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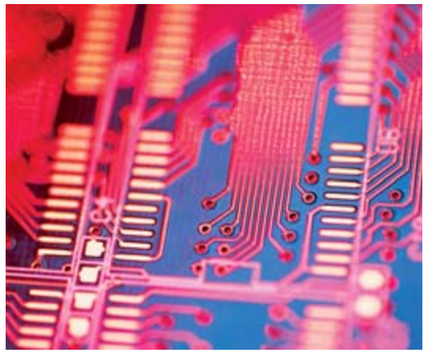


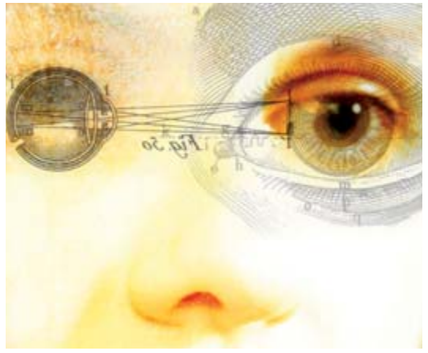



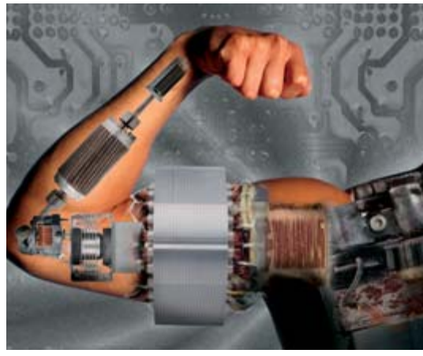

ENGINEERING + HEALTH

Empowering Medical Advances Through Engineering Innovation

NAE'S GRAND CHALLENGES // THE 'SHARK OF CARTHAGE' // THE RIGHT STUFF

USC Viterbi // Engineer

SPRING 2009

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THE CHALLENGES OF OUR TIMES

At a rather unsuspecting time, a mere one year ago, the National Academy of Engineering (NAE) articulated 14 engineering grand challenges. While financial clouds were still very far on the horizon, these challenges were centered on one key element: societal needs. When the clouds brought the devastating global financial storm last fall, societal needs moved from a somewhat abstract subtext to a brutal reality.

Engineering schools, such as USC Viterbi, have embraced the NAE challenges. In March, for instance, the school co-hosted the first national NAE Grand Challenges Summit, along with Duke University and Olin College, to begin a dialogue on ways to address these most pressing issues.

> “The bio-nano-info revolution of the last two decades has ushered in unprecedented new tools we can use. And the advances in information technology and computer science have empowered the ability of engineering to confront issues at levels unthinkable even a decade ago.”

With an ever-accelerating faith in the power of technology and science, our community has eagerly looked to providing solutions to complex problems. The bio-nano-info revolution of the last two decades has ushered in unprecedented new tools we can use. And the advances in information technology and computer science have empowered the ability of engineering to confront issues at levels unthinkable even a decade ago: To engineer incredible new devices, materials and processes, and in the process, dramatically change the scope of the discipline.

The new canvas on which engineers now paint is one that I can characterize as

Engineering + {subject}

This evolution is manifested steadily and, most spectacularly, in medicine, through advances in health care and delivery, a key subset of the NAE challenges. Our own Viterbi School is deeply immersed in this increasingly close relationship with medicine (see page 22). Energy encompasses another vital group of challenges (and Viterbi efforts in this area will be detailed in the next issue of this magazine).

Engineering + is now the norm. But can it, with its potential to transform, help us get out of the current deep financial crisis?

I will not be saying anything novel by stating the relevance of the deductive sequence

Ideas → Innovation → Economic Health

More than ever before, however, ideas and innovation must revolve around concepts that solve real problems and add real value. The NAE grand challenges provide a focus to germinate such ideas. Indeed, one can almost map one-to-one the NAE challenges (see page 32) to the proposed initiatives of the new federal administration in urban infrastructure, health-care reform, green technologies and K-12 education.

Armed with new engineering weapons, we can focus precisely and relentlessly on the new challenges. Solving problems under constraint, even under the severe conditions we currently experience, is the hallmark of engineering. The Viterbi School is committed to take part and be counted as a leader in this effort.

And after we recover, we must address a much tougher challenge, not articulated by the NAE, which resides at the intersection of engineering + social sciences. This intersection, dealing with the variables of human nature, produces constantly changing complex systems. The current global crisis underscores the vast importance of engineering + social sciences. It is time to face it in earnest.

Yannis C. Yortsos
Dean, USC Viterbi School of Engineering

FROM THE DEAN

Olah, Scholtz Named to the National Academy of Engineering

VITERBI SCHOOL IS ONE OF ONLY SIX SCHOOLS IN NATION WITH TWO OR MORE ELECTED FACULTY IN TWO CONSECUTIVE YEARS

George A. Olah (left) and Robert A. Scholtz

Nobel Prize winner George A. Olah, who holds a joint appointment in the Viterbi School, and Robert A. Scholtz, Fred H. Cole Professor of Engineering in the Ming Hsieh Department of Electrical Engineering, were among 65 newly elected members of the National Academy of Engineering (NAE) in 2009.

This is the second year in a row that two engineers from USC have been elected to the NAE, making USC one of only six schools in the nation with two or more elected faculty per year for two consecutive years. Membership in the Academy is the highest professional distinction that can be accorded an engineer.

The election of Olah and Scholtz brings the total number of USC Viterbi School of Engineering-affiliated NAE members to 33. "We are very proud that NAE is recognizing two of our faculty for their superb contributions," said Dean Yannis C. Yortsos. "NAE membership is an indicator of excellence and a testament to the impact of an individual's scholarly work in the field."

Olah, the Donald P. and Katherine B. Loker Chair in Organic Chemistry, a USC Distinguished Professor, a member of the National Academy of Sciences, and the founder/director of USC's Loker Hydrocarbon Research Institute, is jointly appointed to the USC College and Viterbi School. He was recognized for "contributions to the development of chemical technologies for environmentally favored and carbon-neutral energy conversion."

One of the world's preeminent scholars of hydrocarbon chemistry, Olah received the 1994 Nobel Prize in Chemistry for his achievements in superacids and his observations of carbocations, a fleeting chemical species long theorized to exist but never confirmed. Olah devised a way to keep the transient carbocations around long enough to study their properties. What he found revolutionized the understanding of organic chemistry, leading to new discoveries and improvements in the production of gasoline, plastics and pharmaceuticals, to name a few.

His seminal contributions to the technologies of hydrocarbons and energy conversion led to the concept of the "methanol economy," which has the potential of mitigating society's reliance on fossil fuel sources for energy and materials. Methanol and dimethyl ether, which can be produced from carbon dioxide using renewable sources of energy, are excellent combustion fuels and feedstocks for ethylene and propylene production. The chemistry behind the "methanol economy" is now being commercially developed.

Scholtz, who started the first university research program in ultra-wideband radio, was recognized for "contributions to the fields of ultra-wideband and spread-spectrum communications."

A member of the Viterbi School faculty since 1963, Scholtz has spent the last decade studying applications of ultra-wideband—brief signal pulses spread over a very wide band of the radio spectrum—for imaging, data transmission and other tasks. His research interests range from spread-spectrum communications, ultra-wideband and impulse radio, synchronization techniques, adaptive arrays and filters to pseudo-noise generators and communication networks.

In 2006, the first commercial applications of ultra-wideband technology for short-range high bandwidth wireless data links were introduced, thanks to his landmark research. Scholtz was also co-recipient that year of the IEEE Eric E. Sumner Award "for pioneering contributions to ultra-wideband communications science and technology."

Currently director of a research unit specializing in the field, the USC UltRA Laboratory, Scholtz's other IEEE honors include the Donald G. Fink Prize Paper Award, IEEE Communications Society's Leonard G. Abraham and Fred Ellersick Prizes, IEEE Signal Processing Society's Senior Paper Award, and the IEEE Antennas and Propagation Society's Sergei A. Shelkunoff Transactions Prize Paper Award. //

Viterbi Wins National Medal of Science

UNIVERSITY OFFICIALS GATHER TO CONGRATULATE THE USC TRUSTEE AND VITERBI SCHOOL BENEFACTOR

USC honored one of its most prominent alumni, Viterbi School namesake and USC trustee Andrew J. Viterbi, for winning the 2007 National Medal of Science, the highest honor bestowed by the nation in the fields of science and engineering. Viterbi became the third USC scholar in the last three years to be recognized by the White House with a national medal.

In a Doheny Memorial Library courtyard celebration held in October, USC President Steven B. Sample and Executive Vice President and Provost C. L. Max Nikias praised Viterbi for his pioneering research in digital wireless communications and his faithful service to USC.

Sample read the resolution of commendation that was presented to Viterbi, which stated, in part: "The University of Southern California honors the commitment and contributions of Andrew J. Viterbi to the well-being and continued vitality of the university and its mission, salutes his distinguished accomplishments in the fields of engineering and communication, and congratulates him on earning the prestigious National Medal of Science."

Sept. 29, 2008, Andrew Viterbi receives his medal from President George Bush in the White House East Room.

Viterbi, who gave his name to the USC School of Engineering in 2004 with a generous $52 million gift, also holds the USC Presidential Chair within the Viterbi School. He is known worldwide for his development of an algorithm—the Viterbi algorithm—and for his contributions to Code Division Multiple Access (CDMA) wireless technology, which transformed the theory and practice of digital communications.

In accepting his commendation, Viterbi explained the "high five" photo that was snapped just as he accepted his medal from President George W. Bush in a White House ceremony.

"President Bush was very affable, very friendly, and I asked him if he would give me a 'high five' for my grandson, because I had promised him I would do something special like that," Viterbi explained. "I will probably never live that down," he added, laughing with the audience.

Viterbi joins previous USC national medal winners Kevin Starr, a University Professor who earned the National Humanities Award in 2006, and Morten Lauridsen, a professor in the Thornton School of Music, who won the National Medal of Arts in 2005. //

"President Bush was very affable, very friendly, and I asked him if he would give me a 'high five' for my grandson, because I had promised him I would do something special like that," Viterbi explained. "I will probably never live that down."

The Shark of Carthage

COMPUTER SCIENCE GRADUATE OUS MELLOULI WINS THE GOLD FOR HIS COUNTRY

Oussama Mellouli (center) wins the gold medal in the 1500-meter freestyle swimming competition for Tunisia in the 2008 Olympic Games.

In his native Tunisia, the press nicknamed him the "Torpedo" or the "Shark of Carthage." At USC, he's known simply as "Ous."

Oussama Mellouli, a 2007 Viterbi School computer science graduate, made history at the 2008 Olympic Games when he won the gold medal in the 1500-meter freestyle swimming competition. It was the only medal Tunisia won during the Beijing games, and only the second gold medal his country has ever earned, 40 years after runner Mohamed Gammoudi won the 5000-meter race in the Mexico City Olympics.

Not surprisingly, Ous has been hailed as a hero in his country, where he was named Grand Officer of the Order of the Republic by President Zine El Abidine Ben Ali a week after his Olympic feat.

"It's quite humbling," says the smiley, almost giddy computer scientist as he relaxed in sporty Southern California attire. "The Olympics is definitely the highlight of my career. I came a long way to get this historic gold medal in the toughest event in swimming. It's very historic for my country: It's the first-ever swimming medal for Tunisia, the second (gold) ever in all sports… it's been quite awesome."

> "**The Olympics** is definitely the highlight of my career. I came a long way to get this historic gold medal in the toughest event in swimming."

Mellouli enrolled in USC in 2003 after graduating from the Lycee du Rampart in Marseille, France. With an appearance at the 2000 Olympics already under his belt, he established himself as a force to be reckoned with on the Trojan swim team. Although he won several important competitions in the ensuing months, medals eluded him at the 2004 Olympic Games in Athens.

"Four years ago, I was angry I didn't get (any medals), and I started building back by focusing on short term goals," Mellouli says. First on his mind: completing his undergraduate degree in computer science at the Viterbi School. In between his daily training—up to five hours a day—the swimmer tried to make sure he didn't neglect his studies.

"He never asked for any favors, ever," says Associate Professor of Engineering Practice Michael Crowley, who had Mellouli in three of his classes. "I was very impressed by him. He was an engineering student and a top athlete."

Two years ago, as the Beijing Olympics approached, Mellouli asked USC's swimming head coach Dave Salo to train him.

"He had to be more disciplined with my expectations," Salo said. "My program is more (based) on daily performance; it's practicing how you're going to compete. That's something that helped him prepare better."

It was the discipline, the expectations and the rigorous training that put Mellouli over the top, and he gives Salo a lot of credit for it. //

USC and Chevron Extend Partnership

ENERGY GIANT PROVIDES $915,000 FOR VITERBI SCHOLARSHIPS AND TRAINING

Chevron awarded the Viterbi School $915,000 in August 2008 to augment its partnership with the school and sponsor undergraduate and graduate student scholarships and fellowships, some of which will be targeted for disadvantaged students.

The Chevron University Partnership Program (UPP) is a global program developed in conjunction with leading universities around the world to establish new programs, support faculty development and provide student scholarships. The collaboration extends to new competencies required as research and technology development explores innovative ways of tackling critical energy challenges. Universities are selected based on their excellent reputation, forward thinking and results-oriented educational development.

At USC, Chevron supports both education and research through the Center for Interactive Smart Oilfield Technologies (CiSoft). Established in December 2003, CiSoft is directed by Professor Iraj Ershagi and includes the participation of research scientists from the Viterbi School of Engineering and Chevron.

CiSoft offers a master of science degree in petroleum engineering with an emphasis on smart oilfield technologies. Course content is designed to respond to the industry's needs in new technologies and developing skills related to the operation of smart oilfields.

"Chevron's goals in supporting USC include furthering the development of deployable 'smart oilfield' solutions, and tracking and recruiting outstanding graduates of the USC engineering school," says Mike Hauser, Chevron's i-field manager. A special focus is the establishment of a software integration lab that will provide a testbed for training and deployment of new solutions developed within the program.

