Fall/Winter **2006**

USC Viterbi Engineer

Published by the USC Viterbi School of Engineering for Alumni & Friends

Putting a Fingerprint on Electrical Engineering

Alumnus Ming Hsieh Gives $35 Million Gift to Name the Viterbi School's Renowned Electrical Engineering Department

Disentangling the Spooky Quantum Puzzle

The Challenges of Quantum Engineering

Searching for Grandeur

Fighting Heart Disease with MEMs Technology

A Revolution in Prosthetics

Rebuilding Limbs and Lives

Volume 5 Issue 1

USC Distance Education Network

USC Viterbi
School of Engineering

Join our Celebration *Online for 35*

1972

Responding to the aerospace and defense industry's need to educate its workforce, USC's ITV (Instructional Television) is launched to allow students to take classes without interrupting their careers.

Engineering courses in aerospace, electrical engineering and computer science are delivered via state-of-the-art microwave technology from USC to specially-equipped aerospace company facilities throughout Southern California.

1980

ITV shows tremendous growth, offering Master's degree course-work to engineers at Hughes Aircraft, TRW, JPL, Rockwell, Point Mugu Naval Base and Port Hueneme.

1999

At the request of QUALCOMM to deliver USC courses to its engineers in San Diego, the program begins delivery on satellite, allowing it to expand throughout the entire state of California and into Arizona.

ITV changes its name to the Distance Education Network (DEN).

2002

DEN creates and launches its customized online course delivery system. Students can choose from ***12*** graduate engineering degrees entirely online!

2005

Based on student feedback, DEN allows lectures to be downloaded so students can view courses outdoors, on a plane, anywhere! Podcasting of certain courses are also made available.

2007

DEN is the choice of more than ***1300*** students throughout the country. Offering over ***30*** degree programs entirely online, USC offers the widest selection of online degrees among top engineering schools. For ***35*** years, DEN has enabled thousands of engineers to earn their USC Master of Science degree.

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USC

Online *Graduate Engineering Degrees*

features

departments

Cover photo by Philip Channing

For over a century, USC engineering has made history. Today, alumnus Ming Hsieh leaves his own distinctive mark.

Ming Hsieh:

- Founder (1990), CEO, president and chairman of the board of Cogent, Inc., a leading provider of automated fingerprint identification systems.
- USC Alumnus with a BS ('83) and an MS ('84) in Electrical Engineering.
- Recipient of the Mark A. Stevens Distinguished Alumni Award from the USC Viterbi School.

USC Viterbi School of Engineering:

- Celebrating 100 years of engineering excellence.
- Consistently ranks in the top 10 on the *U.S. News & World Report*'s list of graduate engineering programs.
- One of only four engineering schools to have two currently active National Science Foundation Engineering Research Centers. It is also the home of the first Department of Homeland Security Center of Excellence.
- Faculty includes 26 members of the National Academy of Engineering (NAE), four winners of the Shannon Award, one Turing Prize winner, and more than 40 recipients of national junior faculty career awards.
- Electrical Engineering faculty includes 11 NAE members, four of whom are also members of the National Academy of Sciences and the American Academy of Arts and Sciences.
- Home of the Distance Education Network, the nation's leading graduate engineering e-learning program.

Presenting the USC Ming Hsieh Department of Electrical Engineering: Endowed with the largest gift ever for an engineering department, poised to shape the next century.

USC
UNIVERSITY OF SOUTHERN CALIFORNIA

One hundred years ago, the first engineering course taught at USC was in electrical engineering. Since then, this prolific department and its alumni have led the technological revolution of the 20th century with ground breaking research in cell phone technology, communications, photonics, devices, and much more. Ming Hsieh's gift provides a solid foundation for the department's next one hundred years. And this is not his first mark on the world. Raised in China, Ming Hsieh worked his way to USC and went on to found Cogent, Inc., which revolutionized automated fingerprint identification. Now, he's setting a record for generosity to an engineering department that boasts 11 National Academy members, 21 IEEE Fellows, multiple IEEE Gold Medal Award winners and 4 Shannon Awards. In other words, the future isn't just bright. It's brilliant.

http://viterbi.usc.edu

USC **Viterbi**
School of Engineering

On a Glorious Day in Los Angeles…

… you can see the future! And this future will be led by the USC Ming Hsieh Department of Electrical Engineering in the Viterbi School, named on October 23, 2006 in a brilliant celebration on the USC campus. It was a celebration of the accomplishments and the wonder of the human mind, as shown by the illustrious history of electrical engineering at USC — and of the human spirit, as embodied in one man's generosity.

Academic institutions cultivate the mind and the spirit. They demonstrate what it means to be human in the most fundamental way. And the better ones, like USC and our own Viterbi School, shape humanity's future through discovery and creation.

