critical new area of petroleum engineering.

According to DEN's Executive Director Kelly Goulis, DEN's current offering of 22 masters of science degrees and three graduate engineering certificates, all available entirely online, is the largest of any top-ranked research university.

The new degrees added this spring are:

- M.S. in Aerospace Engineering (general)
  http://den.usc.edu/programs/aero
- M.S. in Mechanical Engineering (general)
  http://den.usc.edu/programs/msme
- M.S. in Petroleum Engineering (general)
  http://den.usc.edu/programs/msptegeneral
- M.S. in Petroleum Engineering (Smart Oil Field Technologies)
  http://den.usc.edu/programs/mspte

Goulis says that the Smart Oil Field Technology (SOFT) degree, which teaches new techniques to increase and prolong production from existing fields, is the first ever online. "With petroleum prices at 20-year highs, we believe that this will attract widespread interest," she predicts.

To accommodate the growth in course offerings DEN added two new studio classrooms in Olin Hall of Engineering at USC. This spring DEN successfully implemented its portable "classroom in a suitcase". "These portable systems allow classes to be taught in any networked room on campus," says Goulis.

Enhancing its student support services, DEN recently integrated its own internal database with the university's Student Information System. Synchronizing each student's official background information automatically with DEN's system allows the student to input data only once. In addition, DEN's custom-built e-learning system has been successfully integrated with the BlackBoard system, increasing interactivity and making it more user-friendly for both faculty and students.

Responding to the needs of its students and corporate clients with expanded degree offerings and innovative student support solutions will be what keeps DEN ranked as one of the best e-learning graduate schools of engineering in the country.

FACULTY HONORS & AWARDS

applications ranging from pollution control to security to industrial quality monitoring to systems that can give timely warning of structural problems in vehicles or buildings, to medical instrumentation (in microscopic form).

Krishnamachari's grant includes a commitment not only to research, but to education at the undergraduate level, "as well as outreach to public high school students in Los Angeles."

Citeseer, a service that gathers citations of academic papers, recently compiled the most cited papers of 2002 in computer science. Fourth most cited paper for the year was one co-authored by **John Heidemann**, project leader at ISI. In the same compilation, the second most cited paper was a study of Grid Technology co-authored by ISI grid guru **Carl Kesselman** (MSEE '84).

The Institute of Industrial Engineers will honor **Behrokh Khoshnevis**, professor of industrial and systems engineering, with the Technical Innovation in Industrial Engineering Award. It will be presented during the Industrial Engineering Solutions 2004 Conference to be held May 15-19 in Houston.

Alexander Sawchuk, professor of electrical engineering and deputy director of the Integrated Media Systems Center, and **Zahir Alpaslan**, an electrical engineering graduate student, received the "Best Presentation" award from the International Society of Optical Engineering (SPIE) for their paper *"Three-Dimensional Interaction with Autostereoscopic Displays."* The paper was given in January 2004 at the SPIE Stereoscopic Displays and Applications Conference of the Symposium on Electronic Imaging, and it describes techniques for manipulating and interacting with real or virtual 3-D objects using a light source cursor.

Another USC research effort of rare character and quality attracted some special attention. The American Association of Retired Persons (AARP) has named **Ted Berger** an "Action Hero." Berger, the director of the Center for Neural Engineering, joins nine others, including General Tommy Franks and actress Jessica Lange, in earning the AARP's 2004 Impact Award for being "a person who has had the courage to change our world."

continued on page 18

UPSET Protégé Wins Prestigious Hertz Foundation Fellowship

Matthew Behrend, a senior in electrical engineering at the USC Viterbi School of Engineering, has been working side-by-side with Laura Marcu and Tom Vernier on electric pulsing devices such as the Ultra-short Pulsed Systems Electroperturbation Technology (UPSET). *See feature story on Marcu on page 31. See story on Vernier on page 11.*

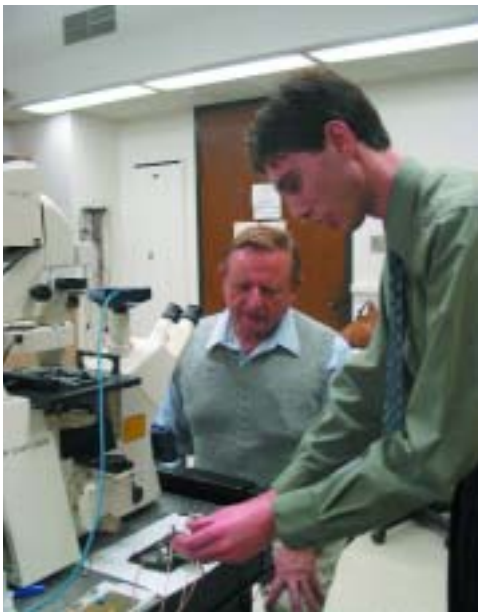
His work has won him a prestigious Hertz Foundation Graduate Fellowship and a National Defense Science and Engineering (NDSE) award that will support his graduate work in electrical engineering.

Behrend helped Vernier design and fabricate a solid-state generator to expose cells to ultrashort pulsed electric fields.

"The electronics are integrated with a microfabricated electrode slide and used with a fluorescent microscope to image cells on a computer screen," he says. "This is the first time we have been able to see the dynamics of how electric fields interact with cells."

Behrend, who graduates in May, was one of only two electrical engineering undergraduates nationwide to receive the prestigious Hertz fellowship award and one of only 19 recipients nationally in science and engineering.

His fellowship and award will pay for his tuition and a personal stipend during his graduate training in electrical engineering. The graduating senior, who has not decided yet whether he will attend USC or MIT, wants to pursue biomedical engineering in retinal prosthetics to help blind people see.



Matthew Behrend, right, winner of two prestigious engineering awards, demonstrates an electric pulse generator used to study cell death, while Martin Gundersen, professor of electrical engineering, looks on.

FACULTY HONORS & AWARDS

Berger leads a team of USC scientists attempting to design and build a brain implant computer chip that could restore mental function in brains that have been damaged by stroke, epilepsy or neuro-degenerative diseases, such as Alzheimer's.

His hope is that such chips can be implanted to perform brain functions previously done by damaged or destroyed neurons. Berger, who holds the David Packard Chair at the USC Viterbi School, has worked on the chip's design for the last 10 years. He anticipates testing it in live rats within the next few years and in humans within the next 10 to 15 years.

Gerald Loeb, professor of biomedical engineering, is also doing original work with a great potential for improving life.

Now the bion microstimulator — an implantable muscle stimulator based on his concepts and patents — has earned the 2004 Medical Design Excellence Award. The Advanced Bionics Corporation, a senior industrial partner of the Biomimetic Microelectronic Systems Center, the new USC ERC, developed the device, currently being tested in clinical trials on stroke patients.

"I am thrilled to see our research turned into a product that will help people cope with disease and disability," says Loeb, who is director of USC's Medical Device Development Laboratory. "I am particularly pleased to see it done with the flair required to win this prestigious design award."

Irving S. Reed, co-originator of the famed Reed-Solomon codes used in CDs, fax transmissions and communications from space, recently added to his long list of honors. Reed will receive the Defense and Security Symposium Lifetime Achievement Award for his contributions to the field of mathematics, particularly in the area of number theory and computation.

The Russian Academy of Sciences has awarded the degree of Doctor Honoris Causa to **Terence Langdon**, the William E. Leonhard Professor at the USC Viterbi School. It was only the 91st honorary doctorate awarded by the academy since its founding in 1724, and the first awarded for materials research on metals.

Ting Chen, an assistant professor of computer science and biological sciences, has been awarded a prestigious Alfred P. Sloan Research Fellowship. His work in the fields of computational biology and bioinformatics applies information theory and mathematics to questions of biology and medicine.

And finally, the parade of international honors for petroleum and civil engineering Professor **George Chilingar** (BSPE '49, MSPE '50, Ph.D. GEOL '56) continues. The most recent entries include the Trofimuk Medal from the Siberian Branch of the Russian Academy of Sciences, the Medal of Honor of Catherine (Russia), and the Russian Order (Medal) of Eagle with Crown. Chilingar is best known for originating the standard means for identifying oil-rich rock by analyzing its ratio of calcium/magnesium.

Indian Initiative

USC and Indian Institute of Technology to Partner

Officials from USC and India's top ranked engineering school, announced the creation of a sister school alliance late in March.

The USC Viterbi School of Engineering and the Indian Institute of Technology at Kharagpur (IIT Kharagpur) outlined four key areas where they will collaborate: joint research, distance learning programs, and student and faculty exchange.

A letter of intent was signed on March 23 after Dean C. L. Max Nikias and USC Senior Vice President of Advancement Alan Kreditor, visited IIT, Kharagpur. The two spent the day touring the campus and meeting with academic department chairs and faculty, as well as with IIT, Kharagpur senior administration.

Vinod Gupta, CEO and founder of InfoUSA and an alumnus of IIT Kharagpur, was the catalyst of this partnership.

"It has always been my dream for IIT, Kharagpur to have a presence and collaboration with a great American university," says Gupta, who previously gave his name to his alma mater by establishing the Vinod Gupta School of Management. "Given the excellence of the USC Viterbi School of Engineering, I believe that when we bring its strength together with the strength of IIT Kharagpur, great things will happen for both schools."

left to right: Professor R. S. Sirohi, director of IIT Delhi, Dean Nikias and Professor S. K. Dube, director of IIT Kharagpur.

"The USC Viterbi School already has extremely strong ties to India and its vastly creative engineering community through our alumni, faculty, and student body," says Dean Nikias, "An alliance with IIT, Kharagpur — one of the most prestigious schools on the subcontinent — will strengthen and cement these ties."

As presented by the educators, the collaboration will initially center on IIT Kharagpur's Gupta School of Management, and involve programs in information technology/communication, biomedical technology and, especially, engineering management. The USC Viterbi School's Distance Education Network, one of the foremost distance education facilities in engineering education, will play a key role.

A formal signing of the memorandum of understanding is expected to take place June 2 at USC in Los Angeles. About 2,500 known IIT, Kharagpur alumni living in the western states of the US will be invited to take part in this important occasion, explains Gupta.

"Vinod Gupta's vision has brought together these two prestigious institutions," says Nikias. "I think engineers on two continents owe Vinod a debt of gratitude for this great initiative. We have the highest hopes for a fruitful and long-lasting partnership."

Dean Nikias (left) with Alan Kreditor at the Taj Mahal, Agra.

"Eventually, I would like to see USC's Viterbi School of Engineering opening an India campus at IIT, and IIT Kharagpur opening a USA campus at USC in California," says IIT, Kharagpur Director Shishir K. Dube.

Earlier in March, Margery Berti, associate dean for graduate affairs, and Cauligi Raghavendra, chairman of the department of electrical engineering-systems, visited four major cities in India — New Delhi, Bombay, Chennai (formerly Madras) and Bangalore. They presented information about USC and the Viterbi School of Engineering to prospective graduate students including many who had already applied.

"They were a mix of masters and Ph.D. students and many of them came with their parents," explains Berti. "In some cases the parents came in place of their children."

Raghavendra made additional side trips to smaller cities. In all, the two estimate they spoke to well over 800 students.

"Reaching out to India is a strategic priority for the School," says Nikias. "For several years USC has been the number one destination for international students and Indian students have historically been one of the brightest and most important student groups in our School."

'MINI-INTERNET' TESTBED WILL DEFEND AGAINST NET ATTACKS

The National Science Foundation (NSF) has awarded a three-year, $5.46 million grant to the USC Viterbi School of Engineering's Information Sciences Institute (ISI) and University of California, Berkeley to improve defenses against Internet-spread computer worms, viruses and denial-of-service attacks. The project, called the cyber DEfense Technology Experimental Research network, or DETER is part of a two-pronged $10.8 million NSF anti-cybercrime initiative.

"With so much of the nation and the world's business now dependent on the Internet," says ISI's Terry Benzel, a nationally recognized expert on cyber-security who is a DETER co-principal investigator, "we are no longer talking about nuisance pranks and vandalism, but potential losses in the billions of dollars. We need better tools to protect ourselves."

Using sophisticated methods, the DETER project will create a facility where those new cyber defense tools can be tested and perfected. The project's architects will build a closed, isolated network that can credibly represent the makeup and operation of the entire Internet, from routers and hubs to end users' computer desktops. The DETER testbed will consist of approximately 1,000 computers with multiple network interface cards. It will be located off the actual Internet. Three permanent hardware clusters, or nodes, at UC Berkeley and at ISI's Southern California and Virginia facilities, will be the core of the system.

This isolated mini-Internet will serve as a shared laboratory where researchers from government, industry and academia can test existing and new security technology, using a wide variety of attack techniques. The testbed will also be an educational resource for training specialists in network security, says B. Clifford Neuman, director of the USC Center for Computer Systems Security, and a co-PI on the project heading the ISI effort. Both USC and UC Berkeley plan to use the facility for existing and future classes.

> The project's architects will build a closed, isolated network that can credibly represent the makeup and operation of the entire Internet, from routers and hubs to end users' computer desktops.

The project will proceed in parallel with a $5.34 million sister project called Evaluation Methods for Internet Security Technology, or EMIST, that will develop testing and evaluation methodologies for the testbed facility. The U.S. Department of Homeland Security is providing some funding for both the DETER and EMIST projects.

"Now, proposed defenses against viruses and worms can only be tested in a few limited-scale private research facilities or through computer simulations that don't adequately represent the way the Internet works," says Professor Shankar Sastry, chair of the UC Berkeley department of electrical engineering and computer sciences, and principal investigator on the project. "This project will develop traffic models and architectures that are scaled down, but still representative enough that people can have confidence that what works here will work on the Internet."