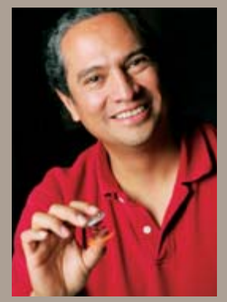
Left to right: Chevron i-Field Manager Mike Hauser, Viterbi School Dean Yannis C. Yortsos, Chevron Vice President/Gulf of Mexico division Warner Williams and USC's Professor Iraj Ershaghi extend partnership to support scholarships and training.

"The Viterbi School is recognized for leadership and innovation in many areas, but has earned particular distinction for its work in smart oilfield technologies," notes Warner Williams, Chevron vice president/Gulf of Mexico and a Viterbi School Board of Councilors member.

"Our ongoing research relationship with Chevron in CiSoft is a model for a productive and mutually beneficial academic-corporate collaboration," says Viterbi School Dean Yannis C. Yortsos. "I am delighted that this relationship will now broaden and deepen with the expanded University Partnership Program." //

Reverse-Engineering the Hand

NEW $2-MILLION STUDY WILL HELP RESEARCHERS MODEL HUMAN MOTOR CONTROL



A USC expert will lead a $2 million, four-year study on "Reverse Engineering the Human Hand," funded by the National Science Foundation's Emerging Frontiers in Research and Innovation (EFRI) office.

Associate Professor Francisco Valero-Cuevas of the Viterbi School Department of Biomedical Engineering and the USC Dental School Division of Biokinesiology and Physical Therapy will work with Chang Liu of Northwestern University, and Yoky Matsuoka and Emanuel Todorov of the University of Washington.

The main goal of the project will be "…to achieve dexterous, approximately optimal control of a hand by having humans and computers perform familiar but challenging tasks of manipulating objects," according to the NSF announcement. "Researchers will use the same algorithms both to model human motor control and to go beyond the present state of the art in robotic manipulation.

"Dexterous robotic hands have a wide variety of possible applications in industry, space and national security. Improved understanding of how humans learn to optimize hand performance will also have broader benefits, particularly for the disabled."

The USC award was one of only four EFRI awards in the area of "Cognitive Optimization and Prediction: From Neural Systems to Neurotechnology." EFRI funded eight others in the area of "Future Infrastructure Systems." //

Engineers As Teachers

A HANDS-ON COMMUNITY OUTREACH PROGRAM INSPIRES KIDS TO EXPLORE ENGINEERING

Three-quarters of young students drew pictures of girls in the role of engineer, indicating that considerable progress had been made to debunk an old gender-specific stereotype (top). Bottom left, aerospace and mechanical engineering senior Ben Vatterott demonstrated buoyancy in a lesson on the physics of sailing. Judging from the expressions, right, kids enjoyed the lesson.

How do you explain the workings of a generator to a 10-year-old? You identify the big ideas (magnetism, electrons, electricity and change in electric field), use simulations and videos to explain the concept, have the students build their own generator, and then get the students to analyze their newfound knowledge. In the process, you've just learned to teach!

Welcome to "Engineers as Teachers." The course is organized and supported by Iridescent, a nonprofit, and by three Viterbi School engineering departments: Aerospace and Mechanical (AME), Biomedical Engineering (BME) and the Epstein Department of Industrial and Systems Engineering (ISE). Undergraduates from these departments sign up for three technical elective units and go through a 13-week training program. The goal of the program is to inspire inner-city kids to strive to be scientists and engineers. In return, engineers learn how to communicate complex ideas to large, diverse audiences.

"Those are very valuable skills if you want to have a powerful career in any field," says Tara Chklovski, president and CEO of Iridescent.

The program has been running for three semesters. "In 2008 alone, 107 engineers—professionals, undergraduate and graduate students—went through the training and taught 1,600 children and parents," Chklovski continues. "The courses are taught either during school hours or after school and each course consists of five, two-hour sessions, held once a week. We also invited families to the courses held after school, so that parents are empowered to support their child's interest in science."

Course topics range from the physics of magnetic resonance imaging (MRI) to animal locomotion.

Sinchai Tsao, a Viterbi School doctoral candidate in BME who's concentrating on medical imaging with Manbir Singh, a PhD researcher, co-taught the imaging course. The course was held at College Ready Academic High School, an inner-city charter school.

"Sinchai used beautiful medical images as a motivation for students to learn key physics concepts, such as the physics of waves, as well as electricity and magnetism, concepts central to magnetic resonance imaging, and that high school students need to master to become college ready," Chklovski says. "He found the experience invaluable in helping develop confidence to present key fundamental concepts, many of which he hadn't revisited in a while."

Guru Sundar, the biomedical "senator" in the Viterbi Graduate Student Association, joined Iridescent last semester and teaches a session on cardiovascular mechanics at Palms Elementary with two USC BME graduate students, Heidi Gensler and Man Nguyen.

"It was rewarding to observe the (students) enjoying their learning," he says. "I hope to continue with Iridescent in the coming years and reach out to high schools, where I can serve as a teacher and a mentor." //

New USC Nano-Imaging Center Opens

STATE-OF-THE-ART EQUIPMENT WILL POSITION USC TO BECOME A NATIONAL LEADER IN NANOSCIENCE

A new USC Nano-Imaging Center has opened on the University Park Campus for scientists and engineers probing the mysteries of nanoscale materials and systems.

The center, which opened in December, houses three new scanning electron microscopes (SEMs). These instruments will allow researchers from a broad range of the biological and life sciences to gain a better understanding of nanomaterials using the latest, most sophisticated 3-D imaging technology available.

Creation of the new center, a core lab operated jointly by the Viterbi School and the College, is located in the engineering school's Center for Electron Microscopy and Microanalysis. Chemical engineering and materials science professor Steven R. Nutt, who directs the Viterbi School's M.C. Gill Foundation Composites Center, believes the new instruments will transform the microscope from a device for static observations to an instrument for bold and vigorous experimentation.

"These new imaging instruments will support multi-disciplinary research in biomedical nanoscience, which could lead to discoveries in the early detection and more effective treatment of disease, as well as the development of prosthetic devices that restore function to tissue and organs," Nutt says. "They will allow us to pursue 3D nano-imaging, nanomachining and nanomanipulation in a big way."

The center was announced at a special symposium, entitled "The Changing World of Electron Microscopy." Researchers from USC, Boston College, JEOL (Japan Electron Optics Laboratory), EDAX, Inc., which makes high-performance X-ray instrument components, and The Aerospace Corporation gathered for a series of talks before taking a tour of the new facility. The new SEMs, considered state-of-the-art for nanoscience imaging and fabrication, were procured with funds from the Provost's strategic Biomedical Nanoscience Initiative, in cooperation with JEOL, and will be available to all USC faculty and students.

"JEOL recognizes USC as one of the elite research universities and values its leadership role in pioneering new frontiers in nanoscience," says Pete Genovese, vice president of JEOL, USA. //

Byungmin Ahn, left, a postdoc in the new Center for Nano-Imaging, stands next to one of the new scanning electron microscopes. Professor Steve Nutt, director of the M.C. Gill Foundation Composites Center, is on the right.

A Week in Asia

During a fall 2008 visit to Asia, Viterbi School Dean Yannis C. Yortsos met with top Shanghai Jiao Tong University administrators, faculty and students to explore future collaborations, student and faculty exchanges, and joint research endeavors. The visit included key discussions with Professor Zhang Wenjun, vice president of Shanghai Jiao Tong University, as well as deans, faculty and students in the Departments of Electronic, Information and Electrical Engineering; Mechanical Engineering; Industrial Engineering and Logistics Management; and the Institute of Image Communication and Information Processing. In a separate visit, he met with Jeff Zhao, president of High Power Holdings, Ltd., to discuss global economics and finance, as well as the business and construction environment in Shanghai and China. From there, he flew to Hong Kong, where he met with Viterbi School constituents and stopped by the USC Globalization Office to discuss ongoing programs. //

Pictured, from left to right, are Hilda Kwan, administrative assistant in charge of the USC Globalization Events Office in Hong Kong; Catherine Leung, director of the Hong Kong office; Viterbi School Dean Yannis C. Yortsos; Katherine Aschieris, Viterbi School Office of External Relations; and Elaine Chan, assistant to the director in the Hong Kong office. //

New Partnership with Mexico

USC AND UNAM WILL EXPLORE NEW STUDENT, FACULTY AND DISTANCE-LEARNING PROGRAMS

Key representatives from both institutions discussed the new partnership over a formal luncheon, hosted by UNAM's Provost Sergio Alcocer. Left to right: Iraj Ershaghi, Ricardo Vidal Valles, Kelly Goulis, Gonzalo Guerrero Zepeda, Viterbi School Dean Yannis C. Yortsos, Sergio Alcocer, Francisco Valero-Cuevas and Ernesto Riestra Martínez.

A USC delegation of engineering faculty and administrators traveled to Mexico City in early December to initiate a collaborative agreement with the National Autonomous University of Mexico (UNAM).

Viterbi School Dean Yannis C. Yortsos and UNAM Dean of Engineering Gonzalo Guerrero Zepeda signed a Memorandum of Understanding establishing a relationship that will encompass a wide range of areas, but will begin with exchanges of students and faculty.

"We believe interaction between institutions like these carrying on research at the highest level is very valuable," said Zepeda. "Technologies like the ones we'll work together on can contribute to the resolution of many important societal issues."

Yortsos paid tribute to UNAM's academic excellence and historic standing.

"This is an extraordinary and excellent institution, a university that traces its roots back more than 450 years," he said. "Engineering is enabling the solution of pressing societal problems worldwide. We're very pleased to have UNAM as our partner in these endeavors."

Viterbi School Associate Dean for Master's and Professional Programs Kelly Goulis spearheaded the initiative that led to the agreement, with the help of Associate Professor Francisco Valero-Cuevas of the Department of Biomedical Engineering. The dean's delegation also included CiSoft Executive Director and Professor of Petroleum Engineering Iraj Ershaghi, and Ming Hsieh Department of Electrical Engineering Co-Chair Alexander Sawchuk.

Potential areas of joint research will include:

- **Megacities:** Study of the problems of huge, 10 million-plus metropolises, is a priority at the two institutions, which are both located in such areas.
- **Energy:** The Viterbi School's ongoing and new initiatives on energy, from smart oil wells to solar and the application of IT to energy, are of strong interest to both institutions.
- **Health:** The increasing overlap between engineering and medicine is also a critical issue.
- **Distance Learning:** Both institutions have active programs, and wish to expand, improve and enhance them.

The Viterbi School delegation was invited to a formal luncheon hosted by UNAM's Provost Dr. Sergio Alcocer, general secretary of the university. The delegation also attended a number of meetings leading up to the signing with various UNAM faculty. //

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Brain Power

ENGINEERS TURN TO NANOCARBON TUBES TO EMULATE BRAIN ACTIVITY

Nanocarbon modeling may be the next step toward emulating human brain function.

That's the focus of USC electrical engineering professor Alice Parker's "synthetic cortex" study—the "BioRC (Biomimetic Real Time Cortex) Project"—which is designed to create nanocarbon brain neurons that can talk to each other.

Her team, co-led by Chongwu Zhou, also of electrical engineering, is studying the behavior of cortical neurons, what makes them fire and send signals through synaptic connectors to other neurons in the human cortex, as well as the neurons' "plasticity," or ability to learn and remember.

Each time a neuron fires, it sends an electro-chemical spark through thousands of other neurons at speeds of up to 200 miles per hour. But the human cortex is massively interconnected, with approximately 100 billion neurons and approximately 60 trillion synaptic connections, which makes study of a neuron's electrical circuitry quite complicated.

"The brain is kind of like a biochemical factory, operating in a sphere that you can't stretch out on integrated circuits and circuit boards in order to emulate all of its electrical activity," Parker says. "The connectivity is too great and too many delays are introduced. We had to turn to nanocarbon technology to build something that was three-dimensional."

Alice Parker (left, seated) discusses 3-D animation of a synapse with BioRC Project team members Chih-Chieh Hsu (center, standing) and Jonathan Joshi (right, foreground).

Ultimately, the researchers hope to find out if science will ever be able to construct an artificial brain of reasonable size and cost that exhibits almost real-time behavior.

"We really don't know if we can yet," Parker says. "We're dealing with something that is massively interconnected, with connections that are always changing as the neurons learn. That's always been one of the biggest hurdles in trying to simulate neural functioning." //

ISI Moves Into Mental Health Research

THREE RESEARCHERS WILL WORK WITH RUTGERS UNIVERSITY TO ANALYZE GENETIC CONNECTIONS TO A VARIETY OF PSYCHIATRIC DISORDERS

Ewa Deelman

Jose-Luis Ambite

Marcus Thiebaux

The Viterbi School's Information Sciences Institute (ISI) will be part of a new Center for Genomic Studies on Mental Disorders, funded by a five-year, $42.4 million grant from the National Institutes of Mental Health (NIMH).

The center will be headquartered at the Rutgers University campus in New Brunswick, N.J. Funding will support maintenance of a comprehensive lab, clinical databases and computational infrastructure to fund national and international research focused on autism, bipolar disorder, depression, obsessive-compulsive disorder and schizophrenia, according to Rutgers.

ISI's role will be the development of advanced computational technologies, following up on its existing collaboration with Rutgers on an NIMH program aimed at understanding the hereditary roots of diseases.

ISI researchers Jose-Luis Ambite, Ewa Deelman and Marcus Thiebaux will participate in the new study. Deelman, a project leader who is adapting her group's Pegasus Workflow Management System to guide the NIMH data acquisition system, will perform a parallel role for the new NIMH study. Likewise, senior ISI research scientist Ambite, who is already doing data structuring and integration, will continue to expand his efforts, building on the expertise of the ISI Information Integration group. ISI systems programmer Marcus Thiebaux will develop new ways to visualize the data that is structured and integrated by his colleagues. //

Megacities: A 'New Dynamic Organism'

ASTANI DEPARTMENT CONFERENCE ADDRESSES MEGA-ISSUES FACING LARGE URBAN CENTERS

Tackling mega-issues (left to right) are conference participants Geoff Martin, a civil engineering professor; Hanh Dam Le-Griffin, a civil engineering research assistant; Astani Department Chair J. P. Bardet; RAND Corp.'s Martin Wachs; and USC Epstein Department Chair James Moore.