One hundred years ago, electrical engineering gave birth to what is now the Viterbi School. In the century that ensued, it propelled the School, Southern California, and the nation forward with marvelous discoveries, new inventions and creative breakthroughs. Today, electrical engineering at USC is propelling the School to yet higher peaks, across time and across the globe.

The inexorable curiosity of the human mind has brought unprecedented changes throughout history, recently accelerated at an astonishing pace. Technology has evolved from a useful tool for humanity into an integral and enabling component of contemporary society. At this pace, the years ahead promise unimagined new vistas.

Indeed, like others, I believe that the 21st century will be the century of engineering. Electrical engineering will most surely lead the way: From communications to quantum computing to nanotechnology and to the development of imaginative partnerships with medicine, business, the arts and the humanities. And the shaping of this future has become that much more secure through the vision and generosity of Ming Hsieh. The second century of USC engineering could not have started in a more exhilarating and auspicious way!

Ming's thirst for knowledge and discovery led him to seek fulfillment in a distant land, distant in both geography and culture, from where he was born and raised, but close to his inner self. It is a story that has been played out before and it is being repeated today, here and across this nation. Engineering schools in this country, and the Viterbi School in particular, have been welcoming and receptive to this quest. Indeed, as early as 1915, two among the eight USC engineering graduates were from Japan.

Like Andrew and Erna Viterbi, who also arrived in this land from across the oceans, Ming had to flee oppression to get here… And also like Viterbi, Ming produced innovations that changed his field and, I might add, contributed to making our world a safer place.

And, as often is the case, the harder the challenge, the greater the accomplishments, the stronger the impulse to give back! I invite you to read this fascinating story on the pages of this magazine.

When I was bestowed with the honor of becoming dean of the School, I encapsulated the vision for Viterbi with four goals:

- First at USC
- A leader in the nation
- With constantly rising quality
- And excellence in all our endeavors

On that glorious fall day on the USC campus in October, the vision was crisp and clear.

Yannis C. Yortsos
Dean
USC Viterbi School of Engineering

Yortsos photo by Philip Channing

Board of Councilors

Meet the Viterbi School Leadership Team

Creating new paths of excellence with a forward-looking agenda and several new positions, Dean Yannis Yortsos introduced his new leadership team shortly after becoming permanent dean June 1, 2006. The team includes, seated, from left to right: Louise Yates, associate dean, admission and student affairs; Dean Yannis C. Yortsos; Maja Mataric, senior associate dean for research; Cauligi Raghavendra, senior associate dean for strategic initiatives. Standing, from left to right: Margery Berti, associate dean of doctoral programs; Christopher Stoy, chief executive officer, external relations; Leana Golubchik, of the Engineering Faculty Council; Robert Calverley, executive director, communications; Kelly Goulis, associate dean, master's and professional programs; Cynthia Harrison, executive assistant to the dean; Linda Rock, associate dean for administration; Barbara Myers, executive director, development; John O'Brien, senior associate dean for academic affairs; and David Murphy, executive director of finance.

USC **Viterbi**
School of Engineering

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http://viterbi.usc.edu/

Leadership team photo by Philip Channing

› STRAIGHT & to the POINT ‹

Gaming the System

Instead of learning, some students "game" computer-based teaching programs. New research at the USC Information Sciences Institute is looking at ways of predicting this behavior, and using such predictions to make the systems fit individual student needs.

"Intelligent tutoring systems (ITS) can provide effective instruction," writes ISI researcher Carole Beal in a paper presented in Boston at the American Association of Artificial Intelligence 21st National Conference on Artificial Intelligence, "but learners do not always use such systems effectively."

According to Beal, motivated students interested in course material take to ITS readily, but others will improvise ways to get through without putting in much effort. For example, they will answer at random or abuse the program's help feature by always asking for help as a way to get the answer without understanding the method.

Limiting access to the help function, for example, effectively defeats this last strategy — but doing so hinders other students, for whom help is part of the learning experience.

To try to find out which students were most likely to game the system, Beal studied the behavior of a sample of 91 high school students working with a math ITS. Her method integrated three data sources: Students' reports on their own motivation; teachers' reports on the same students' motivation; and finally, machine records of how the students in question used a web-based high school math tutoring system.

This last consisted of records of how students attacked math problems, and five different patterns emerged. Two of these were clearly unproductive. In one, students clearly selected answers at random and kept doing so until they found the right answer by chance. In the other, they just started clicking on the help icon immediately after the problem was presented and kept clicking it repeatedly to push through to the answer, and then repeated the process.

Students whose teachers identified them as motivated and who described themselves as motivated to do well in math showed little or no game-the-system behavior. But other results were less obvious.

"Students who described themselves as not good at math, not attracted to math, and not expecting to do well in math were most likely to use the ITS in a way that suggested a genuine effort to learn, by spending time reading the problem, and looking at the help features carefully and thoroughly," says Beal.