"Much good security research from the past 10 years hasn't made its way to commercial products," adds Benzel, who testified before Congress in 2001 regarding the nation's information infrastructure vulnerability to attacks. "One reason for this is lack of sufficient evidence of the benefits and tradeoffs these new technologies bring. DETER will help bridge this gap."

The ambitious project comes at a time when attacks on the Internet have become more sophisticated, frequent, and destructive. The Slammer/Sapphire worm broke speed records in January 2003 by infecting more than 75,000 hosts around the world within 10 minutes, causing ATM failures and network outages and disrupting airline flight schedules. An analysis of denial-of-service attacks by the San Diego Supercomputer Center (SDSC) at UC San Diego revealed that more than 12,000 attacks against 5,000 distinct targets, ranging from high-profile e-commerce sites to small foreign Internet service providers, had occurred in a three- week period in 2001. A follow-up 2003 SDSC study found that in the next two years, the rate of such attacks had increased tenfold.

"These attacks clearly illustrate the need for better defense systems," says Ruzena Bajcsy, director of the UC based Center for Information Technology Research in the Interest of Society (CITRIS) and a co-PI on the DETER project.

CITRIS researchers at UC Davis will be partnering with Purdue University, Pennsylvania State University and the International Computer Science Institute in Berkeley, CA., in the parallel EMIST effort to create new testing tools.

"Science has an essential role in protecting the country's digital and physical infrastructure," says Mari Maeda, acting division director for Advanced Networking Infrastructure and Research at NSF. "Projects such as these demonstrate how NSF contributes both to cutting-edge research and to the nation's security."

Growing Pains

An aging infrastructure and expanding population pose serious challenges for Los Angeles' future

Professors Joe Devinny and Hank Koffman at the Infrastructure summit

Low grades on a 2002 report card of Los Angeles' infrastructure — including its highways, drinking water and storm water quality control — brought engineers, water policy experts, students, faculty and government officials back to the USC campus February 12 of this year to present new strategies for improving the city's livability.

The Infrastructure Summit was co-sponsored by the Los Angeles chapter of the American Society of Civil Engineers (ASCE), the department of civil and environmental engineering in the USC Viterbi School of Engineering and USC's Keston Infrastructure Institute.

L.A.'s infrastructure problems stem from a growing population of more than 18 million people who now live in the second largest U.S. consolidated metropolitan area, an area that includes the five counties of Los Angeles, Riverside, San Bernardino, Ventura and Orange.

While licensed drivers in California have increased by 90 percent, roadway capacity has grown only 29 percent. At the same time, local and regional transportation agencies are increasingly reluctant to spend the money ($1.3 billion annually according to ASCE) needed for roads.

"In the 1960s, local and regional agencies spent about $60 per 1,000 vehicle miles traveled on highway construction; now it's down to about $15 per 1,000 vehicle miles traveled," said Steve Finnegan, transportation policy manager of the Automobile Club of Southern California. "If that's adjusted for inflation, it's about $4 per 1,000 vehicle miles traveled."

One solution — more use of public transportation — isn't quite as easy as it sounds, said James E. Moore II, professor of industrial and systems engineering, civil engineering and public policy and management. Public light rail trains are expensive, he said, and not practical in Los Angeles. *See Moore oped on page 7.*

"In some places worldwide, the trains make sense, but new rail starts don't make a lot of sense in North America," he said. "We can use those transportation dollars in more effective ways. We should spend it on buses."

Moore urged participants to "legalize private transit, avoid options with low-cost effectiveness, such as trains, make more aggressive use of road pricing schemes to suppress peak demand for transportation" and tap local revenues to replace aging infrastructure.

According to Roy Wolfe, manager of corporate resources for the Metropolitan Water District of Southern California, Los Angeles' city water lines are "extremely vast and aging…two-thirds of this infrastructure is probably 40 years old or more and will require refurbishment over the next few years." Skipping preventive maintenance now will lead to earlier and more expensive replacement of pipelines later, he warned.

Joe Devinny, USC environmental engineer and co-director of USC's Sustainable Cities Program, said Los Angeles wastes a great deal of water through urban runoff. Some run-off could be infiltrated into the ground while controlling for biological hazards. He said that could be achieved through landscaping in new areas that promote infiltration, construction of treatment wetlands or the use of storm water infiltration parks.

"The infrastructure community needs to do a better job of enlisting public support for infrastructure maintenance and development," Devinny said. "Politicians will only respond and make the tough decisions to spend money if the public is behind it, and the public will only be behind it if they clearly understand the need. A crisis will accomplish this, but it would be better to build support before a crisis occurs."

One More Star On The BoC

Bryan Min (BSISE '86) is the founder, president and CEO of Epsilon Systems Solutions, a defense engineering and technology firm based in San Diego, CA.

Under Min's leadership, Epsilon experienced an explosive growth of nearly 6000% since its inception in 1998. In just over five years, Epsilon has become one of the premier defense contracting firms in San Diego.

Min immigrated to America with his three siblings in 1972 and helped his parents run multiple family-owned businesses. He enrolled at USC after winning a four-year Naval R.O.T.C. scholarship. He graduated in 1986 and received his commission in the US Navy. He served America for the next seven years as a nuclear trained submarine officer, achieving the rank of Lieutenant, and eventually the rank of Lieutenant Commander. He also graduated from Virginia Tech with his master's in engineering, and from Harvard Business School's OPM Executive Program.

He currently resides in San Diego with his wife Julie and his two children Brandon and Brittany.

P. Daniel Dapkus Elected to National Academy of Engineering

P. Daniel Dapkus

P. Daniel Dapkus, holder of the W. M. Keck Chair of Engineering at the USC Viterbi School of Engineering, has been elected to membership in the National Academy of Engineering (NAE).

The election of Dapkus, internationally known for his research on photonic devices, brings the number of USC Viterbi School of Engineering NAE members to 23, the fourth highest total among private universities.

Dapkus, who holds appointments in the departments of electrical engineering/electrophysics and materials science, directs USC's Center for Photonic Technology.

"Dan has been a pioneer in the field of using light, or photons, to perform tasks that were previously done by electrons; and is now a pioneer in the emerging field of nanotechnology" says Dean C. L. Max Nikias. "On behalf of the School, and the entire University, I congratulate him on this well-earned distinction."

Dapkus is also a fellow of the Institute of Electrical and Electronic Engineers (IEEE) and Optical Society of America. In 2003, he was elected a fellow of the American Physical Society and the American Association for the Advancement of Science. He received the 2001 IEEE David Sarnoff Technical Field Award in Electronics for his work in photonic materials and devices. In 1992, he received the Lockheed Senior Research Award at the USC School of Engineering, and in 1993 became the holder of the Keck chair. He was an IEEE Lasers and Electro-Optics Society Distinguished Lecturer in 1993-94, and was awarded the IEEE LEOS Engineering Achievement Award in 1995.

Dapkus directs the Compound Semiconductor Laboratory, which has designed numerous novel photonic devices based on optical microresonators. These are miniature cylindrical devices that perform diverse functions on an all optical chip. In addition, he has created ultrasmall Vertical Cavity Surface Emitting Lasers and the laboratory has been a leader in the development of efficient light sources for fiber optic systems.

His nanotechnology research involves creating "quantum dots", which are submicroscopic structures of gallium arsenide and other materials, which have potential applications in both photonic and electronic data processing systems.

Before joining USC's faculty in 1982, Dapkus worked for Rockwell International as manager at the company's microelectronics research and development center from 1979 to 1982, and he was a supervisor at its electronics research center from 1976 to 1979. Dapkus was also a technical staff member at Bell Laboratories, in Murray Hill, N.J., from 1970 to 1976, where he developed high-efficiency light-emitting diodes.

Dapkus has worked as a consultant to numerous organizations including the Kopin Corp., GTE Laboratories, Applied Solar Energy Corp., Xerox Corp., E2O Communications, T-Networks, nLight Corp., Ziva Corp., OEwaves and the Jet Propulsion Laboratory. He has also founded three companies in the optical communications business area.

He is the author of more than 350 papers and earned his BS, MS and PhD degrees in physics from the University of Illinois in 1966, 1967 and 1970 respectively.

Make Your Own Gadgets! *USC Engineer Invents a 3-D Desktop Printer*

A USC Viterbi School of Engineering inventor has created a fast and relatively inexpensive machine that can produce three-dimensional "printouts" in plastic and even metal.

The new machine is a significant improvement over the laser sintering machines employed around the world to build complex 3-D forms from computer files, according to its creator, Behrokh Khoshnevis, professor in the Epstein Department of Industrial and Systems Engineering.

Koshnevis has already been granted one patent and others are pending for his process, which promises to put 3-D object making within reach of home offices.

Both traditional laser sintering and Khoshnevis' "Selective Inhibition of Sintering" (SIS) process, start with CAD (computer aided design) three-dimensional form creation software.

The 3-D graphical shapes in the computer are visualized as stacks of very thin virtual layers. Then each virtual layer is transformed into a real one.

Sintering machines build up objects by spreading a thin layer (less than one millimeter thick) of powdered plastic or other material in a work area, and then guided by the computer's software, the machine melts ("sinters") selected areas. The process is repeated numerous times, with unmelted powder shaken off or blown away at the end of the process.

Layer by layer, this process can build up surprisingly complex structures. For example, it is possible to produce objects such as free rolling balls inside of cages. The process, termed "rapid prototyping, was once used almost exclusively to make specialized models or prototypes, or to create molds for die-casting, stamping or other traditional manufacturing. But as techniques have grown increasingly sophisticated, some companies have begun to employ

The Intersection of Science and Religion

Firdaus E. Udwadia (left) and Donald E. Miller, professor of religion and director of the USC Center for Religion and Culture.

When Firdaus Udwadia read the proposal request for the Templeton Research Lecture Grant on the Constructive Engagement of Science, Philosophy and Religion, he immediately contacted Joseph Aoun, dean of the USC College of Letters, Arts and Sciences, who put him in touch with Religion Professor Donald Miller. Udwadia is a professor of civil, environmental, aerospace and mechanical engineering, and of mathematics.

"Firdaus' enthusiasm impressed me tremendously," says Miller, Leonard K. Firestone Professor of Religion. "I knew that if we pursued this jointly, my partner would be someone who really would enjoy the entire process."

Turns out, the pair will be working together for the next four years.

In March, the College received the 2004 Templeton Research Lecture Grant on the Constructive Engagement of Science, Philosophy and Religion.

The grant, made possible by the John Templeton Foundation, will offer up to $500,000 over four years for interdisciplinary studies. The grant will also support a Templeton Fellow and an annual distinguished lecture series. The foundation's mission is to pursue new insights at the boundary between theology and science.

Udwadia and Miller are co-principal investigators of the grant proposal, entitled "Creativity: An Inquiry into the Nature of Innovation in Science, Art, Philosophy, and Religion."

The project will examine how creativity is at work during revelatory moments that occur in the sciences and the humanities. The project brings together 21 faculty from engineering, business, medicine, gerontology, dentistry, fine arts, communication and policy, planning and development. Together, this network of scholars will create new perspectives and paradigms on insight, revelation and inspiration. It is expected that the project will raise broader issues about the human mind and human culture.

"I think there has to be a discussion between the humanities and science because creative behavior does not compartmentalize itself into one or the other," says Udwadia, who is also a professor of information and operations management at the USC Marshall School of Business. "I believe we will have a very vibrant dialogue."

Neurobiologist Michael Arbib, holder of the Fletcher Jones Chair in computer science, will be an essential part of the project as he investigates the neuro-physiological basis for these moments. Arbib is a professor of computer science, biological sciences and psychology and has written extensively on the interaction between the brain and its linguistic abilities, including the ability to verbalize about religious experience.

Only two universities received the Templeton grants. The other school was the University of Arizona in Tucson, for its project, "Astrobiology and the Sacred: Implications of Life Beyond Earth."

"The challenges of the 21st century require new interdisciplinary collaborations, which places questions of meanings and values on the agenda," says William Grassie, executive director of the Metanexus Institute, a Philadelphia based organization that oversees the grant awards. "We need to put questions about the universe and the universal back at the heart of the university."

—Kaitlin Solimine

Photo by Kaitlin Solimine

rapid-prototyping processes, particularly laser sintering, for "direct manufacturing" or "desktop manufacturing" of finished products.

Instead of using a scanning laser beam to do the melting, Khoshnevis' SIS process treats selected areas of each powder layer with anti-sintering substances. It then exposes the entire piece to uniform, high-intensity heat. Untreated areas of powder sinter. Treated areas do not. Various anti-sintering materials can be used, including salt water.

Khoshnevis notes that his SIS process has several advantages over laser machines. The lasers are extremely expensive (up to $100,000 each), short-lived and energy intensive. The heat source for Koshnevis' SIS machine can be a low- tech gas flame or an inexpensive electrical heater filament. In addition to being inexpensive, the high heat that can be used with the SIS process makes it feasible to produce objects from metal as well as plastics. Finally, because lasers have to scan the entire work area, turning on and off to melt the needed sections, they are slower to build up objects. It takes many hours, sometimes days, to produce large, complicated pieces. The SIS machine can complete a layer in as little as 15 seconds.

The advantages of the process make it possible to see a wider range of use for such machines. "Down the line," says Khoshnevis, "home offices may have them right alongside the printer." Shops may have similar, heavier duty units, he says, filling work niches now held by lathes and milling machines.

Khoshnevis has a working prototype machine and has demonstrated the performance of his machine at several conferences. His research has been supported by a grant from the National Science Foundation.