Los Angeles is one of three "megacities" in the United States and 15 worldwide that will continue to grow at unprecedented rates well into the 21st century. With a population soon to exceed 20 million people, the metropolitan region faces increasingly complex urban problems that impact its health, vitality, security and economic prosperity.

That prospect brought together more than 80 experts from academia, industry and government in downtown L.A. last November for a "Megacities Workshop," hosted by the Viterbi School's Sonny Astani Department of Environmental and Civil Engineering. The two-day conference was supported by the international engineering firm MWH, a leading global provider of consulting, engineering, construction and management services in water, natural resources and infrastructure sectors.

"Today, human activity affects the world in ways never before experienced: from the air we breathe, the water we drink, the energy we consume, the waste we generate, and the atmosphere that surrounds us, whether in the microclimate of cities or the global climate itself," says Viterbi School Dean Yannis C. Yortsos.

"Megacities are a new dynamic organism, with unparalleled complexity and immense vitality," he continues. "But they also pose major challenges: complex infrastructure, congested highways, environmental quality, energy and water resources that must be imported, which makes them particularly vulnerable to adverse events, be they natural catastrophes or human-driven."

With 50 percent of the world's population now living in cities, these large urban areas "must evolve to ensure an adequate quality of life for their residents," says Astani Department Chair Professor Jean-Pierre Bardet. A core research thrust to address some of the issues surrounding megacities might involve developing the new concept of "cyber information," which would effectively integrate all of the critical components of megacity systems. USC's location in the heart of L.A. makes it a perfect site for such a multidisciplinary research center, Bardet adds. //

> "**Megacities** are a new dynamic organism, with unparalleled complexity and immense vitality."

Education Without Borders

TO COMPETE FOR TOP ENGINEERING STUDENTS, GLOBALIZATION PROGRAM EMPHASIZES EDUCATION AND RESEARCH OPPORTUNITIES ABROAD

Cauligi Raghavendra

Globalization drives the agenda of modern research universities. A number of goals are typically pursued, from enhancing prestige to maintaining a quality student pipeline, from advancing a service mission to connecting with overseas alumni and other constituencies. In parallel, there are a number of emerging opportunities: increased global demand for higher education, increased global research and development, and the desire for acquiring an international education, at home or abroad.

At the Viterbi School of Engineering, globalization is a strategic initiative, directed by Senior Associate Dean Cauligi Raghavendra. Of course, the Viterbi School has always been a pioneer in globalization, particularly at the graduate student level, where 55 percent of the students are international. To further pursue the school's globalization strategy, Raghavendra has adopted a multi-pronged approach by encouraging transnational research and student exchange, helping in the recruitment of high-quality graduate international students, providing Viterbi students with a global experience and creating unique international programs.

"Our aim is to be a truly global engineering school," Raghavendra says. "It's really critical for the profession because, these days, many companies are global. Innovation occurs more and more often overseas, so we want to be closely connected with top institutions around the world."

Raghavendra is focusing his efforts in rapidly developing regions such as Asia, and countries such as India and China, where science and technology are revered as the key to economic development. To date, Viterbi has active research partnerships with 13 top universities in seven countries, and summer internships that offer outstanding students from the Indian Institute of Technology (IIT) in Kharagpur, India, and from Tsinghua University in Beijing, an opportunity to spend eight weeks studying at USC.

Undergraduate exchange programs with the Hong Kong University of Science and Technology, Nanyang Technological University and National University in Singapore, and Tsinghua University's School of Information Science and Technology give students the opportunity to work side by side with future colleagues from different parts of the globe.

"The initiative has been very successful," Raghavendra says. "But we want to make it even more so, with a stronger presence and more joint research centers. In addition, we want more places where our students can visit, study and learn." //

NAE Induction

USC Viterbi School of Engineering Dean Yannis C. Yortsos (below left) and USC Executive Vice President and Provost C. L. Max Nikias (below right) were inducted into the National Academy of Engineering in a ceremony in Washington, D.C., on October 5, 2008. Election to the academy is the highest professional distinction that can be accorded an engineer. "This is a great day for USC, for USC engineering and for two of USC's finest leaders," said President Steven B. Sample. Yortsos, a chemical engineer, the Chester F. Dolley Professor of Petroleum Engineering and holder of the Zohrab Kaprielian Dean's Chair, was cited for fundamental advances in fluid flow, transport and reactions in porous media applied to the recovery of subsurface resources. Nikias was cited for contributions to the development and diverse applications of adaptive signal processing and for leadership in engineering education. Below, standing next to Yortsos are fellow NAE inductees Wanda Austin, Viterbi alumna and president and CEO of The Aerospace Corp., and Alexis Livanos, corporate vice president and CTO of Northrop Grumman Corp., both of whom sit on the Viterbi School Board of Councilors. //

Biomedical Simulations Resource Lives!

ONE OF THE LONGEST-RUNNING PROGRAMS IS RENEWED FOR ANOTHER FIVE YEARS

David D'Argenio

One of the Viterbi School's longest-running success stories will be running at least five years longer. The National Institutes of Health (NIH) announced a five-year, $5.9 million grant to continue funding the USC Biomedical Simulations Resource (BMSR) through 2013.

BMSR began in 1985, under the leadership of Professor Vasilis Marmarelis. This is its fifth consecutive renewal, probably a record in medical research. BMSR Co-Director David D'Argenio said the latest installment brings the total cumulative funding for the program to $27.3 million.

BMSR's vision—which was radical in 1985, the year that Microsoft introduced the Windows operating system—was that engineering tools, specifically computational modeling, could solve biological research questions. Acting on this vision, BMSR researchers developed a set of those tools and made them freely available to the biomedical research community.

These tools work. "In the past five years alone, more than 2,600 biomedical researchers have used BMSR-developed software," D'Argenio says. These tools include ADAPT drug effect modeling software, the LYSIS nonlinear biological modeling system, the EONS neural modeling system, and PNEUMA, a modeling environment for studying cardiorespiratory function.

All the major pharmaceutical companies employ BMSR tools, according to D'Argenio, which have been used in the development of numerous drugs that are now in use. And, he adds, "because of this experience, Amgen, Bristol-Myers Squibb, and Pfizer are each now funding postdoctoral fellowship programs in BMSR."

The program's mission also includes education. Since 1985, 3,100 researchers from around the world have attended 28 short courses and 23 workshops on BMSR techniques and software. //

Modeling Uncertainties

VITERBI SCHOOL HOSTS CONFERENCE DEDICATED TO EMERGING SCIENTIFIC MODELING TECHNIQUE

Roger Ghanem, a professor in the Viterbi School Departments of Aerospace and Mechanical Engineering and Astani Department of Civil and Environmental Engineering, was the organizer of a two-day gathering on "Opportunities and Challenges in Applying Polynomial Chaos Expansions to Engineering Design and Analysis," which brought together 51 specialists last fall under the sponsorship of USC and Sandia Laboratories.

Modeling is a basic engineering and scientific tool, particularly significant for systems "where it's either not possible or extremely expensive to do actual physical experiments," Ghanem explains.

Examples include design and prognosis of advanced aircraft systems, prediction of behavior of nuclear waste in a depository, and climate change, among other areas.

USC has strength in both mathematical, algorithmic and computational elements relevant to these methods, Ghanem says. But mathematics is exact, and physical reality is messy.

"The only thing you know about prediction," says Ghanem, "is it will never happen exactly as predicted.

"So how do we learn to live with and manage uncertainty?" he asks. "The trick is to predict the unpredictability, and to do so accurately enough that users can confidently use predictions from the models."

To this purpose, Ghanem has achieved increasing success in more than a decade of research, using mathematical operators referred to in the conference title, "Polynomial Chaos Expansions." These PCEs are mathematical techniques for managing processes that work according to established physical rules, but which are subject to uncertainties, either about the rules themselves, or about how to best describe these rules mathematically. //

Infosys Partners Launch New Center

IT GIANT PICKS VITERBI SCHOOL TO BE SITE OF FIRST R&D CENTER OUTSIDE OF INDIA

Viterbi School Dean Yannis C. Yortsos, left, toasts the new center, along with Infosys Technologies Vice President Subrahmanyam "Subu" Goparaju, center, and Viterbi School Professor Viktor Prasanna, right, who will co-direct the new software research and education center.

Infosys Technologies Vice President Subrahmanyam "Subu" Goparaju and Viterbi School Dean Yannis C. Yortsos presided over the official launch of a new software research and education center at USC, funded by the giant IT company, where the now-ubiquitous concept of a "flat world" originated.

The Center for research and education in Advanced Software Technologies (CAST) in the Viterbi School is the first-ever supported outside of India by the Bangalore-based company, which has more than 90,000 employees.

"Infosys is in the business of applying innovative technologies to businesses, and we think collaborative research, such as the kind we're doing with USC, is a great way to fuel growth," says Goparaju, head of Infosys's Software Engineering and Technology Laboratories (SETLabs).

"We are delighted that Infosys has chosen the Viterbi School as the location of its first research center, not just in the United States, but in the world, outside of its home country," Yortsos says.

USC Professor Viktor Prasanna and Goparaju will be co-directors of CAST. "The program will be mutually beneficial," Prasanna said. "Infosys works in IT application areas that can interest engineers at USC, and Infosys can provide practical problems for which USC can find solutions."

Goparaju said USC's level of interest and passion for IT research and development was the deciding factor in Infosys' choice of partners. Infosys has been collaborating with faculty in other academic institutions in the United States, through its "InStep" global internship program and "Campus Connect" industry/academia program, but USC's perseverance, initiative and excellent work persuaded the company to sign with the university.

Yortsos and Infosys Chief Executive Officer S. Kris Gopalakrishnan signed the agreement in Bangalore in March 2008. //

> **"We are delighted** that Infosys has chosen the Viterbi School as the location of its first research center, not just in the United States, but in the world."

Faculty Accolades

MEMBERS OF THE VITERBI FACULTY CONTINUE TO ACCUMULATE IMPRESSIVE HONORS


Michael Arbib


Terence G. Langdon


Aristides Requicha


Shri Narayanan


Laurent Itti


Steven B. Sample


Timothy Pinkston

Three faculty—**Michael Arbib, Terence Langdon** and **Aristides Requicha**—were recently named fellows of the American Association for the Advancement of Science (AAAS) in recognition of their outstanding contributions to science and engineering. AAAS is the world's largest general scientific society and publisher of the prestigious journal *Science*.

Arbib, a professor of computer science, was honored for his "distinguished contributions to computational and cognitive neuroscience." Langdon, a professor of aerospace and mechanical engineering and materials science, was named for his work "in pioneering the processing and properties of ultrafine-grained and nanostructured materials." Requicha, also a professor of computer science, was honored for his "pioneering contributions to solid modeling and nanorobotics."

Shri Narayanan of the Hsieh Department of Electrical Engineering and **Laurent Itti** of Computer Science have extended what has seemingly become an annual tradition at the Viterbi School by winning Okawa Foundation research grants for 2008. Narayanan's multifaceted research is centered on human-machine speech processing, while Itti is doing novel work in the area of biologically inspired computational vision. Narayanan was also elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE), and he had distinguished company—USC President **Steven B. Sample**, who is also a member of the National Academy of Engineering, and Hsieh Department compatriot **Timothy Pinkston** were also elected.

Todd Brun, Krishna Nayak, Michael Neely and **Kostas Psounis**, all of the Ming Hsieh Department of Electrical Engineering, were named senior members of the Institute of Electrical and Electronics Engineering (IEEE).

Narayanan was also one of four Viterbi School faculty members in computer science and electrical engineering who won IBM Faculty Awards for 2008. Joining him were **Barry Boehm** and **Leana Golubchik** of Computer Science, and **Murali Annavaram** of the Hsieh Department. The IBM Faculty Awards are a competitive worldwide program intended to foster collaboration between researchers at leading universities worldwide and those in IBM research and development. Winners are selected for their outstanding reputation and unusual promise for contributions in their fields.

Keith Chugg of the Hsieh Department has received the Frederick Terman Award of the American Society of Engineering Education (ASEE) for 2008. This award goes annually to an outstanding young electrical engineering educator in recognition of contributions to the profession.

A team led by **P. Vijay Kumar** of the Hsieh Department received the Best Paper (Algorithms) Award at the 4th IEEE International Conference on Distributed Computing in Sensor Systems (DCOSS '08). The Viterbi team's paper, titled "On the Average Case Communication Complexity for Detection in Sensor Networks," considers the problem of detecting certain events via algorithms that seek to minimize the probabilities of misdetection and false alarm, as well as the energy expended in executing the algorithm.

Firdaus Udwadia, a professor of aerospace and mechanical engineering, has been named the winner of the 2008 Richard R. Torrens Award of the American Society of Civil Engineers (ASCE). The Torrens Award is given for "outstanding contributions as a journal editor." Udwadia has served as editor-in-chief of the ASCE's respected *Journal of Aerospace Engineering* for the past seven years.

Detlof von Winterfeldt, former director of the National Center for Risk and Economic Analysis of Terrorism Events (CREATE) and a professor in the Epstein Department of Industrial and Systems Engineering, will contribute his knowledge of disaster risk analysis as a recently appointed member of the World Economic Global Agenda Council.

Andrea Hodge of Aerospace and Mechanical Engineering has received a two-year BRIGE grant from the National Science Foundation (NSF) to improve control of a sophisticated manufacturing process used to synthesize thin films of various materials. BRIGE, an acronym for "Broadening Participation Research Initiation Grants in Engineering," is a new program initiated this year by the NSF's Directorate for Engineering.

Yong Chen of the Epstein Department won the Best Paper Award at the 28th annual Computers and Information in Engineering (CIE) Conference, sponsored by the American Society of Mechanical Engineers.

Maria Todorovska, a research professor in the Astani Department of Civil and Environmental Engineering, was among "18 prominent women in civil engineering" selected worldwide as role models for aspiring female engineering students. Todorovska was named in a paper published in the *International Journal of Engineering Education*.