"The relatively high rate of learning-oriented ITS use by disengaged students suggests that technology-based instruction has potential to reach students who are not doing well with regular classroom instruction. The opportunity to learn from software may offer an appealing alternative because the student can seek help in private," explains Beal.

But between these poles, a large uncertain area remains. The largest single group of students were those with average motivation. About half of these followed learning strategies, but the other half guessed. And the guessers were just as likely to be students whose teachers identified them as having higher math skills.

Within this group, one clue emerged. In the questionnaire used to elicit the self-descriptions, those who believed that mathematical skill was something students had or did not have were more likely to guess. Those who thought math was something learnable were less likely to guess.

"This work is only a beginning," says Beal. Her next step will be to use recently developed, sophisticated models of learning based on studies of expert human tutors, who, as Beal writes, accomplish their work "through a repertoire of feedback messages, sophisticated problem selection, and judicious offers of learner control when *continued on page 9*

Carole Beal

Beal photo by Kevin Burke

Technology Guru Joins Integrated Media Systems Center

Technology visionary Cory Doctorow has been selected as the first holder of the Canada-U.S. Fulbright Visiting Research Chair, which will be co-hosted by the USC Viterbi School's Integrated Media Systems Center.

In his new role, announced by the Canadian Fulbright Commission, Doctorow will collaborate with USC faculty and students and deliver guest lectures to the wider community.

"I'm looking forward to being part of the academic discourse on the ways that technology can either liberate or control us," Doctorow said.

"We are excited by this opportunity to work with such a visionary as Cory Doctorow as we continue our research on experiential media for education, journalism and entertainment," noted Adam Clayton Powell III, director of the Integrated Media Systems Center, an NSF-funded Engineering Research Center within the Viterbi School of Engineering.

Doctorow, who edits the widely read culture and technology blog site "Boing Boing," will divide his appointment at USC between the Viterbi School's IMSC and the USC Center on Public Diplomacy.

From 2002-2006, Doctorow was the director of European Affairs for Electronic Frontier Foundation, a technology advocacy nonprofit that works to uphold liberty in technology law, policy and standards, where he remains a Fellow today. He also co-founded the open source P2P technology company OpenCola, which was sold to OpenText in 2003.

Cory Doctorow

Doctorow has worked at the United Nations, with standards bodies, governments, universities and non-profits to lobby for a balanced approach to copyrights that do not trample the public's fundamental rights to privacy, free speech and due process.

"In an era in which technology is changing the very rules by which people around the world learn about each other, it is critical that public diplomacy be current," says Joshua S. Fouts, director of the USC Center on Public Diplomacy. "Cory Doctorow will bring a valuable perspective to the discussion taking place here at USC."

Under the new Canadian-U.S. Fulbright public diplomacy program, a different prominent Canadian will be a visiting scholar at USC each year.

"The research agenda advanced by this new Fulbright Chair in Public Diplomacy is particularly important in the context of today's increasingly complex international environment," explains Michael K. Hawes, executive director of the Canada-U.S. Fulbright Program.

Class of 2010 is Viterbi's Strongest Ever

Entering Freshmen Show Increase in Diversity

Freshmen who enrolled in the USC Viterbi School for the Fall 2006 semester showed a 30 point gain on SAT scores over last year, making it the best of any class in Viterbi history.

"We have just enrolled what is statistically by far the brightest freshman class in our history," says Dean Yortsos. "Our middle 50 percent of SAT scores ranged from 1350 to 1480 and that represents a whopping 30 points increase over last year's range of 1320 to 1450!"

Louise A. Yates, the Viterbi School's associate dean for admission and student affairs, explains that "there is a new scoring system for SATs this year, so these numbers have been normalized for the old system. Our range on the new 2400 point scale was 2000-2190."

The increase comes in a year when national SAT scores have dropped. The Viterbi School continues to attract the best and brightest new engineering students, even as competition for those students heats up nationwide.

"Not only do we have an extraordinary freshman class, but we have also been able to increase diversity with an increase in the number of women and underrepresented minority students," says Yates.

"These are very bright and creative students," Yortsos adds. "Engaging and teaching these students are major challenges for our faculty, but they are ones that we relish."

$20 Million in New Computing Research

The Viterbi School of Engineering is taking the lead in more than $20 million in new research programs announced by the U.S. Department of Energy (DOE), and the school shares in two other grants. The DOE programs deal with extremely large (petascale) computing systems. Petascale computing involves a thousand trillion computations per second.