The dramatic lives of both Andy and Erna Viterbi are the embodiment of the American Dream and an inspiration to all of the students who come to this university from about 70 countries…

A Proper Name

Viterbis Name School of Engineering

by Carl Marziali

What is in a name..? It depends on the name.

The USC School of Engineering is now the USC Andrew and Erna Viterbi School of Engineering, in recognition of the largest naming gift to an existing U.S. engineering school

As much as the $52 million endowment, the prestige of the Viterbi name is an extraordinary gift to the School, Dean C. L. Max Nikias told hundreds of alumni, friends, students and faculty gathered outside Olin Hall on March 2. The name "Viterbi" already carries legendary associations: the Viterbi Algorithm, which enables error-free digital communications; and Qualcomm, the wireless giant Viterbi co-founded. Now with their gift, the Viterbis have invited USC to share in these accomplishments.

"Erna and Andrew Viterbi's gift is dedicated not only to the enrichment of engineering at USC, but also to the improvement of life around the world," said USC President Steven B. Sample. "Their names will forever be associated with the university, and the USC Andrew and Erna Viterbi School of Engineering is a vote of confidence in the faculty and students who, for nearly a century, have advanced the field of engineering at USC and around the world."

Such a gesture was exactly what Nikias hoped for when he announced a $300 million fundraising initiative for the school of engineering, a campaign that is nearing the halfway mark.

"Andy Viterbi is a very unique person. He is recognized as an engineering giant around the world. He is both a captain of industry and a widely admired academic. He is not just an innovator, but a true pioneer who has changed the way we all live and communicate. The dramatic lives of both Andy and Erna Viterbi are the embodiment of the American Dream and an inspiration to all of the students who come to this university from about 70 countries," said Nikias. "The Viterbi Algorithm is often pictured with a characteristic 'trellis' diagram in which multiple binary paths diverge and then come together again. With this naming, the path of Andy and Erna, and that of our School, have come together for good."

Viterbi is also a Trojan and he has been one in almost every way. He has been a student. He is currently a USC Trustee and is a member of the Board of Councilors for the School that now carries his name. He was a serendipitous builder of the faculty and now has agreed to join that faculty. He will hold the Presidential Chair of Engineering.

It is a fitting return for a scholar who began his academic life 42 years ago with a doctorate in electrical engineering from USC. Viterbi chose USC in 1957 because it was the only institution that would let him pursue a Ph.D. and keep his job in the communications research group at Pasadena's Jet Propulsion Laboratory (JPL). Soon to be married to Erna and with visions of growing a family, Viterbi could not afford the luxury of full time graduate study.

It was a wise decision on both sides. Viterbi formed the first link between JPL and USC, starting a fortuitous chain of events. Based partly on Viterbi's recommendation, then Chairman of the electrical engineering department Zohrab Kaprielian invited Solomon Golomb, an applied mathematician who was one of JPL's brightest stars, to join the USC faculty in 1963. Golomb's recruitment soon attracted JPL's Lloyd Welch, William Lindsey, and a handful of other top communications engineers. They became the nucleus of an upwardly bound engineering school at USC that now ranks among the top ten in the nation. *See story on Sol Golomb on page 16.*

Viterbi himself had been one of JPL's best young scientists. He could have enjoyed a long and brilliant career in the young space program. But Viterbi had wanted to be a professor since his childhood days in Boston, when he gazed across the river at MIT He was the only child in an Italian Jewish family forced to leave their native country by the so-called racial laws that targeted Jews and other minorities. He and his parents sailed from Europe just two weeks before the start of World War II, thanks to a tip from someone close to German diplomatic corps.

Later, in one of those breakdowns in communication that Viterbi's work has made archaic, Jewish families around Europe began to disappear, unable to save themselves or to

Andrew as a child in Bergamo, Italy.

Erna and Andrew Viterbi photo by Michelle A. H. Smith

from top: Andrew's mother Maria; Andrew as a child riding a tricycle; his father Achille; and Andrew while studying at USC.

Viterbi simply says:

warn others with a simple phone call.

Safe in Boston, the child refugee struggled with English in kindergarten. The Viterbi family tried to adjust to a new world and to a double prejudice against Jews and Italians. Achille Viterbi, Andrew's father, had a limited medical practice. Private schools and expensive tutors were out of the question. But the teenage Viterbi excelled in the sciences, and after graduating fourth in his class at Boston Latin High School, he won a scholarship to the Massachusetts Institute of Technology.

Viterbi earned bachelor's and master's degrees in electrical engineering at MIT. Then he took a leap that, in hindsight, launched his career. In June 1957, Viterbi moved his parents across the country and took a job — his first out of college — at JPL. Within three months the place was in ferment from the Soviet Union's launch of Sputnik I, the first man-made object to orbit the earth. Edward Teller, father of the hydrogen bomb, declared the U.S. had lost a battle more important and greater than Pearl Harbor. Putting up an American satellite became a mortal imperative, with JPL the key battleground.

Viterbi soon became known for combining excellent mathematical skills with a rare nose for crucial problems. "If he was working on it, it was important," says Bill Lindsey, professor of electrical engineering at USC, who was part of Viterbi's JPL team. "He worked on problems that interested more than just three or four (scientists). The world would turn out to be interested in them. I don't remember too much of any papers he published that didn't lead to something significant."

Viterbi simply says: "The most interesting problems come out of the real world."

He quickly built a reputation as a hard worker. Lindsey remembers he and Viterbi struggling with a particularly hard problem one Friday. The following Monday, Viterbi walked in with a solution. He had figured out the problem at the beach as he and his wife Erna watched their first son, Alan, playing in the sand.

Seven months after Viterbi's arrival, the scientists at JPL had their answer to Sputnik. Officially it was called *Explorer I*. Inside JPL it had a different name — Deal — a reference to the loser's reaction in a card game when the winner wants to cash in his chips and go home.

"We were in the position of wanting another deal of the cards," Golomb says.

Deal turned up a flush for JPL. The January 31 launch went flawlessly. Photographers from *Life* swarmed the control room. Golomb and Viterbi wound up in the magazine.

The satellite had been the work of a small army of engineers and designers whose contributions had far-reaching impacts. By making sure that the satellite and mission control could communicate reliably, Viterbi's small team had solved much more than the problem at hand. It had laid a big part of the foundation for modern wireless communication.

"Up until that time most communications systems were analog. We were working on digital communications. I think that we advanced the theory quite a bit," says Welch, who is now emeritus professor of engineering at USC.

But Viterbi had not forgotten his childhood dream. In 1962 he completed his Ph.D. in digital communications at USC and became a professor at UCLA.

Ironically, it was that move away from applied research and into academia that led to the most famous and applicable of his discoveries. In the mid sixties, after struggling to teach some hard concepts in message coding theory, Viterbi decided to look for an approach that his students would understand. The result was the Viterbi Algorithm.

The algorithm relies on complex probability theory and dynamic programming, and its power was not immediately understood when Viterbi published his seminal paper in 1967. In essence, a Viterbi decoder seeks to retrieve the original voice or data message from a coded digital stream (coding is the addition of redundant bits to protect messages against interference and eavesdropping). Previous

"The most interesting problems come out of the real world."

decoders relied on a "hard decision" method: as each bit came in, the decoder had to decide on the spot if the bit was a zero or a one. Frequently, the message was so muddled that the decision was no more than a guess.

The Viterbi Algorithm looks at all possibilities, or paths, for a digital message. It labels each bit with the probability that the bit is a zero or one. This way, the algorithm suspends judgment on any one bit until more bits can be studied. Then it picks out a path by working backwards in time through the tree of possibilities and finding the most likely route. The key operation at each stage is "add, compare, select."

The beauty of the algorithm is its ability to rule out some paths very quickly. There are two to the tenth or 1,024 paths for a message just ten bits long. For a real-world digital message of millions of bits, the analysis could be unwieldy. Instead, the Viterbi Algorithm takes advantage of the fact that each bit spends a finite time in the encoder. The algorithm also looks at the effects of interference on a baseline sequence of symbols and uses that as a yardstick by which to compare different paths. Taken together, these shortcuts greatly simplify the analysis.

Within a couple of years, Jerry Heller at JPL and Dave Forney at Motorola published papers demonstrating the power of the Viterbi Algorithm. The applications were so obvious that Viterbi formed a company, Linkabit, to sell Viterbi decoders and consulting services. Linkabit's co-founder was a University of California-San Diego engineering professor named Irwin Jacobs (A third partner, UCLA professor Leonard Kleinrock, was initially part of the group).

At first the company won military contracts for digital communications. It was becoming clear that digital was a far better anti-jamming technology than analog. In the early 1980s Linkabit joined a larger company and ventured into commercial satellites, descramblers and other business and consumer applications.

Then in 1985, the parent company began to fall apart — luckily for Viterbi. He and Jacobs quit within weeks of each other and regrouped three months later to form Qualcomm. The now legendary wireless chipset company started with seven employees over a drycleaner's shop in San Diego.

Viterbi confesses that he was not quite sure at first what Qualcomm was going to sell. Its first major venture was OmniTRACS, a two-way satellite communication system for trucking fleets. It was ingenious, profitable and the first commercial application of spread spectrum technology. The military had been using spread spectrum for years to prevent jamming. In its most basic form, it involved "hopping" the signal frequency over a wide band.

The trucking market was limited. But Viterbi had proposed applying spread spectrum to cellular phones as early as 1982. By the late '80s, one of Qualcomm's top researchers, Klein Gilhausen, along with Viterbi, Jacobs and others, perfected a spread spectrum method called CDMA (Code Division Multiple Access).

Technically, CDMA was vastly superior to anything on the market. That was just what the cell phone industry did not want to hear. Manufacturers and phone companies were already invested in a different standard.

"Industry likes to take incremental steps rather than bold new initiatives. When we went to them with a CDMA approach, they pretty much all sent us away," Viterbi says. "Pac Tel (now Verizon) was the only one that really listened."

That all changed after a demonstration of CDMA in 1991, when Qualcomm sent 100 mobile users driving around Mission Bay in San Diego and invited cell phone executives to test the system — "at the end of which they agreed to standardize it," Viterbi recalls.

Qualcomm's troubles were not over. Once it became clear that CDMA was the hot new thing, Swedish cell phone maker Ericsson filed suit, claiming that it had blocking patents for the standard.

Unbeknownst to Ericsson, Viterbi and Qualcomm had a secret weapon from deep in their past: Solomon Golomb of USC. Aside from knowing everything about coding and cell

continued on page 30

Tracking Explorer I at JPL, Andrew with headphones at right. (Life magazine, 1958)

Andrew and Erna with their children Alan and Audrey, 1965.

Erna Viterbi *Family and Flight*

Erna Viterbi

Meet Erna Viterbi, adopted member of the Trojan Family. She is quick to laugh and has been known to cry at just the right time. She has a story to tell that is every bit as interesting as that of her renowned husband.

Important note: The $52 million that is the largest naming gift to an American engineering school is not just from husband Andrew Viterbi, author of the Viterbi Algorithm.

"More or less, we try to do things together. California community property," she says, with a twinkle in her eye. "Andrew suggested it and I enthusiastically agreed. The School is something we are very proud of and glad to be associated with."

Erna Viterbi feels a strong bond with USC and that bond is with people, not any physical aspect of the campus. She does not recall visiting the campus when her husband was working on his Ph.D. But after 46 years of marriage she has learned a great deal about his academic and entrepreneurial worlds. She is smart and she pays attention. She knows who is good and who is, she searches for the right words, "mediocre."

"We have known a lot of professors who worked at JPL and who are at USC now, and they have brought honor and knowledge to the School and its students," she says. "What makes USC special is the caliber of the people. That has had a tremendous impact on the School and what the School is all about. They have hired from all over, excellent faculty, and certainly that has been something that pleases my husband very much. It also pleases me."

"We have met and appreciated many university presidents, but USC's Steve Sample is unique and he has our greatest admiration," she says emphatically.

"Max Nikias is terrific also. I think he's doing great things as dean of Engineering. He has great vision and he works hard making sure his vision becomes reality."

Erna Viterbi, born Erna Finci, is from a Sephardic Jewish family expelled from Spain during the time of the Inquisition. The family fled to Italy for several generations and moved again to the Balkans, specifically to Sarajevo, where for 400 years they lived in a rich stewpot of frequently changing cultures and religions. Fleeing and family are keywords in Erna's life.

"My family escaped to the Italian side at the beginning of the German invasion of Yugoslavia," she says, noting that Italy had also invaded Yugoslavia in 1941. Their family fled to a harrowing existence in Italian-occupied Montenegro before escaping northward to Dalmatia from where they were deported to northern Italy. "We felt we had a better chance with the Italians and we survived. The people of Italy were very good to us, very kind hearted. They saved our lives time and time again, at the risk of their own lives."

She tells how one day in Montenegro when she was not quite seven years old, all the men above the age of 10 in the town, including her father and her grandfather, were arrested after the local resistance blew up a truck carrying Italian soldiers. The men were brought out to the town square where every second one was to be shot in retaliation. When she saw her grandfather in handcuffs, she began to cry. "It really upset me," she says, her voice breaking as memories 60 years old flood back. "To see him in that condition for having done nothing wrong." An Italian officer asked why she was crying and when her family explained, "He said 'I don't want this child crying. Let them go, all of them.'" Thus, Erna's crying saved all the men of her family.

She was 10 when the Germans invaded Italy and the Finci family once again fled, this time to Switzerland. "We walked all night in the mountains and went under the border fence," she remembers. "Often they (the Swiss) sent you back and by then it was daylight, and you would always be caught. So we were lucky."