Detlof von Winterfeldt


Andrea Hodge


Yong Chen


Tomlinson Holman


Wei-Min Shen


Maria Todorovska


Sanjit Mitra

Tomlinson Holman of the Hsieh Department won a Society of Motion Picture and Television Engineers (SMPTE) 2008 Journal Certificate of Merit for his article, "Cinema Electro-Acoustic Quality Redux."

Wei-Min Shen, a member of the Viterbi Computer Science research faculty and the Information Sciences Institute, won a best paper award at the annual Army Science conference. Shen's paper, "Self-Reconfigurable Robots for Adaptive and Multifunctional Tasks," was judged the best in its category, "Autonomous/Unmanned Systems."

Sanjit Mitra, an internationally known scholar in analog and digital signal and image processing, has won the Athanasios Papoulis Award for Excellence in Engineering Technology Education from the European Association for Signal Processing (EURASIP).


Todd Brun


Krishna Nayak


Michael Neely


Konstantinos Psounis


Barry Boehm


Leana Golubchik


Murali Annavaram


Keith Chugg


P. Vijay Kumar


Firdaus Udwadia

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PEER REVIEW

Pulsed Power: Will It Kill Cancer?

VETERAN ELECTRICAL ENGINEER MARTIN GUNDERSEN TRAINS HIS ULTRAHIGH-POWERED PULSE TECHNOLOGY ON A NEW TARGET: SKIN CANCER

One use for the technology Martin Gundersen has developed in more than two decades at USC is to clean up diesel exhaust. Another use is more efficient engines of all kinds, from rockets to internal combustion. And it seems promising as a treatment for some forms of cancer. Did we also mention Gundersen's work in motion pictures?

Gundersen, a USC alumnus (PhD Physics '72), is now a professor in the Ming Hsieh Department of Electrical Engineering who also holds an appointment in the Mork Family Department of Chemical Engineering and Materials Science, and the College of Letters, Arts and Sciences Department of Physics and Astronomy.

His specialty is pulsed power, jolts of electrical energy that have an extremely high power but an extremely short duration. The trick is to intensify pulse power by shortening the pulse duration. In 1986, Gundersen and his team built a device called a back-lighted thyratron (BLT), which produced pulses of unprecedented short duration; they've been developing novel applications for these ultra-sparks ever since.

> "**Gundersen realized** that there was potential for improving the understanding of the physics of pulsed power devices, and along the way, realized that the physics could also translate into new applications."

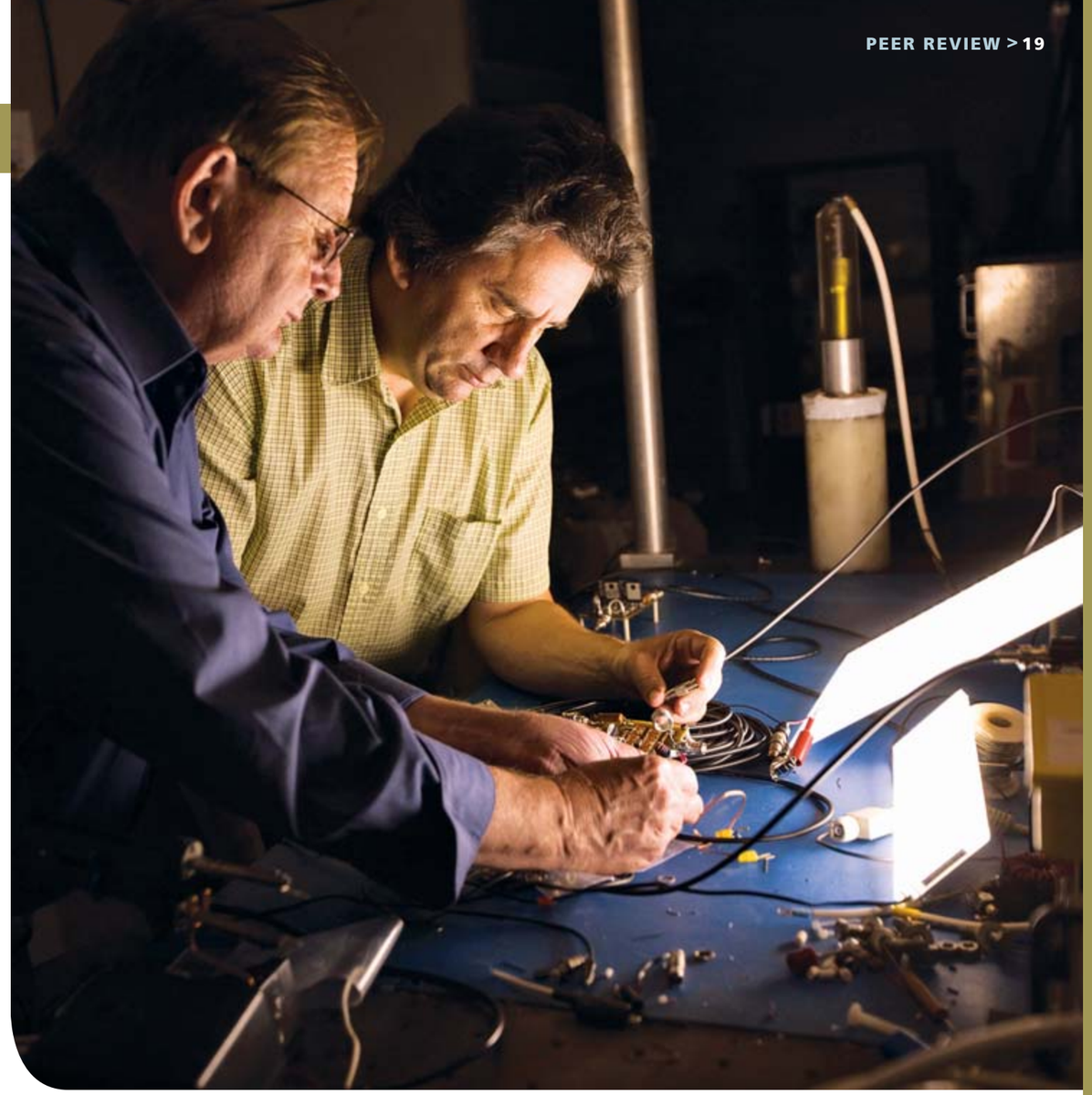
Most early research on pulsed power used it as a means to the end of powering other kinds of devices—lasers or particle accelerators—and more prosaically for photographic electronic flash units. Gundersen's early work at Texas Tech focused on laser research, inventing lasers for applications, including laser isotope separation. The idea of pulsed power was something he came up with as a technology for powering the lasers. Since his return to USC in 1980 and his switch to the Hsieh Electrical Engineering Department, he's concentrated on both the physics and applications of pulsed power—finding ways to create and use the power pulses themselves, as well as investigating novel physics related to its applications.

Gundersen realized that there was potential for improving the understanding of the physics of pulsed power devices, and along the way, realized that the physics could also translate into new applications. By investigating nontraditional pulsed plasma science, ideas and applications in wide-ranging areas emerged.

An early and still developing application was in cleaning up exhaust emissions. Diesel engine exhausts contain substantial quantities of nitrogen oxide (NOx) gases, which have deleterious environmental effects. Gundersen and Russian expatriate Victor Puchkarev did early testing on the effects of pulsed power to break down NOx into harmless molecules of the components nitrogen and oxygen, finding that the shorter the pulses, the greater the efficiency. This work is now again coming into focus as a possible way to deal with emissions from diesel engines on ships in Los Angeles/Long Beach harbor.

A spark plug is an old-fashioned and slow pulse power generator. Gundersen's work is a key element in new, high-performance, "pulse detonation engines," which use "transient plasma" effects from the pulses to ignite fuel and create detonations at higher repetition rates. The pulse detonation engine has the potential for operating at both subsonic and supersonic velocities, and because of this, is receiving attention from the Department of Defense and NASA. The higher repetition rate that's possible using transient plasma ignition increases the thrust, and thus, the potential practicality of a pulse detonation engine. This work is even starting to be considered for possible use in ordinary cars and trucks. The transient plasma approach seems promising, based on studies conducted at Nissan Research Laboratories in collaboration with USC, but the economics are still emerging.

And medically, the prospects are still brighter. For years now, Gundersen and colleague Thomas Vernier have been working with biomedical engineers and, most recently, skin cancer specialist David Sawcer, on a variety of projects using pulsed power to light up injected nanoparticles for imaging, and, lately, to see if skin cancers can be treated by pulsing them. The preliminary results are so promising that trials on human patients are likely to begin this year.



Martin Gundersen, left, and Paul Ronney work on a pulse-generator ignition system in Gundersen's lab. Mark Berndt, *USC Trojan Family Magazine*

Another longstanding Gundersen interest has been the way science is depicted in films. He's served as a consultant on several features, including Real Genius and Congo, and has also played a leading role in organizing a teaching workshop with the American Film Institute. The workshop aims to improve the quality of portrayals of science and engineering in ways that might spark the imaginations of new generations of students. Gundersen's workshop provides technical and scientific scriptwriters with instruction and the tools they need to better portray scientific/engineering events in the movies.

"Martin Gundersen is in a special category," comments Viterbi School Dean Yannis C. Yortsos. "He's created and defined a whole field. We're proud he's associated with USC."

More about Gundersen's work is available on the Pulsed Power Group Web site: www.usc.edu/dept/ee/Gundersen/. //

A Better Way to Run a Clinic

ISE PROFESSOR SHINYI WU IS APPLYING ENGINEERING PRINCIPLES TO HEALTH-CARE DELIVERY IN CLINICS FOR THE POOR

Over the last two years, Shinyi Wu, an assistant professor in the Daniel Epstein Department of Industrial and Systems Engineering who specializes in health-services engineering systems, has been working to develop and test a new system for chronic-illness care in safety-net clinics.

These clinics, for poor and indigent patients, are set up for emergency care, but have increasingly dealt with chronic conditions. Ultimately, Wu hopes to create a better system, the Chronic Care Model (CCM), to deal with these needs, one that can be efficiently disseminated and financially sustained.

The CCM project started in September 2006. Wu, who joined the Viterbi School in January 2008, is project director and principal investigator, working in collaboration with The RAND Corp., the MacColl Institute at Group Health Cooperative and the Safety Net Institute.

Initiated by the MacColl Institute, the CCM summarizes six basic elements of interventions intended to improve care for patients with chronic illnesses.

"We've developed a toolkit containing an implementation guideline and various tools for changing care for chronic illnesses and related business practices," Wu says. "We're currently testing the toolkit, using a practice-coaching approach in two primary-care clinics in two California public hospital systems."

The evaluation examines the extent to which the toolkit is implemented, the effectiveness of the tools, and their impact on quality and efficiency of care. Wu hopes to have results next year.

"From our preliminary experiences in the project, we learned that practice coaching is critical in deploying the toolkit. So a secondary aim of the project will be to develop a practice-coaching manual based on our intervention and lessons learned from the literature and quality improvement practitioners," she says.

"We anticipate that this work would be linked with the toolkit, but the utility of the manual would go beyond how to execute the toolkit itself, and extend to coaching in the service of implementing and spreading clinical improvements more generally." //

Upgrading the Downlink

GIUSEPPE CAIRE IS WORKING TO MAKE THE PROMISE OF THE IPHONE COME TRUE

The iPhone may seem to be today's ultimate wireless communications device, but it isn't to Giuseppe Caire.

"It's very primitive, very slow, because the underlying network is primitive. It's really based on second-generation wireless technology," he says. "But it does have a great user interface."

Caire, professor in the Ming Hsieh Department of Electrical Engineering and co-director of the Communications Sciences Institute, is working to design systems for the next generation of wireless cellular systems.

The first generation of cell phones were analog devices. The second-generation phones were digital, and the wireless systems featured standards like GSM (Global System for Mobile communications), the basis for the iPhone and CDMA (Code Division Multiple Access).

"We're in the third generation now, which is the transition from voice to data," says Caire. "But the third generation isn't really maintaining its promises in terms of data rates, coverage and services. Data rates are too low, and the handsets aren't there yet. We have to solve that problem for the fourth generation."

The problem, says Caire, is the bottleneck in the downlink. When your cell phone is connected to the Internet, the amount of information transmitted on the uplink (from the phone to the network) is relatively small compared to the amount of information sent on the downlink (from the network to the phone). You may send e-mail or maybe credit-card data to a server, but that's mostly text.

> "The iPhone ... is very primitive, very slow, because the underlying network is primitive. It's really based on second-generation wireless technology."

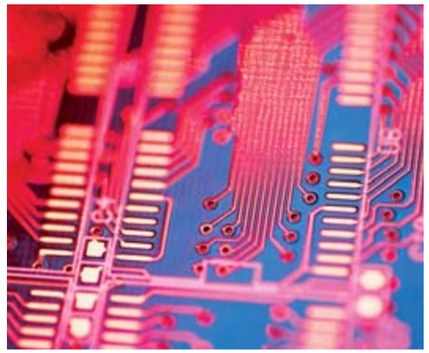
"On the downlink, you need much higher capacity to download multimedia such as songs, movies or maybe a Google map," he says. Streaming multimedia content and downloading other large files has become the killer application for wireless systems.

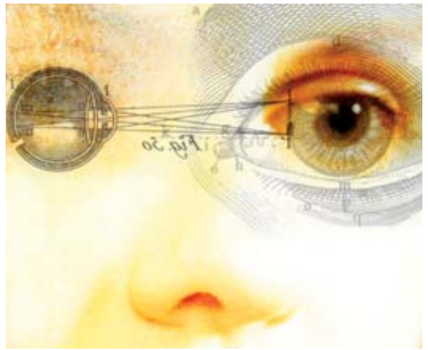
"The solution is to use more antennae to send information down," he says. "To take advantage of the many antennae, you have to share time and frequency, but you're separate in space."

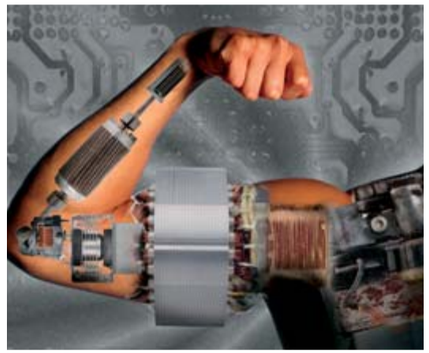
Multiple antennae transmitting multiple beams of data at the same time to multiple wireless device users is straightforward and simple in theory, but in reality, the problem is very difficult.