Robert F. Lucas, director of the division of computational sciences at the Information Sciences Institute, is the lead investigator on a $15 million ($3 million per year for five years) study of "Performance Engineering Research: Enhancing the Performance of SciDAC Applications on Petascale Systems," aimed at optimizing performance of such systems. Lucas will work with ISI computer scientists Mary Hall and Jacqueline Chame on the project, which will also involve collaborations with researchers in nine other institutions.

Priya Vashishta, who has a joint appointment in the Viterbi School's department of computer science and the Mork Family Department of Chemical Engineering and Materials Science, and in the USC College department of physics and astronomy, will lead a $5.5 million study ($1.1 million per year for five years) on "Cracking Under Stress: Developing a Petascale Simulation Framework for Stress Corrosion Cracking." Vashishta will work with his longtime colleagues Rajiv K. Kalia and Aiichiro Nakano at USC, and with investigators at five other institutions.

In addition, grid computing pioneer Carl Kesselman and Ann Chervenak, both of ISI, will work on two other DOE projects:

"Getting the Science out of the Data" is a project "to improve scientific data management so that scientists can spend more time studying their results and less time managing data." The project is a $12 million effort ($2.4 million per year). Kesselman worked with the study's lead, Ian Foster, of Argonne National Laboratories, in developing the Globus grid computing open software system. In addition to ISI and Argonne, three other institutions are participating.

"Scaling the Earth Systems Grid to Petascale Data" is a $13.75 million project to deal with the "massive amounts of data that are distributed across the globe" relating to climate and climate change. Researchers will receive $2.75 million per year. Kesselman is participating in the project, which is led by Lawrence Livermore National Laboratory, CA.

A list of the DOE projects can be found at: http://www.scidac.gov/highlights/06list.html

Top: (left to right) Rajiv K. Kalia, study leader Priya Vashishta and Aiichiro Nakano.

Middle: ISI researchers Carl Kesselman and Ann Chervenak.

Left: ISI researchers Jacqueline Chame, Mary Hall and Robert F. Lucas.

Photos this page by Brian Morri

Natural Disasters in an Era of Global Change

Faculty OpEd

by Costas Synolakis

Hurricane Katrina and the 2004 Sumatran mega-tsunami remind us of how vulnerable we all are to natural disasters, irrespective of the technological prowess of the nation victimized by the catastrophe. The death toll from Katrina was far less than in Sumatra, primarily because hurricanes move at a fraction of the speed of a tsunami — there is more time to warn and evacuate. But Katrina's economic impact — estimated to be over $100 billion — dwarfed the impact of the tsunami. Is this the result of the power of nature or overestimating our own power in planning for nature's fury?

Nature's power is a philosophical matter. The catastrophic 1755 Lisbon earthquake and tsunami, in which one-third of Lisbon's population perished, profoundly influenced the Age of Enlightenment. (Modern estimates suggest that one in 10,000 people in the world died, compared to one in 40,000 from the Great Sumatran Tsunami.) It was the first extreme natural disaster of modern times and transformed philosophical thinking by attempting to reconcile the idea of a benevolent God with the existence of evil. In *Candide,* Voltaire was swept up by the arbitrariness of it all and challenged the papist view of "whatever is, is right." But Jean-Jacques Rousseau angrily defended the Church.

The Greeks were totally fascinated with another disaster, the Minoan eruption of the Thera volcano in the central Aegean where many believe the lost continent Atlantis existed. The sophisticated Minoans of Crete never recovered fully from the earthquake and tsunami occurring about 1600 BC, eventually succumbing to the advancing Northern Europeans. We learn of Atlantis in Plato's dialogs. His fascination with natural disasters preceded Voltaire's by two millennia, but the questions were largely the same.

No other modern natural disaster has captured the world's imagination more than the mega-tsunami of 2004. It directly impacted the economies of 20 different Indian Ocean nations. The death toll included citizens from Asia, Africa, Europe and the Americas. It killed more Swedes that any other disaster during the past century. In contrast to this mega-tsunami, there was a warning issued before the July 2006 West Java tsunami. Yet, the death toll still exceeded 600 people. What went wrong again?

The worldwide emergency preparedness for tsunami disasters has been the focus of numerous UNESCO meetings in Kobe, Paris, Mauritius, Rome and Hyderabad. UNESCO's well-organized gatherings allowed access to donor resources and highlighted international state-of-the-art warning methodology, namely America's experience in the Pacific. Yet, many national delegations focused on local capabilities to build end-to-end systems, some of which were beyond science fiction even for first-world nations. Instant experts aggressively marketed copycat tsunameter technologies similar to those in place in the northern Pacific by NOAA, at huge cost, and with no appreciation that their products had to detect tsunamis reliably the first time around. Stupendous amounts of time and resources were spent covering anew concepts addressed in the Pacific, decades ago. For some nations, the omnipresent buzzword "capacity building" became a metaphor for acquiring more of the technology that already existed locally, rather than seeking to benefit from the state-of-the-art systems or international experience in warning dissemination. Acronyms abounded. Even seasoned professionals had trouble following the organizational charts, committee structures, assignments, and worse, monitoring progress. As a result, when the 2006 earthquake struck, Indonesia relied on newly acquired, untested technology to infer tsunami generation instead of common sense, public education and preparedness, with disastrous results.