When the war ended, her parents decided not to return to Yugoslavia. They went back to Italy where, with no passports or other documents, no jobs or money, and very little hope, they found themselves in a camp for displaced persons in the heel of Italy. "It was still a difficult time," she says simply.

Erna in Sarajevo.

The family applied for visas to come to the U.S., and then they waited, and waited. Finally, in March 1950, they found themselves in Los Angeles, which Erna described as "a huge, huge village with little centers, a different world but one with a promise for a better future."

The Finci family settled in Los Angeles and at some point became good friends with some of Andrew Viterbi's cousins. These cousins pestered Erna, by now a beautiful young woman, to meet their cousin from Boston who was coming west for a visit. "I didn't want to meet anyone's cousin," she says. But eventually she consented to go out for

Erna Viterbi photo by Michelle A. H. Smith

Erna with her family in Italian detention near Parma, 1942.

Erna and her mother in a Rome cafe while waiting for U.S. visas, 1950.

Erna and Andrew's wedding, 1958.

dinner and dancing with them and their cousin at the old Ambassador Hotel. Her eyes light up as she talks about "that ancient long gone history."

"We went dancing at the Coconut Grove. He went back to Boston but when he returned he asked me for a date the minute he arrived in L.A., and that was it. We've been married 46 years."

Erna's new husband got a job at Pasadena's Jet Propulsion Laboratory, but he wanted to complete his Ph.D. An only child, his father had been 54 and his mother 41 when he was born, so he also wanted to care for his aging parents in the warm Southern California climate. And the young couple soon had children of their own.

> *"None of it was very hard work because he enjoyed every moment of it. He honestly did. Somebody said if you love what you do, you'll never work a day in your life. And that's the case with my husband."*

"They were happy years, they were wonderful years," she says. While her husband simultaneously worked full time at JPL and on his Ph.D. at USC, and would later balance full time academics at UCLA with astonishing success as an entrepreneur, he made it look easy. "None of it was very hard work because he enjoyed every moment of it. He honestly did. Somebody said if you love what you do, you'll never work a day in your life. And that's the case with my husband."

The Viterbis have three married children — Audrey, mother of two boys; Alan, who has three little girls, and Alex, who is the youngest and just recently married. The names all begin with "A," reflecting a time when families handed down silverware and fine linens marked with the family initials. There are almost no such family treasures to hand down though. It was all traded for survival.

Both Viterbis vividly recall the day Andrew came up with his famous algorithm. It was Purim, the most festive of Jewish holidays, and the Viterbis had taken their children to their friends' synagogue. There was a costume contest where children dressed up as biblical characters and Erna had made costumes for their children.

"It went something like this: he was doodling, doodling on a piece of paper. 'What are you working on?' I asked. He answered, 'I think I've come up with an idea,' and continued looking at it like he couldn't get away from it. That's where he was totally focused."

Finally, Erna was able to get his attention and tell him that the children had won first prize. "Andrew was embarrassed because he felt it wasn't proper that they should win prizes when we were only guests, but I found the doodling more embarrassing. Finally I asked him if this was something really important.

"'Yeah,' he answered, 'but I thought about it and it's really nothing major.'"

The Viterbi family, March 2, 2004.

A Proper Name *continued from page 27*

The Qualcomm team in the early days.

phone standards, Golomb was fluent in Swedish. Called to the stand as an expert witness, Golomb read memos from Ericsson engineers that directly contradicted the company's claims. Ultimately, the conflict between Qualcomm and Ericsson was settled in a manner which led to a collaboration to further promote CDMA.

There is another link between Qualcomm and USC. Under Dean of Engineering Len Silverman, the school signed up Qualcomm as its first customer for what has become one of the best and biggest distance learning programs in the country, the Distance Education Network (DEN). The very first long distance learning students were Qualcomm's engineers. *See story on DEN on page 17.*

"USC engineering and I grew up together," Viterbi likes to say. "Zohrab created it. I like to say that Len grew the distance learning nationwide just to service my company," he says laughing, "but we were his first customers.

"USC engineering and I grew up together," Viterbi likes to say. "Zohrab created it… And Max's boundless energy and great vision has propelled us into the top ten."

"And Max's boundless energy and great vision has propelled us into the top ten."

Explaining his and Erna's record-setting gift, Viterbi says: "When this fundraising drive came up and this whole issue of naming, I felt it was appropriate. We grew up together. I have great faith in what they're doing and in the future. I think this is a great opportunity right now because most universities are under pressure, and all the public universities in the state are in particular pressure. This is an opportunity of getting really good people and getting research funds, which Max and the faculty have been great at."

At the March 2 ceremony to announce the Viterbis' gift, Nikias said: "We now have a proud legacy to honor, uphold and advance. The responsibility humbles us."

Despite his many accomplishments, despite his membership in not one but three national science or engineering academies, Viterbi also seemed humbled by the occasion.

USC Viterbi School of Engineering naming celebration, March 2, 2004.

"In over 30 years of teaching I don't think I ever had so many students in my audience interested in what I had to say," he told the crowd.

Viterbi added that despite his links to several other universities and research centers, he and Erna have more friends at USC.

"There's a certain warmth in one's feelings for fellow Trojans that goes beyond the rah-rah feeling common at most universities," he said.

At a lunch after the event, Golomb toasted his old friend: "It is a wonderful legacy for future generations of engineering students at USC to go through a school named for one of the great pioneers in the history of engineering, and who demonstrated that one and the same person could be a brilliant researcher, a successful entrepreneur, a generous benefactor and an upholder of the highest standards of ethical conduct and integrity — and he's also a real nice guy."

left to right: Solomon Golomb, Andrew Viterbi and William Lindsey.

Laura Marcu

LET THERE BE LIGHT

A USC biomedical engineer pioneers new optical techniques to detect diseased cells

by Diane Ainsworth

In a few short years, Laura Marcu's (MSBME '95, Ph.D. '98) optical innovations may enable doctors to detect a variety of diseases such as cancer and heart disease at much earlier stages. Her research appears poised to usher in a technological and diagnostic revolution.

Marcu, a research associate professor of electrical and biomedical engineering, is leading an interdisciplinary team at the USC Viterbi School of Engineering and Cedars-Sinai Medical Center in Los Angeles. The team is developing a powerful new optical technique to diagnose these diseases in real time and with greater precision than has ever been possible before.

Marcu works in "biophotonics," a field that incorporates the physical sciences, engineering, biology and medicine. The discipline uses spectroscopy — the study of wavelengths emitted by light — pulsed lasers and molecular imaging to perform studies of living cells. Marcu obtains an image of the natural light sources within cells, and uses light-emitting agents, such as molecular probes or dyes that are introduced into cells, to watch some of the dynamic processes going on in their molecules.

"When molecules in cells absorb photons, or particles of light, they become excited and re-emit them in a different color, an effect called fluorescence," says the bioengineer. "The fluorescence will tell us what molecules are present and, therefore, what kind of disease we are dealing with. It gives us critical information about the biochemical, functional and structural changes that are taking place inside the tissue or cells."

A native of Romania, Marcu received her engineering degree in precision mechanics and optical instruments from the Polytechnic Institute of Bucharest in 1984. She later entered USC's biomedical engineering program, earning a masters of science degree and Ph.D. in 1995 and 1998, respectively.

Her technique is a process to divide wavelengths of light from living tissue much like a prism splits white light into rainbows of color. She measures the amount of time molecules remain in an excited electronic state before returning to a ground state. These changes at the molecular level can reveal how far along a disease has progressed.

For the last year, Marcu has been working with several graduate students in USC's biomedical and electrical engineering program to build miniaturized spectroscopic instruments and high-speed data-processing software that measures cellular fluorescence and the molecular features of human diseases. Their work, funded in part by the National Institutes of Health, is part of a revolution in optical microelectromechanical (MEMS) systems. The size of the instrumentation has been a major hurdle to making fluorescence spectroscopy commercially viable, but her sophisticated automated optical device is no larger than a pen.

At USC, Marcu and her students huddle over a laboratory table and laptop computers to conduct experiments in cellular and molecular imaging at the micro and nano-scales. At Cedars, she directs another group to design these fiber optic scopes and the accompanying hardware and software.

Marcu's optical probe is tethered by a fiber optic cable to a high-speed, automated data-processing system. The probe contains a small lens and lighting system to magnify and light up diseased tissue giving surgeons needed visual information about it. Light transmitted through the fiber optics onto the tissue is deflected back through the scope to a computer processor, which analyzes and displays biochemical information. Cardiologists are eager to use the devices because they can detect the earliest and most dangerous buildups of plaque in the major arteries of the body.

"That could make a difference, because heart attacks and strokes still kill more Americans than any other disease in the U.S. today," Marcu says.

Currently, fluorescence lifetime spectroscopy can identify fatty deposits and other markers of vulnerable plaque with an accuracy rate of about 93 percent, she says. At the same time, the transformations she sees in the tissue, at the intracellular level, are giving cardiologists new insights into the ways in which this disease develops over the years.

The imaging technique is being tested at the Maxine Dunitz Neurosurgical Institute at Cedars-Sinai Medical Center in Los Angeles, where Marcu holds a joint appointment in the Biophotonics Research and Technology Development Laboratory within the Department of Surgery. With funding from The Whitaker Foundation, she and cancer neurosurgeons Keith Black and Brian Pikul are seeing if fluorescence spectroscopy can more accurately define the physical boundaries of the most invasive brain tumors. Surgeons have been pressing the medical establishment to find new ways of identifying the margins of brain tumors very precisely, so that they can target the tumors with powerful drugs. Marcu believes that the new technology will soon spread to many areas of medicine.

"We are on the verge of revolutionizing conventional instruments, such as catheters, endoscopic probes and other types of diagnostic tools to give surgeons instantaneous information about diseased tissue," Marcu says. "These new techniques and technologies will ultimately lead to an improvement in our ability to detect diseases in the early stages and to develop more effective therapeutic methods, such as drug treatments or other therapies, to combat them."

For Laura Marcu and her team of scientists and doctors, it seems the revolution has already begun.

SMALL AND DEADLY

USC ENGINEERS MEASURE ULTRAFINE AIR POLLUTION

by Diane Ainsworth

Constantinos Sioutas sets up an air concentrator to measure tiny particles of urban pollution.

Engineers from the USC Viterbi School of Engineering are developing new technologies to measure the toxic properties of ultrafine particles in air pollution and helping scientists link smog and cardio-respiratory disease.

"We are just beginning to realize that these microscopic specks of dust and soot are far more toxic in the human body than larger, coarser particles," says Constantinos Sioutas, deputy director and co-principal investigator of USC's Southern California Particle Center and Supersite.

"They aren't trapped by the nose and trachea, but travel all the way down to the tiniest branches of the lungs and enter the bloodstream through the alveoli, which are very thin-walled sacs of spongy tissue at the ends of the bronchioles," says Sioutas, an associate professor of civil and environmental engineering.

More residents than ever are falling prey to microscopic soot less than 1/100th the diameter of a human hair. These particles, known as "particulate matter" or PM, lodge deep inside the lungs. They are either rapidly absorbed into the bloodstream or remain embedded for long periods of time.

Recent studies by Harvard University, the National Institutes of Health and others, blame particle smog for a 17-percent increase in premature deaths from heart and lung disease. Nationwide, this invisible soot, which is less than 2.5 microns in diameter, has been linked to roughly 60,000 smog-related deaths in the United States each year. In 2000, the Environmental Protection Agency responded to the paucity of information about particulate matter by establishing the Southern California Particle Center and Supersite, the nation's largest research center focused on understanding the health effects of exposure to airborne particulate matter. With an $18 million grant, the center brought together interdisciplinary faculty from five institutions in Southern California — USC, UCLA, Caltech, UC Irvine and UC Riverside — to measure the physico-chemical characteristics of air pollutants and identify the properties that can aggravate such health problems as chronic asthma, bronchitis, emphysema and other respiratory, as well as cardiovascular diseases.

Particulate matter usually contains a combination of fine solids such as dirt, soil dust, pollens, molds, ashes and soot, along with even finer aerosols formed in the atmosphere from gaseous combustion byproducts, such as volatile organic compounds, sulfur dioxide and nitrogen oxides, says Sioutas. Invisible, for the most part, these particles "snow" on people from a wide range of sources, such as factory and utility smokestacks, vehicle exhaust, wood burning, mining, construction activity and agriculture.

Little is known about the chemical composition of this "invisible soot," Sioutas says. Consequently, federal, state and local air quality management agencies currently regulate only the mass of particulate matter. However, the size and chemical composition of these particles are far more important in determining the degree to which they pose a health risk.

Sioutas' interest in the field began in graduate school at Harvard, where he built his first particle concentrators. He currently holds nine patents on concentrators that can separate the tiniest particles of pollution from the majority of the surrounding gases so that the particles may be studied.

These monitors are able to identify pollutants in discrete size groups. Ultrafine particles are less than 0.1 micrometers and include those generated by combustion. Fine particles range in diameter from 0.1 to 2.5 micrometers and include the ammonium sulfate and nitrate compounds that produce eye-stinging photochemical smog. Course dusty particles larger than 2.5 microns contain mostly soil and sea salt elements.

To help scientists identify the physical and chemical properties of microscopic pollution, the concentrators are being employed by a host of institutes and agencies including the EPA, the USC, UCLA and Harvard medical schools, and the National Institutes of Health in the Netherlands and Canada.

Locally, Sioutas has monitored concentrations of toxic particulate matter in the vicinity of interstates 110, 710 and the 405, which slices north-south through the Los Angeles basin. There are 15 million individuals and 10 million vehicles in the Los Angeles basin. Everyday, nearly 100,000 vehicles travel on the 405 alone.