Modern cellular networks contain many layers, and as the amount of information—all in the form of digital bits, or ones and zeros—transmitted in the network increases, the schemes used to code and modulate the information grow increasingly complex. The multiple antennae, which increase the number of channels, add to the complexity. And the reality is that things like buildings and trees get in the way, scatter signals and create errors.

Caire says the downlink problem "belongs to a class called 'non-degraded broadcast channels,' for which there's no known general capacity formula." But progress has been made in the form of turbo codes and low-density, parity-check codes that are able to perform close to channel capacity with small bit-error rates. //







ENGINEERING + HEALTH

Empowering Medical Advances Through Engineering Innovation

By Eric Mankin

FOR THE 21ST CENTURY, engineering has a new endeavor, perhaps its greatest ever: medicine.

For most of its history, the discipline taught and practiced in engineering schools has posed and solved problems of forces, structures, devices, and materials—of the non-living, inorganic world. Technology has evolved to create bridges and aqueducts, alloys and explosives, hardware and software, aircraft and spaceships, communications and coding, robots and assembly lines. But it has hesitated at the border of life.

ENGINEERING + HEALTH

"The technological revolution of the last century substantially narrowed the gap between engineering and basic sciences. We're now witnessing the direct results in the increasing overlap between engineering and medicine."

YANNIS C. YORTSOS, DEAN, VITERBI SCHOOL OF ENGINEERING

In large part, this was due to the inherent complexity of the living world. An advanced reconnaissance vehicle guided by a computer interface is a marvel of aeronautical design and electronic controls—but a peregrine falcon elegantly solves similar problems using intricate systems that humans are just beginning to understand.

However, the understanding is rapidly growing. Thanks to advances in a wide range of fields, the tools of engineering are now increasingly applicable to the problems of life, and, specifically, to the problems of healing the sick and keeping healthy people well.

Yannis C. Yortsos

"The technological revolution of the last century substantially narrowed the gap between engineering and basic sciences. We're now witnessing the direct results in the increasing overlap between engineering and medicine," says Viterbi School Dean Yannis C. Yortsos. In field after field, from prosthetics to cancer treatment, from medical imaging to genomics, from psychiatry to surgery, one witnesses the new engagement of engineering and medicine.

In fact, USC engineering has pushed these boundaries for some time. USC is the site of the BioMedical Systems Resource Center (BMSR), one of the nation's oldest and most successful efforts to apply engineering techniques to health problems (see story, page 14). BMSR's longevity is the result of another early USC initiative: the establishment, in 1968, by then-Dean Zohrab Kaprielian and founding Chair Fred Grodins of the biomedical engineering department. "We're continuing to reap the benefits from the leadership of these two USC visionaries," says David D'Argenio, BMSR founder and co-director.

In 1998, biomedical engineering at USC was further bolstered when biomedical entrepreneur Alfred E. Mann established the Institute for Biomedical Engineering that now bears his name with a $160 million endowment: The USC Alfred Mann Institute (AMI) was created "to foster the development of innovative medical devices that may significantly improve health and health care, to promote the application of new technologies in biomedical engineering and to put this technology swiftly into the hands of physicians."

The culmination of that vision was the creation, in 2003, of a National Science Foundation-funded Engineering Research Center, the Biomimetic MicroElectronic Systems (BMES) Center. "Our very ambitious goal," comments former Viterbi School dean and now USC Executive Vice President and Provost C.L. Max Nikias, "is to help the blind see, the paralyzed walk and to restore the function of memory," using engineering tools to analyze biological functions and then imitate them in electronic form.

Most recently, another ambitious new research effort has emerged from work carried out at the School's Information Sciences Institute. Building on remarkable success in using modern IT methods to share medical imaging with its prize-winning MEDICUS grid technology system, Viterbi faculty **Carl Kesselman** and **Stephan Erberich** are partnering with St. Johns Hospital in Santa Monica on a new approach to health informatics. Kesselman is also working to update, modernize and make an existing national database more useful, NIH's Biomedical Informatics Research Network (BIRN). (See accompanying story, page 29.)

Recognizing the need to connect the threads of all these efforts and weave a new tissue in the application of engineering to medicine, the Viterbi School and the Keck School of Medicine of USC held a weekend-long retreat in October 2008, attended by more than 100 faculty from the two schools. They discussed joint areas of research, opportunities to strengthen that collaboration and emerging new academic programs.

Theodore Berger

Yortsos offers perspective: "Engineers develop tools to solve problems under constraints. But we don't always know the relevant problems in other areas. Our faculty are eager to learn more about the important medical questions, so engineering and medical faculty can come together to break new paths."

Faculty from Viterbi and Keck have already worked together on development of an artificial retina and neuromuscular stimulation to minimize swallowing difficulties in cancer patients, among many other projects. However, the dean of the medical school sees even greater potential.

"Collaboration between Keck and Viterbi can lead to increased research funding for USC—definitely a priority—as well as enhanced learning experiences for all kinds of students," says Carmen A. Puliafito, dean of the Keck School of Medicine.

Martha Gray, of the Massachusetts Institute of Technology and visiting associate dean for health science and technology at USC, led the discussion at the workshop. She is charged with advising USC on the creation of an interdisciplinary program similar to the Harvard University-MIT model for Health Science and Technology (HST). The proposed new program at USC is referred to as "HST@USC."

"The premise is that many important health and medical problems are too big and too complex to be addressed by a single discipline," Gray explains. "Engineers and physicians look at problems differently, and they need to work together in universities, teaching hospitals and research centers."

What was clear during the discussions was the extraordinary variety of exciting, medically themed research that's going on. A summary follows.

Brain, Vision, Hearing, Speech and Neuro-Rehabilitation

Part of this work is ongoing research in the Biomimetic MicroElectronic Systems Engineering Research Center. It includes longstanding efforts by **Theodore Berger**, of the biomedical engineering department, working with colleagues **Armand Tanguay** and **John Granacki**, to repair brain damage using silicon devices. BMES is directed by **Mark Humayan**, whose pioneering work to create an artificial retina, has already been proven to restore sight. **Norberto Grzywacz** also researches visual function—focusing on retinal cells—as director of the Center for Vision Science and Technology.

Computer scientist **Laurent Itti's** investigations of algorithms used by the brain to interpret visual images helps physicians who are trying to understand these processes. **Shri Narayanan**, who holds appointments in electrical engineering, linguistics and computer science, researches verbal communication and possible barriers to it in children. **Francisco Valero-Cuevas** seeks ways to restore function to the human hand—an extremely sophisticated anatomical structure—through reverse engineering.

Shri Narayanan

Biomedical Imaging

Biomedical imaging has long been a strong point for the Viterbi School, with many research contributions in biomedical engineering, on scales ranging from single cells to the whole human body. **Richard Leahy**, of electrical and biomedical engineering, is the author of standard "Brainstorm" software for synthesizing data from multiple imaging systems to visualize brain function. **Kirk Shung**, of biomedical engineering, specializes in ultrasound imaging, which isn't dangerous to cell tissues, including imaging of small animals. **Jesse Yen**, also of biomedical engineering, is exploring ultrasound to investigate its possible use in prostate and breast diagnostics.

ENGINEERING + HEALTH

Urbashi Mitra

Anupam Madhukar, of the Mork Family Department of Chemical Engineering and Materials Science, visualizes cells and the activity of the molecules that make them up. **Manbir Singh** specializes in magnetic resonance imaging (MRI) and processing. **Grzywacz** has created a 3-D system to image eyes, which helps to diagnose optical pathology caused by diabetes. And **Narayanan** is using MRI images to better understand the complex business of speech production.

One of **Krishna Nayak's** imaging targets is the human heart, using magnetic resonance systems; another is human obesity, in which he uses MRI imaging to map the locations of abdominal fat. Diagnostic imaging of people while they're engaged in day-to-day activity is another challenge, which **Hossein Hashemi**, of the Hsieh Department of Electrical Engineering, is trying to address with new devices.

Krishna Nayak

Diagnostics and Therapeutics

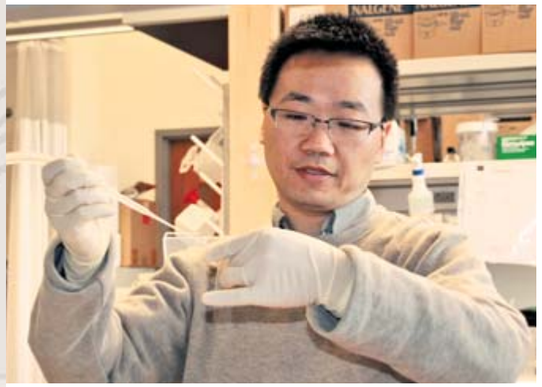
Viterbi investigators are creating sensitive and noninvasive new ways to find out the status of biological systems. **Andrea Armani** of the Mork Family Department is developing ultrasmall, ultrasensitive sensors that respond to the presence of molecules of searched-for materials. **Murali Annavaram** of the Hsieh Department has created novel 'stacked' multilayer chips that have applications in diagnostics. **Tzung "John" Hsiai** is building micro- and nanosensors that will enable prediction, early detection and prevention of acute coronary disease. And **Ellis Meng** is working on microscopic devices that can deliver drugs and otherwise interface with biological systems.

Other investigators include **Peter Will**, who's working on microcontainers for drug delivery made of minute pieces of silicon folded up like paper origami. **Noah Malmstadt**, of the Mork Family Department, is designing novel device architectures for the automated fabrication and stabilization of membrane proteins, which will contribute to new techniques in drug screening, biosensing and basic protein physiology. **Urbashi Mitra**, of the Hsieh Department, is attempting to adapt sensor network systems to sense changes within living bodies. And at BMES, **Gerald Loeb's** efforts to create implantable "bio-MEMS," units that restore function to nerve-damaged muscles, continue.

Another ambitious effort involves electrical engineering faculty **Annavaram**, **Hashemi**, **Tony Levi**, **Antonio Ortega** and **Bhaskar Krishnamachari**, who are designing a super-PDA for patients that would create a "cognitive medical environment, technology that allows the medical professional to know what's happening to patients long before they do." And computer scientists like **Michael Zyda** and other games researchers are working on a new form of preventive medicine—games that instruct and encourage players to exercise and eat healthy foods, while monitoring their activity using built-in sensors.

Andrea Armani

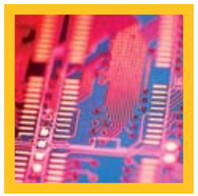
> "Another ambitious effort involves electrical engineering faculty who are designing a super-PDA for patients that would create a cognitive medical environment, technology that allows the medical professional to know what's happening to patients long before they do."



Pin Wang

Regenerative Medicine, Cancer and Stem Cells

For years, **Martin Gundersen** has been researching "pulsed power"—extremely short bursts of high-intensity radio waves—for various applications (see story, page 18). Recently, he has collaborated with oncologists who find that pulsed power has promise for treating certain forms of cancer. **Michelle Povinelli**, of electrical engineering, has been following a separate but related path—her research uses gold nanoshells embedded in cancers, which absorb broadcast energy and turn it into heat, killing cancer cells. **Richard Roberts**, professor of chemistry and chemical engineering, has invented mRNA displays for the purpose of peptide, protein and peptide-mimetic design. He's collaborating with **Pin Wang**, of the Mork Family Department, to implant desired genes in stem cells.



Health Informatics and Bioinformatics

Kesselman and **Erberich** are developing important research in health informatics. In addition, **Ewa Deelman**, **Marcus Thiebaux** and **Jose-Luis Ambite** are collaborating with Rutgers University on extracting possible clues to genetic roots for diseases, including mental illness, from masses of human DNA information (see story, page 11).

Gully Burns is aiding medical and biological research by creating software tools that enable researchers to query masses of complex data efficiently. **Robert Neches** is using information technology to improve emergency response to disasters focusing specifically on help for children, working with **Tatianya Kichkaylo** and **Tanya Ryutov**. Information specialists **Rahul Jain** and **Fei Sha** are also involved in the issue of making medical and research information more accessible.

David Belson, of the Epstein Department of Industrial and Systems Engineering, and **Randolph Hall**, a member of the Viterbi faculty and USC vice provost for research advancement, have worked extensively with local primary care hospitals to help them borrow standard industrial techniques and use expensive capital resources, such as operating rooms, more efficiently. **Shinyi Wu** of the Epstein Department is following a parallel line, improving access to preventive care at such hospitals (see story, page 20). Analysis of environmental factors is a major area of effort with **Constantinos Sioutas**, of the Sonny Astani Department of Civil and Environmental Engineering, carrying out sophisticated analyses of environmental pollutants.

Michelle Povinelli

Systems Biology, Multiscale Modeling in Biomedicine, Drug Design/Delivery

The computing team of **Priya Vashishta**, **Aiichiro Nakano** and **Rajiv Kalia** specialize in research that attempts to model, on the molecular level, the behavior of materials. They've long worked in inorganic materials, but are now starting to use their techniques on biological ones, producing vivid, startling images of the behavior of DNA and other important biological materials. **Roberts** is attempting to model the system that sustains an individual cell—the information flow, via proteins, interactions and modifications, that makes the cell live. "Control these, control the cell" is his vision. BMSR Founder and Co-director **David D'Argenio** is now designing experiments that will eventually permit physicians to understand the genetic and other factors that lead to differential response to anti-HIV drugs.

Developmental and Metabolic Disorders

Viterbi researchers are also working on resources to help physicians both understand and treat common disorders, mental and physical. Computer scientist and Senior Associate Dean of Research **Maja Matarić** is a national leader in "socially assistive" robotics, using robots to help populations such as the elderly with rehabilitation, and, more recently, children with autism spectrum disorders. Autism disorders are a major interdisciplinary focus at the Viterbi School, funded as an outgrowth of a recent NIH grant to Biomedical Engineering Research Assistant Professor **Clara Lajonchere**. **Sioutas** is addressing possible environmental causes for the disorders, with additional work by **Narayanan** on other aspects of the disease. **Itti** is using his work on perception to investigate another widespread mental childhood disorder, attention deficit/hyperactivity disorder, also known as ADHD.