The Viterbi School's Tsunami Research Center has spent 20 years developing much of the technology powering NOAA's real-time tsunami forecasts. NOAA's computational model comes from Vasily Titov's 1996 Ph.D. thesis, aided by the elegant analytical results of another Viterbi Ph.D., Utku Kanoglu. The Viterbi model, along with NOAA's tsunameters deployed in the deep ocean, have brought an impressive reduction in false alarms from the two warning centers protecting all Pacific Ocean nations. Viterbi products resulted in the timely cancellation of an emergency evacuation in Hawaii. It cost $30 million the last time Honolulu was unnecessarily evacuated in 1987.

Viterbi engineers have surveyed all except one of the 15 tsunamis striking the Pacific in the 15 years preceding the 2004 disaster. Findings from Viterbi fieldwork have produced an unprecedented database validating all modern tsunami modeling and forecast tools. We produced all of the maps for California's emergency tsunami preparedness. Pro bono, we have advised many coastal communities on how to improve disaster plans. We have given hundreds of public outreach lectures in hospitals, churches, mosques, elementary schools, city halls and soccer stadiums in places ranging from False Pass, Alaska, to Rapanui, Chile (Easter Island), to Pentecost, Vanuatu, Aitape, Papua New Guinea and Mindoro in the Philippines. We explain that tsunamis are natural disasters and not the work of evil, unnatural forces, and we outline simple steps that locals can take to protect themselves. Viterbi's Jose Borrero was the first scientist to

Synolakis photo by Max S. Gerber

enter Aceh on January 1, 2005, just days after the mega-tsunami. His work was featured in a National Geographic film, which helped put the disaster in perspective within a month of when it struck. The fieldwork has not been easy. Tsunami Research Center engineers travel to largely inaccessible locales in less developed nations at a moment's notice, on a shoestring budget that grants from the National Science Foundation (NSF) allow. And reimbursement for expenses occurs many months afterwards.

But we were not prepared for the worst surprise of all — the massive loss of life occurring on December 26, 2004.

Most working engineers in natural hazard mitigation have thought extensively about what we could have done differently to prevent this type of disaster. As a community of scientists, we failed to anticipate the likelihood of a mega-tsunami in Aceh. However, as engineers, we did not fail. Well-engineered structures in Aceh survived both the tsunami and the long and extensive shaking from the 9.3 earthquake that preceded it. This is amazing, given the often-questionable practices in the Third World.

NOAA produced an animation of the tsunami within 24 hours using a model developed at Viterbi 10 years earlier, and this animation was widely featured in the world media. In essence, we knew what happened as soon as we understood the earthquake motion.

In hindsight, this was not unexpected. NSF grants for studying hypothetical disasters abroad — and for hypothetical disasters at home, such as Katrina — are scarce. When engineers do their work right, nobody notices. When we don't, everybody does. Katrina was not a failure of engineering paradigms, but a massive societal failure where there is undue emphasis on short-term results, and not just in government. The NSF has repeatedly tried to eliminate most civil engineering research and development from its budget, apparently because it is less likely to produce rapid improvements in our quality of life. *Science* and *Nature* had published less than 20 stories and original research articles, before the worst tsunami in their combined history of more than 200 years. Practically the entire world follows the example of the U.S. in terms of research funding and innovation. So if civil engineering is undervalued here, why should it be any different in the rest of the world?

Civil engineers have solved most of society's basic problems. Cities in Europe and the U.S. have clean water and houses largely withstand disasters. But the thousands of digital cameras with intact memory cards found among the dead in 2004 suggest a different take. The images painfully highlight the last moments in the lives of the people who didn't know they were about to die. Victims were taking pictures of their loved ones with the tsunami in the background, not anticipating the deluge that would follow. They just didn't know any better. They could operate gadgets, but didn't know that a rapid shoreline recession resembling an ebbing tide was the harbinger of a massive tsunami and that they should be running away from the beach to high ground instead of wasting valuable seconds taking pictures.

Recent estimates presented in a special meeting of the Royal Society of London suggest that within our lifetimes we will experience a natural disaster that will kill more than one million people in minutes. For some cities such as Istanbul, Tehran or Tokyo, this is a low-end estimate. Global climate change will intensify floods and droughts; a one-meter sea level change in 100 years will make what we now consider "extreme" events "annual" events. We live in mega cities, and we cannot possibly be prepared for every eventuality, as 9/11 so dramatically underscores. In the aftermath of 9/11, we have focused exclusively on preventing a similar disaster. The 9/11 message, as well as that of the 2004 mega-tsunami or Katrina, has been largely lost. We can do much to prevent terrorism, but we can't do much to prevent natural disasters. But in the case of both terrorism and natural disasters, we can do much more to survive.