"It may sound a little odd, since we live in one of the smog capitals of the country, but the lack of conclusive information to link ambient vehicular air pollution to cardio-respiratory disease is a critical gap in our work," says Sioutas, a member of the Air Quality Advisory Committee on Particulate Matter for the State of California. "Automobiles spew millions of tons of this noxious soot into the air every day, but a lot of it is far smaller than anything we have ever been able to measure in the past."

With a team of researchers from USC's department of civil and environmental engineering, as well as from UCLA's School of Public Health, Sioutas made detailed measurements showing that gasoline emissions constituted about 90 percent of all vehicular emissions along the 405 and 110 freeways. But along Interstate 710, 80 percent of the particle pollution came from diesel engines, which some researchers consider to be more toxic than gasoline emissions.

The smallest particles, Sioutas stresses, were the most toxic.

"They're the easiest to inhale," he says. "They can flow all the way down into the alveoli and coat that spongy moist lung tissue, which is then rapidly absorbed in the bloodstream."

The findings have raised serious concerns about the adequacy of current national air quality standards for particulate matter. In spring 2003, the EPA was prompted to initiate a new review of particulate matter standards. The review is not yet complete, but the board is considering a proposal to impose stricter regulations nationwide on particle mass [size] and chemical composition.

Sioutas photo by Irene Fertik

DIGITAL REUNION: THE PARTHENON AND ITS ART

by Eric Mankin

What Britain's Lord Elgin tore apart, USC's Paul Debevec is putting back together — digitally.

This summer, USC Viterbi School of Engineering computer graphics technology will reunite priceless Greek treasures that have been separated by 202 years and 1,500 miles.

In 1802, British agents removed dozens of sculptured figures from one of antiquities' greatest architectural treasures, the Parthenon, and shipped them back to Britain, where they are now displayed in the Duveen Gallery of the British Museum.

Paul Debevec, a research assistant professor of computer science in the USC Viterbi School of Engineering, and his research group at USC's Institute for Creative Technologies (ICT) are returning these sculptures to their former places of honor in the Parthenon. It is a virtual return — a simulation — but a simulation of unprecedented realism and fidelity that will be presented at this year's prestigious SIGGRAPH conference.

The Parthenon, dedicated to the goddess Athena, was the crowning monument of the Athenian Acropolis built during the reign of Pericles. Designed by the architects Iktinos and Kallikrates, and dedicated in the year 438 B.C.; the Parthenon has been partially destroyed by nature and warfare, yet remains one of the world's best-known and most architecturally revered structures.

The Parthenon's sculptures include the marble statues from its triangular pediments and high-relief metopes from its outer entablature; as well its famed low-relief frieze that encircled the inner entablature of the temple, all carved under supervision of the sculptor Pheidias. In the early 1800's, when Athens was part of the Ottoman Empire, Thomas Bruce, the seventh Earl of Elgin brought the majority of the Parthenon sculptures to England, where they are now on display in the British Museum. Whether they should remain in London or one day be returned to Athens is a topic of current and historic controversy between England and Greece. Other relics from the Parthenon remain scattered throughout Europe.

Paul Debevec

To reunite them in simulation, the USC team developed two custom 3-D scanning processes — one for the sculptures, and one for the architectural ruins. For the sculptures, Debevec worked with Chris Tchou and Tim Hawkins of ICT to build a custom structured-light scanning system to record highly detailed, 3-D geometric models using a desktop video projector and a digital video camera.

To obtain access to sculptures, the team worked with Tomas Lochman, the director of Switzerland's Basel Skulpturhalle, a museum that features high-quality casts of all of the Parthenon's sculptures, including the ones in London, Athens, Paris, and other locations. In five days, Debevec, Tchou, Hawkins, and Philippe Martinez, a collaborator on the project from the archaeology department of Ecole Normale Superieure in Paris, captured over 2,000 scans of the collection, which the team could assemble into millimeter-accurate models of the frieze, metopes and pediment sculptures.

The 73-meter-long Parthenon was a different matter. Working with the ongoing Acropolis restoration effort, the team brought a time-of-flight 3-D laser scanner to Athens to record the geometry of the ancient temple. The device, manufactured by Pittsburgh-based QuantaPoint, Inc., uses an infrared laser reflected off of a spinning mirror to scan a spot of light across the surface of the structure. By measuring the time it takes for the laser light to return to the device, the distance to each point on the structure can be determined.

In five days, the team acquired 120 panoramic laser scans in and around the Parthenon comprising over six billion 3-D point measurements of the site. Team member Andrew Gardner worked with student researchers Nathan Yun and

from left to right: John Shipley, Quantapoint Field Services Supervisor; Paul Debevec, Executive Producer; Maya Martinez-Smith, Location Coordinator; Andrew Gardner, Research Programmer; Chris Tchou, Research Programmer; Brian Emerson, Digital Animator; Philippe Martinez, Archeological Consultant; Tim Hawkins, Supervising Producer/Graphics Research.

Therese Lundgren to assemble 53 of the laser scans into a 90 million polygon model of the Parthenon and its surrounding environment.

Just as important, the team used a novel surface reflectance estimation technique to record the Parthenon's surface colorations. Digital photography was part of the solution, but not all of it, since a photograph only shows what a structure looks like under a particular form of illumination with whatever shading, highlights, and shadows might be present. To correct for the effects of lighting, the team used a new "light probe" device to measure the incident illumination from the sun, sky and clouds at the same time as each digital photograph was taken of the structure.

Then, in the laboratory, Tchou and student researchers Jessi Stumpfel and Andrew Jones were able to "unlight" the photographs, determining the true colors of the Parthenon's varying time-worn surfaces. Comparisons to traditional reflectance measurements made at several points on the Parthenon showed that the color estimates were accurate to within five percent of the actual surface colors, making their computer model the most accurate record of a scene's geometry and reflectance to date.

With the necessary 3-D models in hand, Debevec's team virtually repositioned the sculptures into their former places on the Parthenon, and then set out to create virtual renderings of the reunited ensemble. To make this happen, "We had to have realistic lighting," says Debevec. He has specialized in computer techniques to illuminate digital objects with recorded and precisely reproduced real-world lighting. These techniques have already found their way into movies, where they have helped to create special effects for, among others, the Matrix and X-Men films.

Capturing just the right illumination required waiting for the right combination of clouds and sun over several weeks, time that the team's schedule in Greece did not allow. Instead, the group captured the lighting on the roof of the ICT in Los Angeles and with software used it as the virtual lighting for their renderings of the Acropolis. "The latitude is about the same and we're both close to water, so hopefully we're not too far off," Debevec explains.

Elgin Marbles in their gallery at the British Museum.

In addition to their 3-D models and their research publications, a central product of the team's work is a short film simply titled *"The Parthenon."* It is a two and a half-minute creation that takes viewers on a virtual journey through the majestic temple and its sculptural decorations.

In addition to the Parthenon, Debevec's team visited the Duveen Gallery in the British museum, home to the Parthenon sculptures. There, they modeled and rendered the sculptures with breathtaking realism using the graphics lab's techniques. In their film, the two sites merge and the marbles reappear in the original niches and ledges in the temple from which they were removed.

As the camera moves, the light reacts as it would in a real environment. The intensity of light also changes during the tour, moving seamlessly from cloudy-bright to direct sun

As the camera moves, the light reacts as it would in a real environment. The intensity of light also changes during the tour, moving seamlessly from cloudy-bright to direct sun. Internal effects, such as the light reflecting off one surface and illuminating the one opposite, are rendered, "automatically," says Debevec. This is done with a groundbreaking rendering system written by former visiting ICT researcher, Marcos Fajardo.

Virtual reconstruction and restoration placed sculptures back in their original location.

In the film's final sequence, the Parthenon and its sculptures are restored to their ancient glory — the bright painted colors of the sculpture's original decoration fade in and the stone blocks of the Parthenon lost to time are back in place. "We used the best archaeological sources available," explains Debevec, noting that "any reconstruction of an ancient site requires making educated guesses."

The measurements of the ancient Parthenon and its surroundings came from the works of Manolis Korres, a Greek scholar who has been an advisor on the project. Using these plans, Brian Emerson, the group's lead 3-D artist, led a group of computer animation students from USC's School of Cinema-Television to model the ancient Acropolis. Marc Brownlow, the group's 2-D digital artist, again using the best archaeological information available, restored the coloration on the Parthenon's sculptures.

No one could ever guess that the sunlight illuminating the virtual Parthenon was captured on the roof of the modest office building that houses Debevec's lab, or that many of the scenes are really computer-generated models. The film is a new milestone in more than a decade of computer graphics research by Debevec, whose strikingly innovative work has made important advances in understanding how people, objects, and environments from the real world can be photorealistically digitized inside the computer.

Debevec's research in photorealistic image-based rendering began at the University of Michigan, where as an undergraduate in 1991 he created a 3-D computer model of his Chevette from photographs. Throughout his academic career he continued to develop techniques that improve upon existing methods for 3-D modeling and lighting. His 1996 Ph.D. thesis at UC Berkeley presented a new technique for modeling architecture from photographs, and using this system, he was involved in creating photorealistic 3-D models of the UC Berkeley campus, the Rouen Cathedral and St. Peter's Basilica.

Many of Debevec's projects have produced short computer animations as well as research publications, a tradition he hopes to continue. "Our films help other researchers and especially people in industry see the potential of the techniques we're developing," he says, adding that "having to use our own techniques in a small production usually shows us where the next research frontier is."

The Parthenon film will premiere this August at ACM SIGGRAPH's prestigious "Electronic Theater" film show at the Los Angeles Convention Center. And through an Internet connection, the USC team's models of the Acropolis and the Parthenon sculptures will also appear in a short film by the acclaimed Greek director Costa-Gavras the following week at the Athens 2004 Summer Olympic Games. Though the ownership of the real sculptures will likely be debated for years to come, USC technology has helped them make — at least virtually — a return to Greece.

Ken Dahlberg, MSEE '69 *Playing Big*

Ken Dahlberg

Ken Dahlberg wants to play big. Bigger than his company is right now.

That's why the recently named president and CEO of San Diego-based Science Applications International Corporation, better known as SAIC, has reorganized the company, turning six large divisions into three that are bigger.

"If you are a company that is made up of hundreds of small businesses, then you will continue to act small," says the leader of a 43,000 employee-owned research and engineering firm specializing in information technology, systems integration and e-solutions for commercial and government customers. "If, on occasion, you bring some of those businesses together, and have them interact and collaborate on larger pursuits, then we can act bigger than we are and gain market share from some of the larger companies."

A self-admitted "goal freak" and "Type A personality," Dahlberg got his nose for business by diving into it as early as he could. In the mid-1960s, he co-oped at General Dynamics in Groton, Connecticut, while earning his bachelor's of science degree in electrical engineering at Drexel University in Philadelphia. In 1967, he took a job at Hughes Aircraft Co. in El Segundo, Calif., so that he could enter a master's fellows program in electrical engineering at USC.

Among his favorite professors was former Engineering Dean Zohrab Kaprielian, a "terrific guy, whose heart and soul was in applying all of the fundamentals, all of the theorems, all of the axioms to difficult, challenging, breakthrough technical solutions," Dahlberg recalled. "He loved to rap with us."

The 59-year-old CEO, formerly a top executive at General Dynamics, was named chief executive officer and president of SAIC November 3, 2003. SAIC is the world's largest employee-owned research and engineering company, with offices in 150 cities worldwide and core businesses in high-tech, electronics and defense contracting. Three short months after his appointment, Dahlberg implemented sweeping changes to streamline the organization and pull disparate business segments into a more unified chain of command.

From his earliest days at Hughes, Dahlberg has been building up companies by consolidating business units and streamlining operations. He has a sixth sense about the process of team building, a critical ingredient in consolidation, which he attributes in large part to a lifelong involvement in sports.

"Actually, quite a bit of it [business sense] came from sports," he says. "I was very active in baseball and basketball, team-based activities, so I learned how to translate that into business acumen and lead people." Long before the terms "empowerment," "team-based culture," and "integrated product teams" came along, Dahlberg was already putting them into practice. It caught on at Hughes.

Dahlberg started at SAIC without a management team, but that didn't faze him. "I've always been parachuted into companies without a team," he says. But as an outsider facing skepticism from company employees, he was quick to announce his intentions of preserving "the entrepreneurial spirit that's made this company great."

"I knew after the first two months on the job, that SAIC was yearning for consolidation, the next step," Dahlberg explains. "The company had a lot of entrepreneurs and the technical competence for competitiveness. We were in some strong markets, such as homeland defense, intelligence and some commercial information technology (IT) businesses. So the challenge, really, was to develop a strategic direction and a vision that the employees, the share-holders really, could be passionate about."

He set about restructuring a company that had been characterized as a "loose federation of entrepreneurial companies" into larger businesses. Creating synergy among employees and new business divisions was not new to Dahlberg either. Former colleagues have praised his friendly manner and called him "people oriented." Delighted to be at SAIC, Dahlberg has already turned his attention to that issue. "I like leading scientists and engineers, because that's me. I talk their lingo."

Dahlberg photo by James Baird/The San Diego Union-Tribune

McLean Tower, SAIC headquarters, San Diego, CA.

continued on next page

Dahlberg *continued from page 36*

He's focused on developing next-generation leaders for SAIC. "And if I can get every one of our 43,000 employees to understand how they help us meet our goals and objectives, then we'd have the world."