Maja Matarić

Constantinos Sioutas

The impressive breadth and depth of health-related engineering research at the Viterbi School has the institution well positioned. It's already at the forefront internationally in many areas and, with new faculty members and an intensified focus on medical research, which is likely to unfold in the new Obama administration, looks forward to further success.

ISI Wins NIH National Neuroscience Database Coordinating Center (BIRN)

Carl Kesselman

The Viterbi School's Information Sciences Institute (ISI) will be the new central clearing house for an ambitious, ongoing national project to collect and integrate a wide range of biomedical data, making it more accessible to physicians and researchers.

The National Center for Research Resources, a component institute of the National Institutes of Health (NIH), has awarded USC a major grant to support the Biomedical Informatics Research Network Coordinating Center (BIRNCC) at USC.

Carl Kesselman of the Epstein Department of Industrial and Systems Engineering and ISI will lead the five-year, $22.2 million task to revamp and update a critical element of an evolving NIH effort to improve access to the exploding volumes of biomedical research information.

BIRNCC brings together a network of world-renowned researchers developing bioinformatics tools for the broader scientific community. USC is the lead partner on the project, which includes collaborations with UCLA, UC Irvine, the University of Chicago, and Massachusetts General Hospital. With this grant, USC is poised to become a leader in the emerging field of bioinformatics, which is the computerized analysis of biological data.

The Biomedical Informatics Research Network (BIRN) is part of NIH's National Center for Research Resources. BIRN collects biomedical imaging data from institutions all over the country, currently with a heavy emphasis on neuroscience. BIRNCC has the task of facilitating collaboration and data sharing between the research centers.

In addition, BIRNCC will help ensure that important innovations reach society. As it stands, medical researchers develop many discoveries and therapies that never connect with people because of the overwhelming quantity of data that geneticists and others produce. BIRNCC will create a nation-wide computer network that facilitates collaborative biomedical research.

"Without a sophisticated bioinformatics capability—which only top engineers can provide—we cannot hope to translate the basic science into drugs and treatments that will improve the quality of life," says Kesselman. "BIRNCC can accelerate the rate of discoveries for many areas of biomedical research."

"The new BIRN contract is an outstanding example of how the Viterbi School, and ISI in particular, are building from strengths to become a leader at the intersection of engineering and medicine," says Viterbi School Dean Yannis C. Yortsos.

"This grant is enormously significant—not only for what it says about USC and its research, but for what it will do for our society," adds USC Executive Vice President and Provost C. L. Max Nikias. "It also underscores the tremendous value of our Office of Research Advancement in Washington, D.C. Without this office, USC wouldn't have competed for this grant, and this multi-university collaboration would never have been assembled." //

"Engineering is helping to change the shape of health care and medicine. And I am proud of the significant role that the Viterbi School is playing in this process."

YANNIS C. YORTSOS, DEAN, VITERBI SCHOOL OF ENGINEERING

THE RIGHT STUFF

TO ACHIEVE MISSION SUCCESS, IT TAKES THE RIGHT TEAM AND THE RIGHT PROCESSES. THAT'S WHERE VITERBI SCHOOL'S WANDA AUSTIN, PRESIDENT AND CEO OF THE AEROSPACE CORPORATION, COMES IN. *By Diane Ainsworth*

Wanda Austin (PhD ISE '88) spends most of her time evaluating the technical capabilities of space systems orbiting 22,000 miles above the Earth's surface, in a rarified layer of the atmosphere that's teeming with communications, broadcast, weather and remote-sensing satellites.

In her line of business, it takes the right people and the right processes to understand how these systems operate. All the while, new systems are being developed, tested and validated for launch by her company's government sponsors, the U.S. Air Force, the Department of Defense, NASA and the National Oceanic and Atmospheric Administration (NOAA).

Assuring space mission success is the tagline for The Aerospace Corporation, a leading architect of national security space programs and a principal technical resource for space and launch programs of national significance. Austin is the driving force behind the corporation.

"Most people don't appreciate the tremendous potential that space holds for all of us, for safeguarding our planet and advancing science, for gaining a better understanding of our weather and greening our planet, for securing our borders, developing a seamless global air transportation system and protecting cyberspace," Austin says. "This doesn't just happen. It's very much a disciplined process where people understand the importance of mission assurance."

Aerospace's testing, verification and validation process is designed to ensure that what's being launched is, in fact, what's been designed and requested. And adhering to this disciplined process is what allows for success after success, she explains.

> **"Most people don't appreciate the tremendous potential that space holds for all of us, for safeguarding our planet and advancing science, for gaining a better understanding of our weather and greening our planet…"**

30-YEAR VETERAN

Austin has been at The Aerospace Corporation for 30 years, stepping into the top position of president and chief executive officer on January 1, 2008. She oversees a staff of nearly 4,000, including more than 2,000 of the finest engineers and scientists in the world; together they contribute to the design of next-generation satellites that will someday join their aging counterparts in space. But as the fabric of space technology becomes more intricately woven—and the skies more crowded—the industry is heading toward an even greater need for systems-of-systems engineers.

"Fifteen years ago, we were designing and developing hardware as a stovepipe, as individual platforms unto themselves," Austin says. "But the world is far more complex today. Our systems interact with each other. Some are crewed, some are uncrewed, and some satellites are operating fairly independently. It's very different, and we don't have an overarching responsive space architecture right now. So when we talk about architecting the future of space, it's really important to do it in terms of those future capabilities."

Knowing a satellite system inside out isn't a tall request for Austin, whose love of space and all things technical goes back to her youth. Internationally recognized for her work in satellite and payload system acquisition, systems engineering and system simulation, she discovered her gift for mathematics while growing up in New York City. She earned her bachelor of arts degree in mathematics from Franklin and Marshall College, then went on to the University of Pittsburgh for advanced degrees in both mathematics and systems engineering.

"That's where I discovered I could use my interest in applied mathematics to address real-world problems," she says in her sixth floor presidential suite atop The Aerospace Corporation headquarters in El Segundo. "That's when I got hooked."

After graduation, she headed west at the urging of a friend and, shortly thereafter, joined The Aerospace Corporation. After a few years and a few assignments as a member of the technical staff, she was coaxed into returning to school for a Ph.D. Eberhardt Rechtin, The Aerospace Corporation's much beloved former president, did the coaxing.

VITERBI PH.D. PROGRAM

She enrolled in the Viterbi School's Daniel J. Epstein Department of Industrial and Systems Engineering, where she met a group of faculty who became her next mentors. They included Professor Behrokh Khoshnevis, director of the Viterbi School's program in manufacturing engineering; Professor Gerry Nadler, former Epstein Department chair and a fellow member of the National Academy of Engineering (NAE); and Professor George Bekey, robotics pioneer and professor emeritus of computer science.

Professor Khoshnevis, her Ph.D. advisor, recalls Austin's remarkable work as a student.

"Wanda was the top student in my computer simulation courses. This tempted me to suggest a very challenging Ph.D. dissertation project to her. It required advanced computer science tools, which, at the time, were still in development, but Wanda managed to obtain them, understand them and creatively use them in her complex and very ambitious research project," Khoshnevis says.

"I was amazed that complexity never concerned her," he continues. "It seemed like the harder the problems became, the more determined and creative she became in solving them. I was so proud of what Wanda produced and was not at all surprised when the Society for Computer Simulation awarded her the Best Ph.D. Thesis of the Year Award."

ANALYTICAL SKILLS

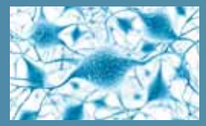
"It was a very enriching experience, not just for getting the degree but for developing problem-solving skills that could be applied to real-world problems," Austin adds. "Professor Khoshnevis' approach was to analyze pieces of a problem and understand how each piece fit into the larger picture. Those are analytical skills that have served me very well to this day."

After earning a Ph.D. in 1988, she went on to serve in positions of increasing responsibility at The Aerospace Corporation, including general manager of the MILSATCOM (Military Satellite Communications) Division, senior vice president of the Engineering and Technology Group, and senior vice president of the National Systems Group in Chantilly, Va.

Austin, a member of the Viterbi School Board of Councilors, was recently inducted into the NAE for her technical and leadership abilities, becoming the second African-American woman to hold membership in the organization. She was inducted along with Viterbi School Dean Yannis C. Yortsos and USC Executive Vice President and Provost C. L. Max Nikias. //

NAE's Grand Challenges

VISIT WWW.ENGINEERINGCHALLENGES.ORG FOR MORE INFORMATION





The National Academy of Engineering (NAE) has announced 14 grand challenges that must be addressed in the early years of the 21st century if we are to safeguard our natural resources, promote quality of life worldwide, and build a more secure and sustainable future for an ever-growing global population.

The Viterbi School has welcomed NAE's call to action. In fact, it is already involved with a plethora of ongoing research initiatives that nearly match one-for-one all of NAE's challenges.

"Our faculty are ahead of the curve in many of these critical research areas, recognizing that the key to our global well-being in the 21st century is intricately tied to the Academy's challenges," said Viterbi School Dean Yannis C. Yortsos. "We are moving quickly to address some of these very complex issues, from developing energy alternatives to green technologies to improving cybersecurity and advancing the frontiers of medicine and health informatics, to name just a few. The NAE challenges make a strategic map that is useful for future directions."

A very brief summary of the school's current research in the context of the NAE Grand Challenges is provided below in terms of broad categories. In many cases, such research is conducted in the form of major centers already in place:

HEALTH

Advance Health Informatics: Stronger health information systems not only improve everyday medical visits, but they are essential to counter pandemics and biological or chemical attacks.

Engineer Better Medicines: Engineers are developing new systems that use genetic information, sense small changes in the body, assess new drugs, and deliver vaccines.

Reverse-Engineer the Brain: The intersection of engineering and neuroscience promises great advances in health care, manufacturing, and communication.

- *Biomimetic MicroElectronic Systems (BMES) Engineering Research Center:* Developing biomimetic devices and prostheses; reverse-engineering parts of the brain (Mark Humayun, Gerald Loeb, Ellis Meng, Theodore Berger).
- *Biomedical Simulations Resource (BMSR):* Using computational engineering tools to solve biological phenomena (David D'Argenio, Vasilis Marmarelis).
- *Center for Genomic and Phenomic Studies in Autism:* Survey and build world's largest database of genetic, physical and behavioral profiles of children with autism (Clara Lajonchere, Constantinos Sioutas).
- *Resource Center for Medical Ultrasonic Transducer Technology:* Developing new UV imaging technologies for disease detection and treatment (K. Kirk Shung).
- *Center for Health Informatics (CHI):* Creating a global computing platform for the exchange of health information (Carl Kesselman, Stephan Erberich).
- *Biomedical Informatics Research Network (BIRN):* Facilitating biomedical data-sharing (Carl Kesselman).

ENERGY AND THE ENVIRONMENT

Make Solar Energy Economical: Solar energy provides less than 1 percent of the world's total energy, but it has the potential to provide much, much more.

Develop Carbon Sequestration Methods: Engineers are working on ways to capture and store excess carbon dioxide to prevent global warming.

- *CiSoft (Center for Smart Oilfield Technologies):* Using information technologies to improve oil production and discovery (Iraj Ershaghi).
- *Solar power:* Applications of nanoscience to solar and lighting (P. Daniel Dapkus, Chongwu Zhou).
- Developing CO2 sequestration techniques (Dongxiao "Don" Zhang and Kristian Jessen).
- Combustion, fuel cell technology, alternative fuels, nanopulse power for efficient combustion (Fokion Egolfopoulos, Martin Gundersen).

SECURITY

Prevent Nuclear Terror: The need for technologies to prevent and respond to a nuclear attack is growing.

Secure Cyberspace: It's more than preventing identity theft. Critical systems in banking, national security, and physical infrastructure may be at risk.

- *USC Center for Risk and Economic Analysis of Terrorism Events (CREATE):* Studies of nuclear, chemical, biological threats to major urban centers, airports and harbors (Isaac Maya).
- *Information Sciences Institute's DETER (Defense Technology Experimental Research) program:* Developing systems to prevent cyber attacks and develop countermeasures (Clifford Neuman, John Wroclawski, Jelena Mirkovic, Terry Benzel).
- Wireless network research (John Heidemann, Bhaskar Krishnamachari, Konstantinos Psounis, Michael Neely, Urbashi Mitra, Wei Ye).
- Computer architecture, computer engineering, coding and networking (Clifford Neuman, Yigal Arens, John Wroclawski, Bob Braden, Craig Knoblock, Ted Faber, Jelena Mirkovic).
- Center for Computer System Security: Overseeing programs to build new computer security systems and virus detection software (Clifford Neuman).

MEGACITIES

Restore and Improve Urban Infrastructure: Good design and advanced materials can improve transportation and energy, water, and waste systems, and also create more sustainable urban environments.

- *Southern California Particle Center (run jointly with UCLA):* A leading center in the nation for the study of airborne particulate pollution (Constantinos Sioutas).
- *METRANS National Transportation Center:* Supports research, education and outreach to solve metropolitan transportation problems (James E. Moore, Petros Ioannou).
- *Megacities Initiative:* Advance geospatial information technologies, structural improvements, natural disaster mitigation, construction management and green technologies (Jean-Pierre Bardet, Roger Ghanem).
- Groundwater modeling and movement of underground water (Dongxiao "Don" Zhang).

PERSONALIZED LEARNING

Advance Personalized Learning: Instruction can be individualized based on learning styles, speeds, and interests to make learning more reliable.

Enhance Virtual Reality: True virtual reality creates the illusion of actually being in a different space. It can be used for training, treatment, and communication.

- *USC Integrated Media Systems Center (IMSC):* Developing immersive visualization technologies for geospatial decision-making (James Baker, Ulrich Neumann, Cyrus Shahabi).
- *USC GamePipe Laboratory:* Supporting serious games research and development (Michael Zyda).
- Developing Web-based education systems, multimedia and intelligent tutoring systems (Shrikanth Narayanan).
- Personalized game-based learning research (Victor Lacour, Dennis McLeod, Margaret McLaughlin).
- Technology-assisted learning for children and adults with special needs (Maja J. Matarić, Shrikanth Narayanan).
- Improving K-12 tools and outcomes (Dan Davis, Robert Lucas, Maja Matarić, Gigi Ragusa).