This is exactly what we in civil engineering refer to as the last mile. In an era of global citizenship when a lot of us travel for pleasure or business several times a year, how can we make sure that we are safe wherever we might be when disaster strikes? Can we economically engineer a structure to withstand the strike from a fuel-full 787? Can we engineer our cities so that neither global sea level change nor a mega-tsunami nor a mega-thrust earthquake nor a meteorite will impact us severely? Can we engineer a building, a dike or breakwater to monitor itself and inform us when maintenance is needed? Can we reduce the uncertainties in the predictions of the impact extreme events? Can we look ahead enough to educate ourselves to make the right decisions when disaster strikes and immediately take steps and save lives? What is the right balance between gadgetry, computational tools, medicine and emergency management? What tools do we need to understand this continuously changing balance? These are highly interdisciplinary questions we ponder at Viterbi, as we educate our engineers whose work will impact all of us in this 21st century.

"This is exactly what we in civil engineering refer to as the last mile…"

To paraphrase Homer, one omen is best: defend the world we live in, our one universal homeland.

Costas Synolakis is a professor of civil engineering and director of the Tsunami Research Center in the USC Viterbi School of Engineering.

Gaming the System

continued from page 5

the learner appears to be flagging."

By refining the ability to determine how a student is using the system — what their strategy is — Beal believes she and her team will be able to make ITSs more useful not just for the two categories of students using game-the-system strategies, but also for the other three, who seem to be trying to learn.

Beal also holds an appointment as a research professor at USC's Daniel J. Epstein Department of Industrial & Systems Engineering. Her collaborators include graduate students Lei Qu and Hyokyeong Lee, both in the USC Viterbi School of Engineering computer science department. The work was funded by a grant from the NSF.

CREATE Begins Third Year of Research to Improve National Security

USC's Homeland Security Center for Risk and Economic Analysis of Terrorism Events — known as CREATE — has begun its third year of research under the guidance of director Detlof von Winterfeldt, a professor of industrial and systems engineering in the Daniel J. Epstein Department of Industrial and Systems Engineering.

CREATE is the first university-based research program in the nation aimed at improving national security through modeling and analysis of potential terrorist threats. Its work to bring the human and economic consequences of major terrorist events into the forefront of public policy requires a collaborative effort by experts in many fields, including computer science, civil engineering, industrial and systems engineering, economics, the social sciences, risk analysis and public policy.

Detlof von Winterfeldt

The work of the center is supported by the U.S. Department of Homeland Security. CREATE relies on faculty from USC, the University of Wisconsin and New York University to develop advanced models that gauge how and where terrorist events may occur, to estimate the economic consequences of such attacks, and to identify what parts of the country are most vulnerable. Policymakers are using these tools to plan against and prepare for major threats, such as chemical, biological, nuclear, radiological and cybersecurity attacks.

A variety of studies have been initiated or completed this year in five research areas: border security, transportation security, infrastructure protection, weapons of mass destruction and intelligence analysis.

One recently completed study analyzes the longer-range economic consequences of developing countermeasures to protect commercial aircraft from "Man Portable Aerial Defense Systems" (MANPADS) attacks.

"There is a real threat to the United States of terrorists attacking planes," explains von Winterfeldt. "We think there are at least 4,000 to 5,000 of these surface-to-air missiles (SAMs) in the hands of terrorists, and there's a market for them in the U.S."

Countermeasures Program Initiated

Because of that, Congress initiated a special $100 million program in 2004 to study new technologies that could be used as countermeasures to protect commercial aircraft from potential terrorist attacks. This program has just received another $40 million to continue its effort through 2007.

CREATE addressed the cost-effectiveness of directed infrared devices — infrared jammers — that could be used to interfere with missile homing seekers and deflect SAMs away from an airplane.

"Although these technologies can be very effective in protecting airplanes, they are also very expensive to install," von Winterfeldt says. "It can cost $1 million to $3 million to install these systems, and $1 billion to $2.5 billion per year to operate a fleet equipped with the system."

Over 10 years, the cost of building and outfitting an entire fleet of commercial aircraft with these infrared systems could run as high as $35 billion, according to an earlier RAND Corp. study.

All things being equal, the CREATE study suggested that these countermeasures would be worth the investment if three conditions prevailed: 1) the probability of a MANPADS attack is greater than 40 percent over 10 years; 2) the economic losses are very large (greater than $75 billion); and 3) the countermeasures prove relatively inexpensive (less than $15 billion) to implement.