That's not the only major change at SAIC. Dahlberg intends to double the company's value — taking it from a $6 billion enterprise to a $12- to- $15-billion enterprise — in the next five years. His strategy is to leverage up. The smaller companies that have merged into larger groups will be able to bid for the bigger contracts. His integration work at General Dynamics is proof that the strategy works. In

SAIC®
An Employee-Owned Company

his three years there, Dahlberg tripled General Dynamics's assets, building it from a $2 billion business into a $6 billion business.

"It really spirited passion and enthusiasm and zeal to grow the business," he says. "It got people aligned to the strategic objectives."

Dahlberg is optimistic about SAIC's growth potential. He sees emerging markets in homeland security and increasing demands for intelligence systems. In fact, one of SAIC's highest profile contracts has sent 100 employees to Athens, Greece, to set up security systems for this summer's Olympic Games. But other, more staid industries, such as telecommunications, are beginning to rebound, Dahlberg says, and the company is now branching into new markets such as the pharmaceutical industry.

"We're not everywhere, we're not a mile wide and an inch deep, but we've got a strong presence in focused areas," Dahlberg explains, "and we approach those businesses, I think, from a unique perspective, from the science and technology side, rather than from a purely IT services-oriented side."

Dahlberg, whose oldest daughter, Melissa, earned a bachelor's degree in finance in 1999 from USC, resides in the Carmel Valley area of San Diego with his wife, Joy.

Kenneth Wiley, Jr., BSAE '80

A commercial pilot, Kenneth Wiley, Jr. brings a unique background to the cockpit

Kenneth Wiley, Jr.

"I have experienced commercial aviation from the engineering classroom to the drawing board, to the manufacturing plant, to the test facility, to the maintenance hangar, and finally to flight operations," Wiley explains. All since earning a bachelor's degree in aerospace engineering from USC in 1980.

"I designed parts of the B-757 nacelle and thrust reverser," he says, "so I now fly B-757 aircraft equipped with parts that I personally designed over 20 years ago!"

Wiley and USC seemed well matched from the get-go. "I applied and was accepted to USC and a couple of other schools — including that place over in Westwood. I felt a much more personal connection with USC. I remember getting calls at home from aerospace engineering faculty members encouraging me to attend."

Wiley now lives in the Rancho Bernardo area of northern San Diego County with his wife Judy and daughter Lauren. His father attended USC on a Navy ROTC scholarship. "USC is in my blood," he beams.

Wiley's Trojan experience flew by, but produced a number of fond memories. "I lived in the late, great Touton Hall my first two years of school," he recalls, smiling. "Lots of late night runs to Tommy's."

As a student, Wiley landed a spot as a kicker on the football team in the fall of 1979, a testament to his work ethic and tenacity. "I got to suit up for the home games and had my picture in the program, but I never got to kick in a game."

But that does not mean he simply stood around during practices. "The coaches made good use of my old high school centering skills. Whenever there was some sort of passing or running drill without the regular linemen involved, I played center. This helped give the quarterbacks much more realistic ball handling and timing practice than they would have gotten without me."

Coach John Robinson saw this as a significant contribution. "When he introduced me at our season-ending awards banquet, he didn't say a thing about my kicking or punting," Wiley recalls. "But he said something like, 'He's the best 180 pound center in the country.'"

Wiley relished his football experience. "I got to kick and punt during all phases of special teams drills. I worked quite a bit with engineering alumnus Bruce Matthews since he was the backup long snapper for punts and placekicks." *See alumnus profile on Matthews in the Fall 2003 edition of USC Engineer.*

After graduating from USC, Wiley worked for several years as an engineer, holding positions at Rohr Industries, Inc., General Dynamics, American Airlines and United Airlines.

But he eventually returned to his childhood passion. "Growing up through the '60s and '70s, I absolutely loved flying and anything to do with aviation," he recalls. "I started taking flying lessons at age 16 and earned my private pilot certificate five days after my 17th birthday."

In the mid-1980s, Wiley found that airlines eagerly sought to hire new pilots. "I decided to go for it," he says. He did flight instruction after work and on weekends. "In early 1989, I had obtained enough flight experience to get an interview and be hired as a pilot with SkyWest Airlines." He remained with the company until 1995, the year UPS hired him as a pilot.

"I upgraded to First Officer on the Boeing 757 and 767 in July 1996 and have been in that position since." With additional seniority, Wiley will become a captain.

In the meantime, he continues to soar. "I love this job because it combines the technical side of me with a bit of the physical and creative side."

Firouz Naderi, MSEE '72, Ph.D. '76

Firouz Naderi

Most days, Firouz Naderi's thoughts are hundreds of millions of miles away. As the head of the Mars exploration program at NASA's Jet Propulsion Laboratory (JPL), he's more worried about dust storms on Mars than he is about earthquakes in L.A.

The USC Viterbi School of Engineering alumnus oversees a $600-million a year program at the space agency's Pasadena facility. The program is designed to explore Mars with robot spacecraft every 26 months, when Earth and Mars are in a favorable alignment.

This year, NASA scored a grand slam home run on Mars with the successful landing of two rovers on opposite sides of the planet. Naderi was ecstatic, not only with the engineering success of the landings, but with all of the breakthrough science that has been streaming down.

"It all points to the existence of an ancient sea at one of the landing sites," he says. "The overarching objective of this program is to determine if Mars is, or ever was, a habitat for life. The strategy we adopted was to 'follow the water,' since water appears to be a necessary ingredient for life."

Mars has been a favorite target for planetary explorers. For 40 years, the United States, Russia and the Europeans have been hurtling spacecraft by it and into it.

"The first time we flew by a planet and took images, it was Mars," Naderi says. "The first time we orbited a planet, it was Mars. The first time we landed on a planet, it was Mars. And the first time we roved around the surface of a planet, it was Mars. We go there often."

But Mars rarely lays down the welcome mat for its robotic visitors. Two-thirds of the nearly 40 spacecraft sent to Mars over the years by various space agencies around the world have failed to accomplish their missions.

"Batting 300 may be a good average in baseball, but not in the kind of business we are in, where missions cost hundreds of millions of dollars and people spend several years of their lives developing them," he explains.

Naderi was called in to lead the Mars program after the twin failures of an orbiter and lander in 1999. The decade had begun with the rollout of NASA's new "faster, better, cheaper" way of doing business. It got off to a good start, with the highly successful 1997 *Mars Pathfinder* mission, but the success was short-lived.

"In 1998, we tried to launch two missions for the price of one and lost both," Naderi remembers. "We were squeezed by our budget, and we had become a little bit too careless."

The program was scrapped, and in summer of 2000, Naderi helped to design a more intricately woven program of missions, in which new space technologies were spread out evenly across multiple missions rather than being plopped on one spacecraft all at once. He was assigned the responsibility for the end-to-end implementation of the new program and since then, has overseen a winning streak: three successful missions, including the spectacular landings of the *Spirit* and *Opportunity* rovers.

Naderi, who was born in Shiraz, Iran, and moved to America 40 years ago, did not start out with "a space bug" like many of his JPL colleagues. He was hoping to become an architect. "I found out that drawing was not one of my skills, so I went into electrical engineering," he says. First he earned a bachelor's degree from Iowa State University, Ames, in 1969, and then went on for a master's degree and Ph.D. in electrical engineering at USC.

He studied image processing, "way back when microprocessors were just coming around," attending USC on a partial scholarship from Iranian National Television. After completing his doctoral work in 1976, he returned to Iran to work for the television network as part of the scholarship agreement. At the end of a three-year stint, in 1979, Iran was at war and Naderi headed for JPL to take a job in telecommunications.

His early work at JPL was on system design of large satellite-based systems for nationwide cellular phone coverage. From there, he went on to NASA headquarters in Washington, D.C., for two years in the mid-1980s, and served as the program manager for the Advanced Communications Technology Satellite (ACTS), the front-runner of today's multi-beam, space-switching commercial satellites.

Gradually, he grew interested in Earth-observing missions and became project manager for the NASA Scatterometer (NSCAT), a global weather-forecasting satellite aimed at making measurements of winds over the global oceans. Later, he became manager of NASA's Origins program, designed to search for life in the universe. His oversight of these programs earned him a NASA Outstanding Leadership Medal.

In addition to his current responsibilities on the Mars program, Naderi also serves as director of the Solar System Exploration Program, which is focused on planetary exploration and astrobiology — the search for life outside of the solar system. Like the majority of his colleagues, Naderi does not question the existence of life outside of the solar system. He is quick to add that it will take time — perhaps many decades — to find it, but that ultimately, that is what civilization will be remembered for.

"People are really impatient, and this isn't something as fast-paced as, say, a hockey game," he says. "But I have no doubt that in the universe, there is life outside of the Earth. If, by chance, we find that there was life on Mars, however primitive, and that's the first place we've ever looked, what do you think the possibilities are for life elsewhere in the universe?"

Naderi lives in the Pacific Palisades area of Los Angeles, and when he is not exploring the geography on Mars, he enjoys hiking in the beautiful Santa Monica Mountains, right here on Earth.

Judith Love Cohen, BSEE '57, MSEE '62

Judith Love Cohen

In junior high school, when Judith Love Cohen showed up for the first day of her intermediate algebra class, she looked around the room and made a quick discovery: she was the only girl. This didn't daunt her — after all, in fifth grade, kids had already started to pay her to do their math homework.

In high school, her guidance counselor recommended she find "a nice finishing school" and encouraged her to "learn to be a lady." But growing up in Brooklyn in the 1940s, Cohen had different plans: she would trek to California to earn her bachelor's and master's degrees in electrical engineering at USC, seduced in part by the sunny Rose Bowl images she had long seen on television.

At USC, Cohen found her calling almost by accident. "My boyfriend was studying engineering and I was studying math," she recalls. "We used to do each other's homework since I liked the applications of math and he liked the abstractions. I was solving real problems while he was dealing with letters and dots. When he decided to change his major, I was devastated. So he suggested I change my major."

Cohen went on to spend a solid 30 years working for aerospace companies on a number of high-profile NASA projects, including the Hubble Space Telescope, for which she was a system engineer for the Science Operations Ground System, and the Lunar Excursion Module, for which she was a sub-project manager on the Abort Guidance System.

But becoming a woman engineer in the 1950s was no easy task. As an undergraduate, Cohen recalls hearing criticism from fellow students, barbs from those who believed she should pursue a husband more ardently than a degree. These memories surely stuck with her.

But things brightened in graduate school. "My experience there was wonderful because the faculty was heavy with professionals who worked in industry and provided real world perspectives on such things as guidance system design and electronics."

Cohen's time at USC set her up for a stellar career. As she completed her undergraduate classes, she worked as a junior engineer for North American Aviation.

In 1957, she graduated from USC and joined Space Technology Laboratories, where she worked from 1959 to 1990. (The company later became TRW and is now Northrup Grumman).

"During that time I went back to graduate school at USC, got my Professional Engineer license, and joined the Society of Women Engineers, the American Institute of Electrical Engineers and the Institute of Electrical and Electronics Engineers professional societies. I briefly left TRW for three years and went to work at Western Union on the Tracking and Data Relay Satellite."

In 1990, Cohen left TRW for a position at Command Systems Group, but in 1993, the company lost its contract, and she ventured out on her own as JLC Engineering.

Despite her own glittering resume, Cohen believes the field continues to embrace men more warmly than women. "Even though there appeared to be a narrowing of the gap (between women and men) in the 1980s, the dot.com companies seemed to be heavily male. Girls are still avoiding computer science careers even though they use computers earlier and better than ever."

She adds, "I recently read a study that there are fewer women science teachers and professors. This robs students of important role models."

Not surprisingly, Cohen doesn't just notice these disturbing trends — she does something to change them. For more than 14 years, she and her husband, illustrator David Katz, have created a series of children's books for 3rd to 6th grade girls, encouraging them to pursue nontraditional careers. Cohen penned the first — *You Can Be a Woman Engineer* — and partnered with highly accomplished women in other fields to produce 16 more *You Can Be a Woman…* books, ranging from architecture to zoology. Cascade Pass, Inc., which Cohen and Katz co-founded, publishes the series.

"Life is funny," she writes in the 1991 series debut. "When I was a little girl, I looked through a very small telescope. Little did I know that years later I would lead the team in the ground system design for a huge, powerful new telescope

that was sent into space." This was the Hubble Space Telescope.

Last November, Cohen and Katz published *You Can Be a Woman Movie Maker,* which seems particularly fitting for Cohen. Now in her early 70s, she co-produced a feature length documentary, *Sixty Spins Around the Sun: the Randy Credico Story* with Will and Grace writer Laura Kightlinger, and an animation short, *Cartoon Sea,* which aired on more than 100 PBS stations.

Apparently, Cohen has a knack for choosing professions traditionally dominated by men. But today she stands as a role model for young women. "Girls have to believe that they can do anything they want," she says, "and no one can tell them otherwise."

snapshots

USC School of Engineering Events
Winter 2003-2004 & Spring 2004

Hosts Leo and Ivy Chu with USC development officer Laurie Firestone and friend of USC Engineering, Bruce Barnes (BSBA '59).

Hollywood Park Casino Holiday Party

Board of Councilor member Leo Chu and his wife Ivy hosted the Viterbi School at a holiday party for alumni and friends at the Hollywood Park Casino on December 17, 2003. Over 80 guests enjoyed the Chus' hospitality and spent the evening playing in a mock Blackjack Tournament. The first and second place winners of the tournament were given use of the Chus' box seats at Staples Center, and the third place winner received a bag of School of Engineering gifts.

Dean Nikias and guests enjoying the Fergusons' hospitality at Shady Canyon Country Club.