ENGINEER THE TOOLS OF SCIENTIFIC DISCOVERY

In the century ahead, engineers will continue to be partners with scientists in the great quest for understanding many unanswered questions of nature.

- Interactive Knowledge Capture team (Yolanda Gil) is building "knowledge acquisition tools," easily usable by scientists who are not computer science experts.
- ISI's Pegasus Project (Ewa Deelman) automates discovery steps, "compiling not just software and data, but expertise." Deelman and Jose-Luis Ambite are applying these tools to DNA database exploration.
- Distributed networks of sensors and robots for aquatic, forest and other environmental monitoring and characterization (Gaurav Sukhatme, John Heidemann). //


Jean-Pierre Bardet


Terry Benzel


Fokion Egolfopoulos


Iraj Ershaghi


Kristian Jessen


Maja Matarić


Isaac Maya


Urbashi Mitra


James Moore


Shri Narayanan


Ulrich Neumann


Paul Ronney


Cyrus Shahabi

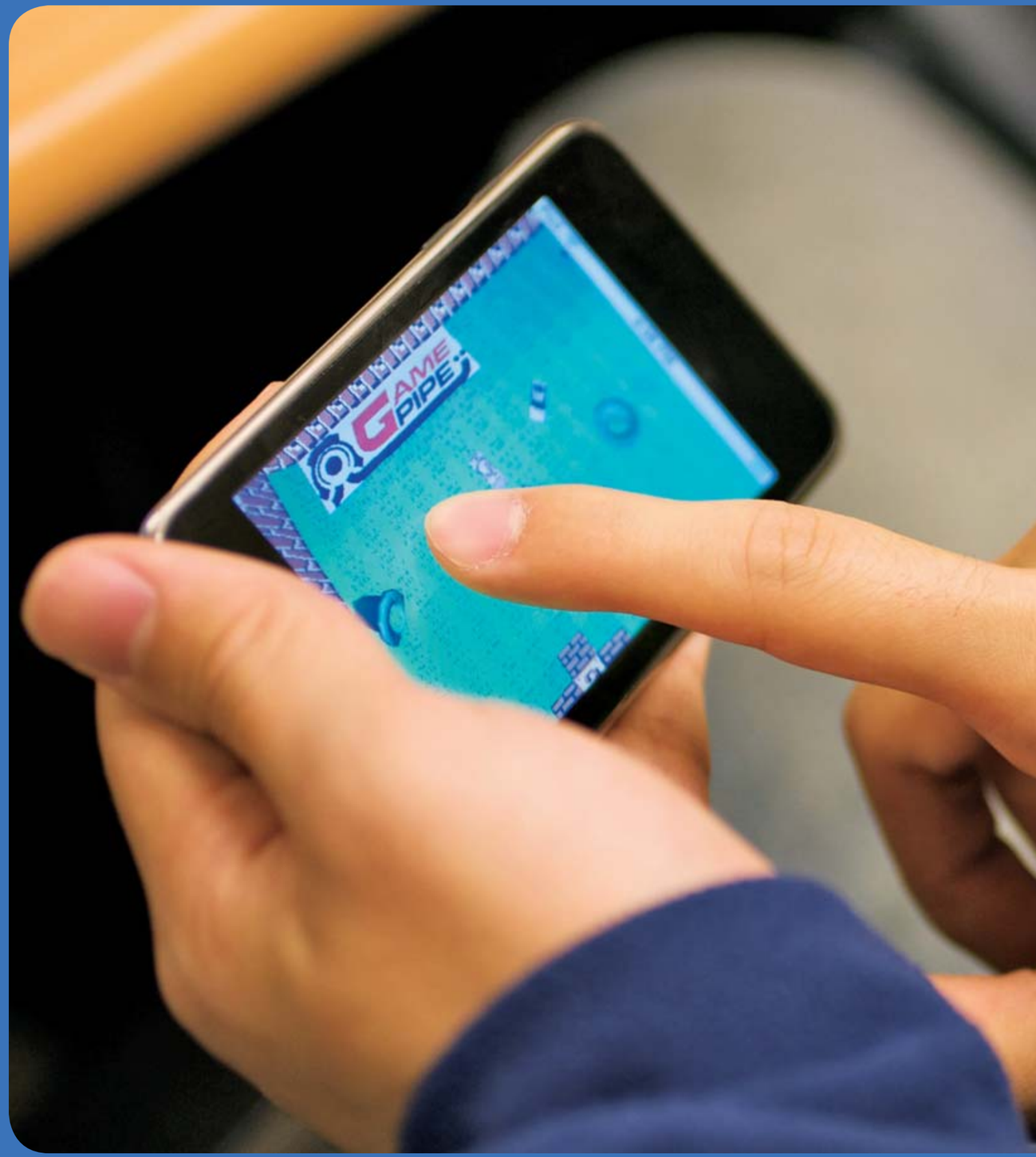

Constantinos Sioutas


Milind Tambe


Don Zhang

Game On!

IT'S THE ENERGY-PACKED CLIMAX to an entire semester of hard work. Students in the Viterbi School's nationally recognized GamePipe Laboratory, bleary-eyed from the consecutive all-nighters they spent polishing their final presentations, demoed their work to teachers and representatives of the game industry. In addition to grades, internships and possible jobs, the students could get rewards for excellence. Here's the scene inside the GamePipe Laboratory on Demo Day at the end of fall semester 2008. You can see the games presented—this semester and in previous semesters—at the GamePipe Laboratory website: **gamepipe.usc.edu**. //



ALUMNI NEWS

VITERBI ALUMNI RELATIONS

Your membership in the Trojan Family does not end at graduation. The USC Viterbi School's Office of Alumni Relations is here to build and sustain your connection to USC, to the Viterbi School and to your fellow Trojan Engineers—a connection that is truly lifelong and worldwide.

You are part of a distinguished group of more than 35,000 Viterbi School alumni. We hope you take advantage of the many opportunities to build connections with this group through volunteering, guest lecturing, career mentoring and supporting the school.

Alumni also stay connected to the engineering community through our online database, lifetime email forwarding, networking and attendance at annual events such as Homecoming and the Viterbi Awards.

Stay Connected

We rely on your accurate mailing and emailing addresses to ensure you receive our many publications and invitations to special events. Please update your information online at http://viterbi.usc.edu/alumni or by contacting the VSoE Office of Alumni Relations at (213) 821-2424.

Kevin Gibbs (MSCE '85; MSCS '87), at right wearing sunglasses, enjoys the Bay Area Weekender with family and friends.

Bay Area Weekender

The Viterbi School made its annual trip to Northern California for the 2008 Bay Area Weekender. The event was held in San Francisco at the E & O Trading Co. A group of alumni and friends gathered for appetizers and drinks at the restaurant on Thursday, November 13. Then the Viterbi School joined the Alumni Association for their annual pep rally at the Westin St. Francis in San Francisco on Friday, November 14, and ended the weekend with a pre-game tailgate before the USC vs. Stanford football game on Saturday.

Hollywood Bowl

On September 6, the Viterbi School hosted its 6th annual "evening at the Hollywood Bowl." Before the concert, more than 100 alumni and friends gathered at the Bowl's museum garden for a reception and dinner. Fred Vogler, the Hollywood Bowl's sound designer, gave a presentation before guests enjoyed the "Tchaikovsky Spectacular" and a special appearance by the Trojan Marching Band.

VITERBI ONLINE EDUCATION

Master of Science Programs Online: For 35 years, the Viterbi School's innovative Distance Education Network (DEN) has enabled thousands of engineers to earn their M.S. degrees from USC without having to set foot on campus. With just a high-speed Internet connection, students throughout the country can view the same courses as our on-campus students. More than 30 M.S. programs are available entirely online—visit **www.den.usc.edu** to see how to get started this spring semester.

Left to right: Aditya Mandavilli '04, Rahul Mani '07, Rushil Kadakia '07, and Karan Sheth '07 hold up the fan banners at the Bay Area Weekender event.

Engineering Me

MY NAME: Vanessa Martinez

DEGREE: B.S., Biomedical Engineering, 1996

JOB TITLE: Consultant

LIFELONG DREAM: To leave behind a positive footprint.

FAVORITE VITERBI PROF: Stanley Yamashiro

BOOK I'M READING: *Brides o'the Emerald Isles*

ON MY IPOD: *Simple Kind of Life* by No Doubt

WORDS TO LIVE BY: "It is what it is."

ENGINEERING HERO: Alfred E. Mann

NEXT TRIP: Hawaii or Europe

BEST TIME OF DAY: Sunset

FAVORITE GADGET: Kitchen Aid Mixer and my Palm Centro

BEST USC MEMORY: Football games and tailgates

TOUGHEST ENGINEERING CLASS: BME402 Control and Communication in the Nervous System

NUMBER ONE URL: www.delish.com

NUMBER OF TROJANS IN MY LIFE: Too many to count

PROUDEST MOMENT: The realization of true happiness

BIGGEST CHALLENGE: Living a balanced life

INSPIRATION: My loved ones

Me...Engineered

VITERBI STORE

Visit the Viterbi Store. Show your pride with custom-designed Viterbi gear and gift items. Shop at the USC Bookstore on campus or online at the Viterbi Store, viterbi.usc.edu/viterbistore/ to purchase your Viterbi items today!

USC Homecoming

MORE THAN 400 ALUMNI, FRIENDS AND THEIR FAMILIES came back to USC on November 1 for the annual Viterbi School Homecoming picnic. Before watching the Trojans defeat Washington, guests mingled with fellow alumni and friends while enjoying delicious barbeque and drinks. The popular raffle was a success, as always, with one lucky guest taking home tickets to the USC vs. Notre Dame football game. //

Charles and Victoria Woods.

Philip (MSEE '76) and Debbie Gallagher.

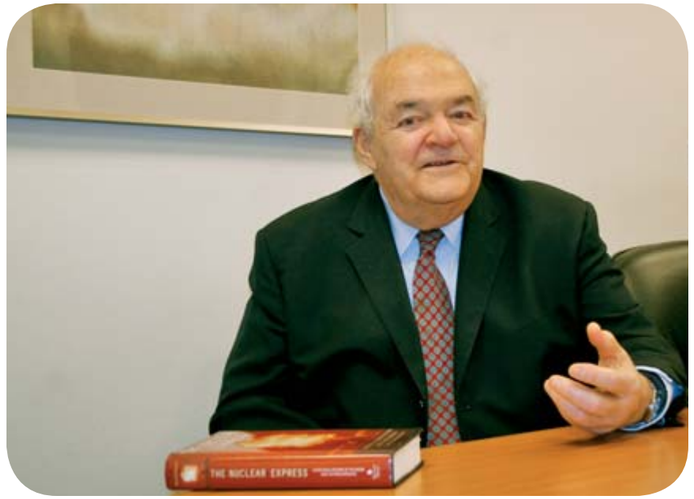
Photos by Brian Morri

Maria (BSCSCI '85) and Bernard Barrera (BSSAFE '86) with their friends the Gallardo family.

Ron Valdivia (MSME '89) with his wife, Lisa, and their daughters, Amy and Natalie, and friend James and Lynne Rodino.

Nuclear Express

ALUMNUS TOM REED TRACES SPREAD OF NUCLEAR WEAPONRY IN NEW BOOK



Viterbi School alumnus Thomas Reed (MSEE '59), former U.S. Air Force Secretary under Presidents Gerald R. Ford and Jimmy Carter and former weapons expert at Lawrence Livermore National Laboratory, traces the spread of nuclear weaponry through the world in his new book, *The Nuclear Express: A Political History of the Bomb and Its Proliferation* (Zenith Press, 2009).

The book is a chilling insider's account of how countries with nuclear weapons came to acquire them. Co-written by Danny Stillman, former director of the technical intelligence division at Los Alamos National Laboratory, the authors claim that all nations that built nuclear weapons, including the United States, spied on or were given access to the work of other nuclear powers. An examination of post-Cold War national and geopolitical issues surrounding nuclear proliferation, and the effects of Chinese sponsorship of risky regimes, especially Pakistan, caught the attention of *The New York Times*' book critics, as well as other major national media outlets, prior to the book's publication in early January.

"The reckless 'nuclear weapons programs for sale' exporting of technology by Pakistan is truly chilling, as is the on-again/off-again North Korean nuclear weapons program," one reviewer wrote.

The authors warn that the world faces a "new kind of Armageddon nightmare," one that is based on the ability of terrorists to build and transport nuclear bombs in their trucks. From the book's inside cover flap: "The sense of relief the world felt at the end of the Cold War has been replaced with a different kind of Armageddon nightmare. Instead of an East-West power struggle with the rest of the world on the sidelines, the collective dread this time is over terrorist organizations getting their hands on a nuclear weapon, then using it to effect chaos and collapse on civil society." //

VITERBI CAREER SERVICES

If you're interested in becoming involved in hiring current Viterbi engineers, or would like to know where to start for Alumni Career Services, please visit: **viterbi.usc.edu/students/undergrad/careers/alumni/**.

Or visit the Career Services Office:

3710 S. McClintock Avenue
Ronald Tutor Hall (RTH) 218
Los Angeles, CA 90089-2900
Phone (213) 740-9677
Fax (213) 740-9586
viterbi.careers@usc.edu

2009 VITERBI AWARDS

The Viterbi School will hold its annual Viterbi Awards Banquet in downtown Los Angeles.

When: April 1, 2009
Where: The California Club
538 South Flower Street
Los Angeles
Time: 6:00 pm – Reception
7:00 pm – Dinner and Program

This year, the School will be honoring:

- **Narayana Murthy**, Chairman, Infosys Technologies, Ltd., *Daniel J. Epstein Engineering Management Award*
- **Thomas Reed**, former U.S. Air Force Secretary, *Mark A. Stevens Distinguished Alumni Award*
- **Don Paul**, Executive Director, USC Energy Institute, *Distinguished Service Award*

For more information, please call **(213) 821-2424** or visit **viterbi.usc.edu/awards**

Clarence E. Foster III (BSChE '84)

A VITERBI SURGEON IN IRAQ

Dr. Clarence E. Foster III (BSChE '84), a transplant surgeon at UC Irvine Medical Center, spends most days saving lives in a modern Orange County hospital, but last spring he spent 90 days on the front lines in Iraq, about 100 miles southeast of Bagdad, treating soldiers and civilian casualties of the Iraq war.