Detlof von Winterfeldt, right, showcases CREATE research to Congresswoman Diane Watson and DHS Undersecretary Jay Cohen on Capitol Hill.

Other Ongoing Research

In the area of biological weapons, CREATE is also working on Phase 2 of a new homeland security study to assess the risks of 30 biological agents that could be used by terrorists in an attack on the U.S. The agents include anthrax, smallpox, rycin, e. coli, the plague and other biological pathogens.

> "36 percent of U.S. imports enter into the country through the ports of Los Angeles and Long Beach."

In another study closer to home, the center has completed an analysis of the consequences of a "dirty bomb" attack on Los Angeles and Long Beach harbors, which are inherently attractive targets for terrorists. They are "large and bustling, making up the third busiest ports in the world. Annually, 11.4

von Winterfeldt photo by Philip Channing

million 20-foot equivalent containers traverse through their waterways, totaling in value about $218 billion. In addition, 36 percent of U.S. imports enter into the country through these two ports."

The analysis suggested that closure of both ports from a radioactive bomb would cost in the neighborhood of $20 billion per month and contaminate the harbors for months thereafter. In addition, the psychological aftermath of possible radioactive exposure could scare off workers for a prolonged period of time and cause a shutdown.

Also of note is an ongoing infrastructure pilot study being conducted for the California Governor's Office to protect critical infrastructure, such as dams and chemical plants, from terrorist attacks.

In this study, researchers are looking at 60 sites by sector (type of site) to determine which would be the most vulnerable to an attack and have the most serious long-term economic consequences for the state.

Dams and chemical plants are leading the list, von Winterfeldt says, followed by recreational sites, stadiums and some commercial buildings. Homeland security funding for safeguarding specific sites will be based on the results of this study, which are expected to be delivered to the Governor's Office later this year.

Yates photo by Brian Morri

KIUEL Update

by Louise Yates
Associate Dean for Admission and Student Affairs

The building blocks for the Klein Institute for Undergraduate Engineering Life (KIUEL) rest on a solid foundation of building community and include leadership, service learning and cross-disciplinary programs. During the Fall '06 semester, KIUEL activities hit all of these areas, beginning with the launch of the Leadership Development series.

Starting the semester, at the *KIUEL Weekend 4 Leaders,* 35 students gathered to further develop their leadership skills. Around campfires and through experiential learning exercises, they learned how to motivate themselves and others.

The main goal of the remainder of the leadership series was to get students to consider taking on key leadership roles within the School. But it also provided them with opportunities to learn more about themselves as potential leaders.

Workshops included *Leadership and Your Career and Learning About Your Leadership Style* through participating in the Myers-Briggs Indicator inventory. The series culminated with the presentation *Leadership Team Building and Business Strategy* by Peter Kaufman and Alexis Livanos of Northrop Grumman.

KIUEL also invited the Viterbi School's student competition teams to participate in a project management workshop. Students in the teams have sometimes expressed frustration that they don't know how to perform project management. The workshop was designed specifically toward organizing student projects and the timelines associated with them. This will assist student teams in proactively scheduling their work in order to be more successful in their respective competitions.

After starting out with faculty oversight and help, Viterbi students have now completely taken over a service learning Technology Application Program project to create a computer lab for a local elementary school. In addition to the lab, they are developing training modules for the elementary school's faculty and parents.

Cross-disciplinary activities during the fall semester included the Viterbi Tailgates, organized by Viterbi external relations. Undergraduate students were invited and had the opportunity to meet and mingle with alumni.

Viterbi students have also started the Viterbi Book Club, which will include faculty-led discussions of selected books. This semester they are talking about one of Dean Yortsos' favorites, *The World Is Flat,* by Thomas Friedman.

Finally, they are participating extensively in the USC Provost's arts and humanities initiative, Visions & Voices.

There is a big buzz about KIUEL on the Viterbi School campus. There will be more to report in the next issue of *USC Viterbi Engineer,* including the Viterbi Talent Show, the Viterbi Ball and the upcoming trip to Honduras by our chapter of Engineers Without Borders.

student works

Energy Experts Urge Transition to New Energy-Fuel Sources

Viterbi School faculty confronted the nation's energy problems in two high-profile, day-long energy symposia held last summer on the USC campus and this fall in Sacramento.

Dean Yannis C. Yortsos opened the June 15 USC event, *The National Energy Symposium: Confronting Costs To New Technologies,* which included presentations by Viterbi faculty from the department of aerospace and mechanical engineering, the department of electrical engineering, and the Mork Family Department of Chemical Engineering and Materials Science.

Left to right: John Sheehan, National Renewable Energy Laboratory; Iraj Ershaghi, director of the Viterbi School's Petroleum Engineering Program; Craig Smith, Lawrence Livermore National Laboratory and Anupam Madhukar.