Ferguson Event

Robert and Carolyne Ferguson, parents of current sophomore engineering student Ryan Ferguson, hosted an alumni reception at Shady Canyon Country Club in Irvine on Thursday, February 12. Dean Nikias joined in hosting more than 70 alumni and friends for a dinner and lecture. Senior Associate Dean and Director of the USC Homeland Security Center of Excellence Randolph Hall presented a talk on the "Risks and Economic Analysis of Terrorism Events".

Sally Jercha (CHE '00), ExxonMobil recruiter talks to USC students at Career Expo.

Career Expo

Career Services and Student Affairs hosted another successful Career Expo in February. Dozens of companies, industry alumni representatives and students took part in the one-day expo which is the central event of national engineering week at USC. Contacts made during the expo often lead to jobs after graduation.

ARCS members enjoy student presentations during lunch.

ARCS Luncheon

The Los Angeles Chapter of the Achievement Rewards for College Scientists Foundation (ARCS) made their annual visit on Thursday, March 25. The members of the ARCS University Relations committee attended a tour of Professor Gerald Loeb's laboratory regarding his work on BIONS, and then joined ARCS scholarship recipients for a lunch. During lunch, ARCS scholars Santhosh Joseph and Nick Palmer presented their research findings.

USC in DC

The Honorable Christopher Cox of the U.S. House of Representatives hosted "USC in DC" on March 9 at the Marriott at Metro Center in Washington, D.C. The event, which featured remarks by Dean Nikias and Senior Associate Dean Randy Hall on the new USC Department of Homeland Security Center for Excellence, was a networking opportunity for USC alumni and friends living and working around the Beltway, and part of USC's federal relations outreach. 142 alumni, friends and government representatives were in attendance and they all received USC Viterbi School of Engineering T-shirts as they departed the reception. Dean Nikias also participated in the League of Cities briefing on Homeland Security in the Longworth House Office Building on March 10.

Randy Hall (center) with the Honorable Christopher Cox and Congresswoman Diane Watson.

Trojan Founders Circle members visited the construction site of Ronald Tutor Hall, which is scheduled for completion in December 2004.

Trojan Founders Circle Luncheon

The annual Trojan Founders Circle luncheon was held on campus on April 29 to recognize and thank those members of the Trojan Family who have made planned gifts, such as bequests, trusts and annuities, to the University. The USC Viterbi School of Engineering presented commemorative pins to alumni and friends who have designated their planned gifts to the School. Guests also enjoyed a special presentation — "USC Campus: Past, Present and Future". After the luncheon, guests were invited to take a bus tour of the current construction sites on campus, including Ronald Tutor Hall, the future home of much-needed research laboratories, classrooms and undergraduate student services for the USC Viterbi School.

If you are considering a planned gift to the USC Viterbi School of Engineering, please contact Lambert Bittinger, director of planned giving, at 213/740-7510.

Urbashi Mitra, assoc. prof. of electrical engineering systems, with Qualcomm CEO, Roberto Padovani.

CSI Review

The Communication Sciences Institute (CSI) holds a research review annually to bring together the CSI Industrial Affiliates, CSI faculty and students for an exchange of ideas on communications research and technology. Representatives from fourteen corporations and research organizations attended the 2004 CSI Research Review on Feb. 26 at the Radisson Hotel near USC campus.

The program included a keynote talk by Dr. Roberto Padovani, CTO of Qualcomm, Inc. Padovani said that "CSI faculty and students are focusing on some of the most forward looking research activities in the field of telecommunications. The research conducted in the areas of Ultrawideband (UWB) transmission, Sensor Networks, and RFCMOS technology, to name just a few, will help in shaping the way we will communicate in the decades to come."

The review also included research presentations by six CSI faculty and 24 poster presentations by CSI graduate students. Since the review, CSI has signed up a number of new affiliates.

Student Event Highlight

Concrete & Steel

Civil Engineering Students Build Strong

ASCE member students with their uniquely designed, suspension steel bridge.

Each year USC's chapter of the American Society of Civil Engineers participates in the annual ASCE Pacific Southwest Regional Conference which occurred this year from April 1-3 at Cal Poly, San Luis Obispo. The conference is an assembly of university students from sixteen civil and environmental engineering schools in Southern California, Arizona, Nevada, and Hawaii. PSWRC involves competitions and activities that test students' analytical, creative, technical and physical skills through various technical and non-technical activities. There were a total of fifteen competitions at the 2004 PSWRC and for the first time in many years, the USC student chapter of ASCE participated in all events at PSWRC (fifteen events in total).

Preparation for the PSWRC starts months before the conference. Two major features of the conference have been the steel bridge and concrete canoe competitions. Students on each team started preparing for the competitions during October 2003. Each team received the rules of the competition and held several meetings dedicated to coming up with the best design for their entry while fulfilling the rules of the competition. Through the design process, freshmen and sophomore students reap important insight into concepts that will be part of upper division courses, while upper classmen apply knowledge from the classroom toward practical problem solving.

For the concrete canoe project, the canoe must use a concrete mix designed by students. Numerous hours and man power are put into pouring and reinforcing the canoe. Team members also spend many hours paddling to prepare themselves for the canoe races. With a solid performance in the races and a strong canoe design, this year's concrete canoe, captained by senior Cattleya Valencia and sophomore Danielle Elkins, was very competitive. With three layers of concrete and mesh reinforcing, the canoe survived five races before being damaged because it collided head-on with another canoe. USC advanced to the finals in two of the five competitions; men's sprint and coed 4-man sprint.

The steel bridge team spent just as much time working on their project. Their rules are more complicated since they have dimension requirements and limits. Once the design for the bridge is finalized, members spend numerous hours cutting steel, sanding down rough edges, and formulating an efficient routine to construct the bridge at the conference.

This year's steel bridge entry, captained by junior Patrick Maguire, was once again an innovative design. Although every other school used a simple truss bridge, the USC steel bridge featured a suspension design intended to reduce the deflection of the 25 foot bridge to under a quarter inch with a 2,500 pound load. The bridge weighed only 170 lbs. The beam members of the bridge were tube steel cut with a computer controlled plasma cutter, also unique to the competition. The steel bridge team was able to build the bridge in 13 minutes, 2 seconds, which was an amazing feat given that the construction involved 56 pieces bolted together and required the tightening of the suspension cables.

Faculty advisors Professor Hank Koffman and Dr. John Caffrey also attended the conference along with students Allen Au, Amanda Merrick, Boniface Kinnear, Brian Vietch, Cattleya Valencia, Chris Cho, Danielle Elkins, Jamie Adams, Jennifer McClean, Kasie Noren, Kathryne Ceballos, Lisa Chow, Lois Mitsunaga, Melissa Lao, Patrick Maguire, Peter Leclaire, Ray Sykes, Richard Stegemeier, Rowena Lau, Ryan Bonniwell, Ryan Souther-Zajda, Sarah Morrisroe, Shannon Smith, Tammy Tosounian, Vickey Lee, Blanca Michel, Rosanna Lau and Elena Fuan.

Alumni Relations Advisory Board

The Alumni Relations Advisory Board is made up of alumni, friends and supporters of the School of Engineering. The board is instrumental in helping to spearhead and create new activities and programs for alumni. 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, BSME '66 (Chair)
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
William C. Taylor, BSISE '73

MARK YOUR CALENDAR!

Scheduled Events for Spring and Summer 2004

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

Student Recognition Program
Acknowledges student academic, leadership and service achievements
May 3
5:00 PM-7:00 PM
Upstairs Commons
USC Campus

W.V.T Rusch Engineering Honors Program Senior Luncheon
Honoring graduating seniors
May 15
11:00 AM-12:30 PM
Garden Court, Upstairs Commons
USC Campus

USC Baccalaureate Ceremony
May 15
5:00 PM
Bovard Auditorium
USC Campus

2004 Commencement
May 14
9:00 AM University Ceremony
Alumni Park
School of Engineering Ceremonies
Archimedes Plaza
10:30 AM Undergraduate Ceremony
2:30 PM Graduate Ceremony
Receptions will immediately follow the ceremonies.

One Day Symposium on BioNEMS
(Biomedical applications of nanoelectromechanical systems)
May 22
Davidson Conference Center
For more information go to http://www-lmr.usc.edu/Symposium04.html

Dean's Circle and USC Associates Regional Reception
June 13
4:00 PM-6:00 PM
Pasadena

JPL Exploration Family Tour
July 2004
Date and Time TBA

Viterbi School Hollywood Bowl Night
The Tchaikovsky Spectacular with Fireworks
Featuring the USC Trojan Marching Band
August 14
8:30 Concert
Hollywood Bowl
**Please call 213/740-2502 for more information and tickets to this event.*

San Diego Regional Reception
Midway Aircraft Carrier & Floating Museum
August 2004
Date and Time TBA

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

International Symposium on Confined Concrete, China

Under joint sponsorship from the NSF Pacific Earthquake Engineering Research Center (PEER), the National Natural Science Foundation of China, the Ministry of Education of China and many other professional organizations, USC Civil Engineering Professor Yan Xiao is planning the International Symposium on Confined Concrete, June 11-13, 2004, in the resort city of Changsha, China. The workshop will attract many world renowned experts in this research area. Confined concrete is one of the most fundamentally important subjects for modern concrete structures, particularly in earthquake-prone regions. Prof. Xiao has been working on related research ever since his Ph.D. study, and has made several significant contributions during his tenure at USC, including a recent invention called the Confined Concrete Filled Tubular (CCFT) structure.

For more information about this event, contact Prof. Xiao at civileng@rcf.usc.edu.

Alumni news & notes

Winter and Spring 2004

1937

Merwyn C. Gill (BSCH) received a prestigious Merit Award at the 71st annual USC Alumni Awards celebration on April 2 at the Regent Beverly Wilshire Hotel in Los Angeles. Seven exceptional Trojans in total were honored for their contributions to USC, the local community and the world. M.C. and his wife Hester, both members of the School's board of councilors, established the Merwyn C. Gill Foundation Composites Center within the School in 1995.

1974

Radha Basu (MSEE) is currently CEO of SupportSoft, a California-based IT firm which she manages out of Bangalore, India. In 2000, she was named Silicon India's CEO of the year, and the San Francisco Business Times included her in its list of 75 Most Influential Women in 2002.

1985

Rachmini D. Ibrahim-Manning (BSPE) has been living and working in Indonesia since the day after graduating from USC. He just recently moved back to Los Angeles.

1995

Peter D. Sabido (MSEE) earned his J.D., magna cum laude, from the Northwestern School of Law of Lewis & Clark College. He passed the Oregon state bar exam and is currently an attorney at Kolisch Hartwell in Portland, Oregon.

1997

J. Scott Goldstein (Ph.D. EE) was recently promoted to vice president/operations manager at SAIC, located in Chantilly, VA. Scott was elected this year to the National Academy of Engineering's Frontiers of Engineering Program as one of the top 100 young engineers from academia, industry and government. Scott was also elected to the SAIC executive science and technology council.

2001

Christa Bollig (BSCE) is happy to announce her engagement to Michael Meakins. The wedding is planned for November 13, 2004.

Edmond B. Au (BSCS) has been an application developer for IBM Global Services for the past two years.

2003

Jason Allen Keim (BSBE) is currently an engineer at NASA's Jet Propulsion Laboratory in Pasadena, assigned to the *Mars Lander* Project and the Terra Planet Finder missions. Jason had the honor of meeting with Vice President Cheney in early April. The vice president visited JPL to extend congratulatory remarks to the *Mars Lander* team for the success of the *Spirit Lander* and *Martian Rover*. *See profile on Firouz Naderi on page 38.*

Faculty & Staff News

Henry Chang of civil and environmental engineering, was appointed as chairman of the certification committee for the American Backflow Prevention Association.

Bart Kosko, professor at the Signal and Image Processing Institute, has been re-elected by the membership of the International Neural Network Society to a three-year term as a member of its board of governors.

Anupam Madhukar, professor of engineering and materials science, recently became a fellow of the American Physical Society.

Florian Mansfeld, department chair and professor of materials science, has been appointed by the executive committee of the International Society of Electrochemistry to a three-year term as a member of the advisory board of Electrochimica Acta.

Joyce Oo Mayne (BSG '99, MSG '02) was recently promoted to director of development. She previously held the position of director of development operations within external relations at the School.

Barbara Myers joined the Viterbi School in December 2003 as executive director of development, following eight years at the Marshall School of Business serving as executive director of development and associate dean of external affairs.

Cyrus Shahabi had been promoted to associate professor of computer science.

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 Viterbi School of Engineering, Olin Hall 300, Los Angeles, California 90089-1454

Department Update

Medioni Continues as Chair of Computer Science

Saluting his "clear strategic vision," Dean C. L. Max Nikias announced that Professor Gérard G. Medioni (Ph.D. '80) will continue as chair of the USC Viterbi School department of computer science.

Medioni's second three-year term begins May 15. Under his stewardship, Nikias said, "the department's quality grew steadily in all its academic endeavors."

Medioni, a specialist in multimedia, pattern recognition and graphics, received his Ph.D. from USC in 1980 and immediately joined the faculty as a research assistant professor. Except for a four-year period spent as CEO of IC Vision, and a year on sabbatical as CTO of Geometrix, Inc, he has been with USC either as student or faculty member since leaving France in 1978.

Medioni pioneered methods of integrating visuals in video images — a technology now routinely used in broadcasts of football games, where the virtual image of the first down line appears as a seamless part of the broadcast.

In addition to numerous papers, Medioni holds five patents and has six others pending. He is now nationally prominent in an effort to resolve a longstanding tension in computer science between research and academic faculty roles. During this summer's upcoming Computing Research Association Chairs meeting, he will be co-chairing a seminar on "The Role of Research Faculty in an Academic Department."