The experience was life-altering for Foster, a major in the Army Reserves, who's been deployed three times since 2003, though this was his first time in Iraq.

"Serving my country was something I'd always wanted to do," Foster said, "but I had a lot of trepidation going over there."

Foster grew up in New Orleans and was influenced by three uncles who were drafted in the Vietnam War. He did well in school, was named valedictorian of his high school class, and entered USC's undergraduate program in chemical engineering on a university academic scholarship. During his sophomore year, while working on the hemodynamics (pressure, flow and resistance) of central venous catheters, as well as CFCs (chlorofluorocarbons), with Mork Department Chair Theo Tsotsis, Foster decided to go into pre-med.

Foster was at the top of his class—a member of Omega Chi Epsilon, the national honor society for chemical engineering, as well as the honorary Trojan Knights fraternity. After graduating from USC, he was accepted at The Johns Hopkins University School of Medicine; a short time later, he decided to specialize in transplant surgery. He also realized that he could use his surgical skills to serve his country by joining the National Guard.

"When I was a surgery resident, I switched to the Army Reserves, but I didn't finish my surgery residency training until 1997," he says. "And then I had to wait a while. I wasn't mobilized until 2003, when I went to Fort Irwin, then to Madigan Hospital in Tacoma, Wash."

Photo by Paul R. Kennedy

Foster in pre-op at UC Irvine Medical Center talks to a nursing assistant and patient.

In 2004, he was sent to Walter Reed Hospital, where he did transplant surgery during the height of the first Iraq invasion during the current war.

Transplant surgery is a very specialized field, and Foster had spent years perfecting his skills. He never thought he'd wind up performing trauma surgery on the front lines in Iraq a few years later.

But in April 2008, he was deployed to Camp Delta in Al Kut, Iraq, about 20 miles from the Iranian border, where he was assigned to a "forward surgical team." These teams are the first line of medical care for soldiers and civilians who've been injured during combat.

"This wasn't like anything I was used to. It was emergency surgery, but we didn't have any of the equipment, like CT scans, X-ray machines or other diagnostic technologies," Foster says. "We had two surgeons, three nurse-anesthetists, that's it. The conditions were austere and grim. It was traumatic to see so many burned bodies, especially women and children."

Foster spent all of his time treating people who'd been shot, severely burned or had lost a limb to an IED (improvised explosive device). When he wasn't performing surgery, he was educating the local Iraqi doctors, inviting them to camp for lectures and hands-on training.

After two months in Al Kut, he was sent to Camp Bucca, a U.S. Army-run Iraqi detainee camp in the vicinity of Umm Qasr, in the southernmost province of Iraq. This time, he performed elective surgeries, such as hernias, appendectomies and gall bladder operations in a much more sophisticated facility.

The detention camp was "a rough place," Foster says, but the medical facilities

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Engineering Me

MY NAME: Alfonso Anaya Jr.

DEGREE: B.S., Computer Science, 2001

JOB TITLE: Entrepreneur

LIFELONG DREAM: To someday help many people on a very large scale

FAVORITE VITERBI PROF: Professor Crowley and Professor Horowitz

BOOK I'M READING: *Darwin on Trial* by Phillip E. Johnson

ON MY IPOD: Sublime, Pearl Jam, Elvis

WORDS TO LIVE BY: "Never, ever, ever, give up."
—Winston Churchill

ENGINEERING HERO: Bill Swanson, Engineer and Chairman and CEO of Raytheon

NEXT TRIP: Toronto, Canada

BEST TIME OF DAY: Late at night. I get most things done with few interruptions.

FAVORITE GADGET: Canon SD1000 Digital Camera

BEST USC MEMORY: Breaking away from my studies in order to see a football or basketball game.

TOUGHEST ENGINEERING CLASS: Compiler Theory & Operating Systems

NUMBER ONE URL: www.yahoo.com

NUMBER OF TROJANS IN MY LIFE: Too many to count—A BIG Trojan Family

PROUDEST MOMENT: Graduating from USC!

BIGGEST CHALLENGE: Graduating from USC!

INSPIRATION: My mother. She's strong emotionally, physically, and spiritually. She has overcome insurmountable odds.

Me...Engineered

>> Continued from page 41.

The surgical team in Iraq, left to right: a nurse anesthetist, a fellow surgeon and Foster.

included an emergency room, internal medicine clinic, optometry clinic, psychiatric services, orthopedic/surgical unit, physical therapy clinic, pharmacy, dental clinic and more.

The only time Foster really feared for his life was when he was traveling from one place to another, by plane or helicopter. "That was really the most anxious time because you were out in the open and vulnerable to attack," he says. "But I wanted to be there, because if I wasn't there, who would be? That's the main reason I want to stay [in the reserves]."

Nonetheless, he was glad to get back to Orange County in August 2008 to see his family again and to use his season tickets to the USC football games. Each year, he also comes to campus for the Mork Family Department of Chemical Engineering and Materials Science's Advisory Board meeting. Some day, he says he would also like to hold a lecture for undergraduate chemical engineering majors and share his experiences in Iraq.

"I like staying connected to the world and to USC," he says. "I've made lifetime friends through my service overseas, and I think I can give chemical engineering students some valuable insights into what it's like over there and what the medical profession is all about. It would be very rewarding to be able to help engineering undergraduates decide if they want to go into medicine." //

—Diane Ainsworth

MASTER'S AND PROFESSIONAL PROGRAMS

How has Viterbi helped shape your professional life? We always appreciate the chance to hear feedback from Viterbi alumni, so we can share the experiences of our graduates with prospective students. Interested alumni are invited to submit a brief testimonial and photo to include in future marketing and recruitment materials. While we won't be able to use all of the submissions, in appreciation of your time, we'd like to send you some USC Viterbi gear in exchange for your testimonial. We hope to hear from you soon!

Please send your testimonial and photos to Billy Schwerin at **schwerin@usc.edu**.

PROFESSIONAL PROGRAMS RESPOND TO ENGINEERING NEEDS

The Office of Master's and Professional Programs provides individuals and companies the opportunity to experience the world-class continuing education offered by USC Viterbi School of Engineering.

Under the direction of Candace House, Professional Programs offers seminars, certificate programs, and custom and short courses for non-degree seeking professionals. The majority of courses are taught by USC faculty and focus on real-world issues currently being tackled by engineering professionals.

"We're developing new programs that address industry's immediate needs," House says. "For example, we're offering a new, short course, 'Process Improvement for Health Care,' in which participants will learn methods to improve efficiency in health-care processes in order to reduce costs and improve patient care. This course just became available in March 2009."

"Courses On Demand" will also be available beginning in early 2009. These are semester-length, graduate-level engineering courses that have been videotaped via the school's Distance Education Network (DEN). The courses are edited for audiences seeking course content rather than academic credit. To obtain continuing education units (CEUs), students must complete a course assessment.

For more information on upcoming Professional Programs, visit **viterbi.usc.edu/professionalprograms**. //

A Viterbi Marriage

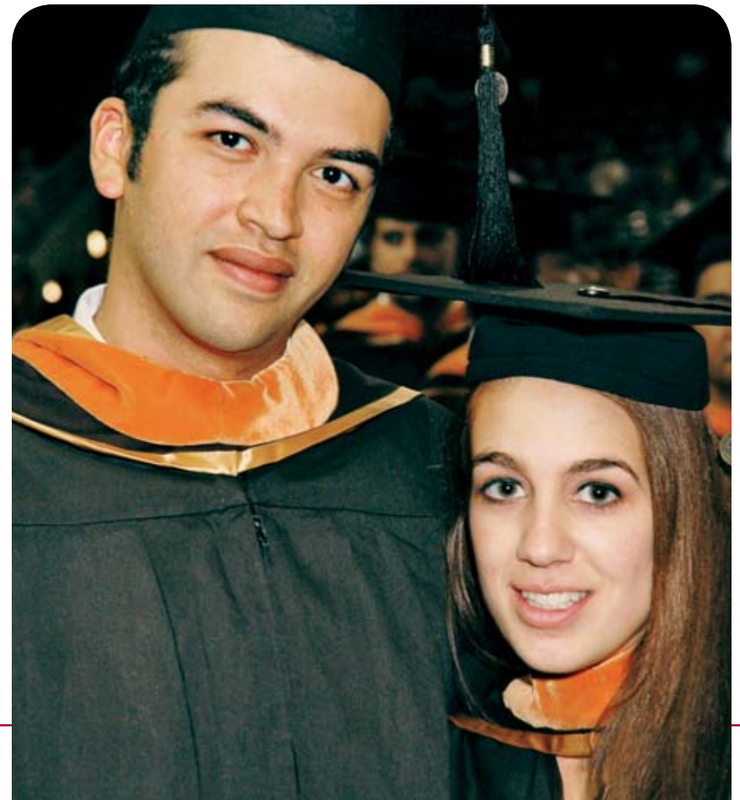
TWO ENGINEERING STUDENTS FALL IN LOVE

Love just happens when you least expect it. I'd already been living in California for two years when I decided to apply to USC to get a master's degree in construction engineering and management. I got accepted and enrolled in the program to start in the spring semester of 2007. Andres had already started his master's in the fall of 2006. Until then, he'd been living in Colombia, where he'd gotten his bachelor's degree in civil engineering and was working full-time for a construction company. We both decided to apply to USC because of its great reputation and outstanding construction program.

Andres and I met on the first day of class in CE 559 in the spring of 2007. That day, I was running late to class and as I walked through the door, the professor made me introduce myself in front of everyone. When I said I was from Colombia, the professor pointed towards Andres, as he mentioned that he was also from Colombia. I then asked Andres what part of Colombia he was from, and he asked me the same question. He answered he was from Bogota, the capital of Colombia, and I told him I was from Barranquilla, a small city on the northern coast. We started going out shortly after that introduction.

Life has been great since graduation. Andres got hired as a project engineer by a general contractor, and I got promoted to sales/estimator in the company that I worked for. We really enjoy our lives together. We're getting married in summer of 2009 and plan to have our wedding reception on the USC campus, where our love started. //

—Ivon Farah



Calendar of Events

VITERBI EVENTS

We look forward to seeing you at Viterbi School events, where you'll join fellow alumni and friends who share a passion for USC engineering. We have a fun and diverse schedule, so make plans now to join us at one or more of the following:

The Viterbi Awards
April 1, 2009
6:00 pm, Reception
7:00 pm, Dinner and Program
California Club, Los Angeles, California

Viterbi Bay Area Alumni Reception
Weekend of October 3, 2009
Bay Area, California

Regional Networking Events
Ongoing
Los Angeles, Orange County, San Diego, San Francisco

USC EVENTS

Commencement
May 15, 2009
Undergraduate – 10:30 am, Archimedes Plaza
Graduate and PhD – 2:30 pm, Galen Center

Fall Semester Classes Begin
August 23, 2009

USC Homecoming 2009
Annual Viterbi Reunion Picnic
November 14, 2009, USC Campus

Visit our website for the latest information:
viterbi.usc.edu/alumni

Q&A

Q&A with Kelly Goulis

Kelly Goulis is the associate dean of the Viterbi School's Office of Master's and Professional Programs

What is MAPP?

MAPP is our Master's and Professional Programs Office, which supports 3,000 master of science and Professional Program students. Our services range from the recruitment of talented students to the creation of an exceptional experience once they become part of the Viterbi family. We also offer seminars, certificate programs, and custom and short courses for non-degree seeking professionals. Programs are available both on campus and online through our Distance Education Network (DEN).

What distinguishes USC's DEN program from distance-learning programs offered by other engineering schools?

DEN has offered entire degree programs via distance since 1972. With more than 1,200 students across the country, DEN has enabled thousands of engineers to advance their education and their careers with a degree from USC, without having to set foot on campus. Most of our DEN students are employed full-time while earning their degrees part-time, and are employed by industry leaders, such as Boeing, Chevron and Microsoft. Our distance program is continually on the forefront of new learning technology, and we anticipate more growth in the coming years with new Master's programs in exciting niche areas such as green technologies, finance engineering, and health systems management engineering.

We're also leveraging social media, such as LinkedIn and Facebook, to create more interactivity between current students and alums of the DEN program. Students can use these platforms to create study groups, share ideas and network.

Is the current economic downturn impacting enrollments?

It's too early to tell. However, we take great care to ensure that our programs are responsive to market forces, and all our applicants know that their degrees will further their careers. We also offer specialized programs in emerging industries, such as information technology and health informatics, through Professional Programs. These courses give students an opportunity to update skills or acquire new ones, so they can compete for jobs, even in a very competitive environment.

What are Professional Programs all about?

Professional Programs are non-degree courses for a continuing education audience, while Master's Programs are degree granting. Professional Programs can fulfill continuing education or professional development requirements needed by engineering professionals. Professional Programs strives to enhance the skills set of professionals in the workforce and provide an in-person or virtual environment that allows engineers to collaborate with colleagues facing similar real-world challenges. Candace House directs the program (see story, page 42).

How does the Viterbi School position itself to recruit applicants?

As one of the top 10 graduate engineering schools in the country, we have a comprehensive campaign, which involves university visits, Web seminars, special events on the USC campus and personalized meetings with students. Through programs such as our Viterbi Integrated Master's Program (VIP), the school can partner with universities that have outstanding undergraduate engineering programs and provide those students a unique opportunity to complete a master's program at USC. I'm also very pleased that the MAPP office has successfully implemented a number of merit-based scholarships to help students with the cost of tuition.

Are you seeing any other enrollment trends?

Yes, in fact, we're seeing a rise in enrollments overseas. Just as in the United States, many professionals in countries such as India, China, Mexico and Canada would like to earn advanced engineering degrees, so we've increased our outreach efforts abroad, with positive results. For instance, the number of master's of science applicants from India has risen by 23 percent; the number of newly enrolled students from mainland China has increased by 156 percent; and we've had an 11 percent increase from Taiwan. //