"I would like to express my sincere gratitude for the service Professor Medioni has rendered the department in the past three years, and thank him for agreeing to continue serving in this important leadership position," said Nikias in his announcement.

James Moore Named Chair of Epstein ISE Department

Dean C. L. Max Nikias announced the appointment of Professor James E. Moore as the new chair of the Daniel J. Epstein Department of Industrial and Systems Engineering, effective May 15.

Moore's principal academic appointment moved from civil and environmental engineering to the Epstein department in 2003, bringing with him the program in transportation engineering, of which he will remain director. His chairmanship term is three years.

A graduate of Northwestern with a Ph.D. from Stanford, Moore's research interests include mathematical programming and connectionist models to study transportation network performance and control, especially in networks subject to earthquake or flood damage, evaluation of new transportation technologies, and computation models of the land use and transport systems. He is a frequent author of newspaper op-ed columns on transportation planning policy. *See Moore's op-ed in this issue on page 7.*

"Professor Moore's appointment was recommended enthusiastically by ISE faculty," Dean Nikias noted in his announcement.

Moore succeeds Randolph Hall, senior associate dean for research at the Viterbi School .

"Under the able leadership of Professor Hall," said Dean Nikias, "the Epstein ISE department has experienced steady growth in quantity and quality. I would like to express my sincere gratitude for his exceptional guidance of the department in the past three years.

Board of Councilors News

Board of Councilors News

Jay L. Kear (BSME '60), chairman of the board of councilors at the USC Viterbi School of Engineering, has formed a new $100 million venture capital fund called Southern California Ventures (SCV). The fund will invest in early stage, high technology companies in Southern California.

Fariborz Maseeh was honored at a ceremony on April 4 when *Computerworld* magazine and its parent company, International Data Group, recognized IntelliSense's achievements, (prior to its merger) with the *Computerworld* Honors Medal of Achievement. Fariborz founded IntelliSense in 1991.

Regina Smith's new book "*The Genomic Age*" will be in bookstores September 1, 2004. Targeting non-scientists, the book explains recent news and developments in genomics, cloning, stem cell technology, anti-aging, cancer treatments and more.

Robert Anthony Arrington *Always on Patrol*

Robert Anthony Arrington (MBA '62, MSEE '66) was born on June 26, 1929 in Shreveport, Louisiana, but grew up in Tulsa, Oklahoma. In 1949, he was awarded a Naval ROTC scholarship to Tulane University, where he met his wife Imelda Jane and earned a bachelor's degree in electrical engineering. He later completed two master's degrees at USC, one in business administration and one in electrical engineering.

"He went to school at night, worked during the day and somehow found the time to build his family," says son Walt Arrington. "His time at USC began a love affair with the University that lasted his entire life."

Robert Arrington died of a heart attack on January 22, 2004 while on one of the daily jogs he had enjoyed for almost 40 years.

After graduating from Tulane in 1953, Bob was ordered aboard the *USS McCaffrey,* a destroyer in Newport, Rhode Island. At 27, and with three children, he completed his course work at submarine school in Connecticut and moved to Hawaii. He began his tour of duty aboard the submarine *USS Blackfin* deep inside Soviet waters.

In the early 1960s, Bob resigned his commission and began his civilian career by working as lead engineer and project manager for North American Aviation and Northrop Corporation, respectively. His specialty was in the development and design of new digital computing systems for integration into ballistic missile programs, including the Minuteman and Phoenix missile systems.

Bob subsequently accepted a position as vice president general manager with Acker and Acker, where he developed and patented an analog to digital converter, and also filed patents for a digitized voice transmission system.

His career in the Naval Reserve blossomed during the 1960s. He rose from Lieutenant (jg) to Commander by the end of the decade. When he eventually returned to civilian life, his master's degrees helped him secure senior management positions in different space and defense programs. He was program manager for several new computer system integration designs that were required for the Apollo program's command and lunar modules rocket systems.

He left the Apollo program in 1971 to become director of engineering for a regional company. Bob's son Walt recalls that during this time, his father raised 10 children, coached their football teams and avidly followed USC football.

"He was a loving father who enjoyed the outdoors," Walt recalls. "Our many trips centered on fishing, camping and backpacking. He even found time to teach mountaineering to others.

"He ran his family like he ran anything in the Navy or in business: organized and efficient. If you wanted money, he said, 'Submit a budget and be ready to thoroughly explain your request.' He stressed the importance of education. He was up before us everyday, jogged and often had our regular oatmeal breakfast ready before we got up for school."

Arrington with his children.

In March 1974, Bob received the rank of Captain. Four months later, he became Commander of the Submarine Reserve Force of the entire Pacific Fleet — 23 submarine units in all.

However, Bob did not stop there. Always motivated to achieve and contribute more, in the late 1970s, he played a senior management role on the development of the *Columbia* space shuttle. This work eventually brought him to Texas, where he finished the design just as *Columbia* became an active spaceship.

He stayed in Texas and went to work for E Systems. In another senior management role, he helped develop and design the Global Positioning System for the military. He quickly moved up to a senior role in a new military defense application known as the Strategic Defense Initiative, or Star Wars. Bob retired from the military in 1987 and from civilian work six years later. He continued to teach, became active as a philanthropist and spent time with his family. He climbed Mt. Whitney in 2002 and learned how to snow ski in 2003.

A life member of the IEEE, Bob lived in Dallas and served as president of the USC Alumni Club of North Texas. His energy and passion for USC drew a loose-knit group into a collaborative and forward-thinking team. One of the last things he did, on the evening of January 21, was lead a club meeting. "Bob was very special to every one of us in the club," says Ray Martinez (BA JOUR '80), the current president of the club and Bob's friend. "We respected him, followed him everywhere he took us, and we helped him any way we could because Bob wanted the club to be the best in the nation."

For many of his children, the last time they saw Bob was at the family tailgate party outside the Rose Bowl on January 1, 2004. Bob referred to it as "one of the greatest times of his life." Bob and eight of his children attended the game. "Dad's tickets were on the 50 yard line and he was ecstatic," says daughter Mary Jayne Pugh. "It was a wonderful day that we will never forget."

"I thought how great for Bob to have done some of things he truly loved in his last year with us," wrote Martinez in a letter to the Arrington family. "He was president of our club. He saw his beloved Trojans win at Notre Dame, he saw the USC women's volleyball team win the national championship here in Dallas. He watched the Rose Bowl and saw USC win the national championship for the first time in 25 years. Like a true Trojan, Bob went out a champion!"

Bob is survived by his ten children and 21 grandchildren. Three of his children also graduated from USC: Nanci Irwin (BS ACCT '77), Walter Blessey Arrington (BS PUAD '83) and Melanie Belger (BS BUS '89).

The USC Alumni Club of North Texas is establishing the Bob Arrington Memorial Scholarship Award and plans to kick off the scholarship fund with a silent auction and the Bob Arrington Memorial Golf Tournament in Dallas. Donations to the scholarship fund may be sent to: USC Alumni Club of North Texas, 3100 Main Street, Dallas, TX 75226.

In Memoriam

Nelson T. Bogart (BSCE '37) passed away on July 21, 2003. Nelson served as vice president of the Chevron Corporation for the last 15 years, making his total employment there 39 years. He is survived by his wife of 59 years Doris, daughter Joyce, son David and grandchildren Nancy, George, Jonathan and Sara.

Ivan Garet (BSME '42) passed away on Saturday, April 3 at the age of 84. For most of his career he worked for the architectural firm Welton Becket and Associates, retiring as vice president of mechanical engineering. He is survived by his wife Cynthia Ann Garet, and sons Michael and Ronald, who is the Carolyn Craig Franklin Professor of Law and Religion at the USC Law School.

George Gilbert Ellis, Jr. (BSPE '43) was a WWII veteran of the *USS Becuna* and the *USS Bluegill*. He retired in 1981 as CMR. George passed away on December 19, 2003 from emphysema at the age of 82. He is survived by his wife Helen and son Tim.

Robert L. Good (BSEE '29) passed away on February 14, 2004.

Theodore A. Jacobs (MSME '55) died of cardiopulmonary arrest on February 23 at the age of 76. Theodore was a former aeronautics researcher and was deputy assistant secretary of the Navy for research and advanced technology for seven years before he retired. He is survived by his wife of 43 years, Joan G. Jacobs of Annandale; a son, Steven Douglas Jacobs of Pasadena California, a brother and a sister.

Robert D. Mijares (MSAE '68) of Santa Clarita, Calif., passed away on November 9, 2003 at the age of 67. In August of 1961, he retired form the Air Force Reserves to join Lockheed Aircraft Corporation in Burbank, Calif. In 2001, he celebrated 40 years as an engineer at Lockheed. He is survived by his mother Helen Begaii, his wife Reverend Grace Bonnell, his 3 children Jennifer, Loretta, and Richard and grandchildren Jason and Carolyn.

Ronald G. Minnet was a very valuable member of the School's chemical engineering faculty for many years. He passed away in early January 2004 after complications from a fall. Ronald developed new undergraduate courses on environmentally-friendly processes, taught design courses to seniors which incorporated his broad industrial experience and helped develop an extensive research program. His expertise and passion for working with students will be very hard to replace.

Robert M. Pickard (BSME '48) passed away in August of 2003 at the age of 77. He owned his own business in Fresno, Calif. called Valweld Supplies, which sold industrial gases from 1970 – 1988. Prior to that he worked for Cosmodyne in Torrence, Calif. He is survived by his wife Sheila, sons Robert Jr. and Michael and grandchildren Robbie and Stephanie.

Ronald James Roop (BSME '53) passed away on November 16, 2002 at the age of 73 from multiple myeloma. He never forgot that it was his education at USC which gave him a start in engineering, a field which he dearly loved. He is survived by his wife Vivian and son James.

John Tahl passed away in early December 2003. Although he did not graduate from USC, he never forgot the lean years when he first started his company Comtal Corp, and was aided by Dr. Pratt of USC. To show his gratitude, he became a donor to the School of Engineering for many years. He is survived by his wife Connie, children Laura, Marjorie and Patrick and grandchildren Chelsea, Dylan, and Heather.

F. Russell Wade (BSPE '40) passed away in December 2003.

DEVELOPMENT *f* OCUS

Charles and Rose Ann Flanagan with scholarship recipient students Lourdes Versoza and James Bowden.

Development Focus

Charles P. Flanagan (BS '45) and his wife Rose Ann recently established a Charitable Remainder Trust to benefit the USC Viterbi School of Engineering. The Flanagan's gift will establish an endowed fund to provide scholarship support for engineering students.

On Friday, April 9, the couple met with engineering students Lourdes Versoza and James Bowden for lunch at the Mission Inn in Riverside, California. The students expressed their gratitude to the Flanagans for their ongoing support of USC engineering students and for the trust that will ultimately provide financial support for future generations of students.

Now retired and living in Indio, Calif., Charles spent most of his career in real estate, brokerage, investment and development. He and Rose Ann enjoy membership in the USC Associates, Engineering's Alumni Advisory Board and the Trojan League of the Desert.

Both avid football fans, Charles and Rose Ann can be found at home and away games cheering the Trojans to victory.

A Newly Named School Celebrates

Hundreds of faculty, staff, students, alumni and well-wishers crowded into USC's engineering quad Tuesday, March 2, to honor Andrew and Erna Viterbi for their $52-million gift.

"Andrew Viterbi has transformed the world in which we live and has brought great honor to USC."

–Steven B. Sample

USC President Steven B. Sample, a fellow engineer, made the formal announcement. After a drum roll from the Trojan Marching Band, he turned to watch as a 20-foot by 50-foot cardinal red banner bearing the name of the new school was uncovered on the south side of Biegler Hall. Sample then thanked Viterbi for opening the frontier of digital communications and forever changing the world of cellular technology.

"The gift by the Viterbis will be a powerful catalyst for bold research and innovation, and will forever associate USC's engineering school with one of the most illustrious names in the history of engineering," Sample said. "As a distinguished USC alumnus, and as a visionary communications pioneer, Andrew Viterbi has transformed the world in which we live and has brought great honor to USC."

Cheers, applause and whoops of joy rang out in the plaza. Erna, Viterbi's wife of 45 years, was visibly moved by the show of appreciation.

An ebullient Dean C. L. Max Nikias called Viterbi "a true pioneer."

He announced that a new Viterbi Museum to showcase Viterbi's many academic and entrepreneurial accomplishments will be opened next year, on Viterbi's 70th birthday, in the engineering school's new Tutor Hall.

Viterbi said he was "overwhelmed" with all of the kind gestures and kudos extended to him from USC faculty, alumni and supporters in recent weeks. He said his commitment to USC goes back four-and-one-half decades, but that his ties had "only grown [stronger] over the lengthy interim."

Morning engineering classes were canceled so that students and faculty could join in the campus celebration. A crush of spectators filled the "e quad", which was decorated with red, gold and white balloons.

After the presentations, a group of undergraduate engineering students, some of whom were featured in a full-page newspaper advertisement of the school's new name, ran up the center aisle wearing cardinal red T-shirts with the new Viterbi School of Engineering logo on the front. A schematic of the Viterbi Algorithm, looking a little bit like hieroglyphics to the lay person, was etched in white lettering on the backs of the shirts. Lunch, music and T-shirts were offered to all in the engineering plaza after the celebration.

Photos by Irene Fertik

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Please take a moment to send your gift in the enclosed envelope. If you have questions, or need additional information, please call Matt Bates, director of annual giving and special gifts, at 213/821-2730 or matthew.bates@usc.edu.

Together, we can make history.

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