Experts predict that over the next 20 years, global energy demand will increase by 40 percent. Currently, the U.S. consumes one-fourth of the world's energy, more than the energy consumed by the 2.9 billion people living in five other nations: China, India, Germany, Japan and Bangladesh. Climate changes and environmental concerns, such as the prospect of intense hurricanes, storms and drought-sparked forest fires, melting glaciers and rising sea levels, contribute to global energy problems.

Researchers agree that no single alternative — wind, photovoltaic, solar thermal, solar electric, biomass, hydroelectric or geothermal — will be the "silver bullet," but that diversification could stave off an impending crisis.

"We need to enlarge our vision and go beyond the next five or 10 years," said Anupam Madhukar, the Kenneth T. Norris Professor of Engineering in the Mork Family Department of Chemical Engineering and Materials Science. "All of our energy sources have to be pushed to their limits."

A proponent of solar power, Madhukar said that only the sun's energy would be able to supply the difference between about 28 terawatts of energy — the amount that would be needed to support the needs of a global population of 10 billion to 11 billion people in the next three decades — and the 18 terawatts of energy estimated to be available from all sources, other than nuclear and solar power. That difference is the amount of energy produced by roughly 10,000 nuclear power plants

Energy consumers will need to change their ways, according to T.C. Cheng, a professor of electrical engineering/electrophysics at USC and holder of the Lloyd F. Hunt Chair in Electrical Power Engineering. He said consumers waste 30-to-40 percent of the electricity that is generated in the U.S. by leaving lights on in their homes.

"If we could capture even 20 percent of all wasted electricity, that would go a long way toward saving energy," he said.

Iraj Ershaghi, the Omar B. Milligan Professor and director of the Petroleum Engineering Program in USC's Viterbi School of Engineering, stressed that there is still plenty of oil to be recovered in the near term, but that better methods of recovery are needed. He said the current oil recovery rate is insufficient, with two-thirds of petroleum left in the ground, a fact he attributed to insufficient use of technology and inadequate research expenditures to develop smart technologies to tap stranded and residual oil.

"Over the last century, we have produced about 180 billion barrels of oil from the oilfields in the U S., but that's only 33 percent of what is in the ground," Ershaghi told the audience.

"The mistake we make is abandoning oil fields, closing them down and making them inaccessible to future generations when there is plenty of oil still in the ground. It's just getting harder to find new oil and, therefore, more expensive to recover the remaining oil in place," he said.

Paul Ronney, a professor of aerospace and mechanical engineering at USC and a former NASA astronaut, said just driving smaller, lighter cars could have a significant impact on energy conservation.

"Sure, hybrids will save some money, but you have to weigh that against the extra cost of going to hybrids, the costs of replacing batteries, all those other costs," he said.

The National Energy Conference was held shortly after USC announced the formation of a new cross-disciplinary research program called the USC Future Fuels and Energy Initiative (FFEI), which is aimed at managing the transition to a more secure and sustainable energy future. The FFEI research program will both advance the science of alternative fuels and energy conversions and address the economic, social, environmental and policy issues associated with the transition to a new energy-fuel paradigm.

Viterbi Researchers are Part of $10 Million in Defense Projects

In 2006, USC was one of seven universities to win more than one Multidisciplinary University Research Initiative (MURI) grant from the Department of Defense. Viterbi School faculty are heavily involved in both of the research projects, each of which has been funded with up to $5 million over five years.

Florian Mansfeld

Paul Ronney

Hai Wang

Mansfeld, Ronney and Wang photos by Brian Morri

Florian Mansfeld, professor of chemical engineering and materials science; Paul Ronney, professor of aerospace and mechanical engineering; and Hai Wang, associate professor of aerospace and mechanical engineering are working to develop microbial fuel cells that could act as remote power supplies for a multitude of purposes, ranging from remote sensors to tiny insect-like drones. Kenneth Nealson, professor of earth sciences and biological sciences in the USC College, leads the project. Researchers from Rice University and from the Korean Institute of Science and Technology are also part of the project.

The second project is an attempt to automatically track large groups of moving targets. Isaac Cohen, research assistant professor of computer science (currently at Honeywell); Paul Cohen, deputy division director of the Information Sciences Institute and Christos Papadopoulos, assistant professor of computer science, are working with researchers from the USC College, from UCLA and from the University of Illinois-Champaign. That project is led by Boris Rozovsky, professor of mathematics in the USC College, who also has an appointment in the Viterbi School's department of aerospace and mechanical engineering.

The MURI program is administered by the Department of Defense and funds multidisciplinary projects at U.S. universities with both military and commercial potential. Projects generally intersect more than one traditional science or engineering discipline. A goal of funding the projects is to hasten the transition of research findings to practical application.

Noise Faculty Book Review

by Eric Mankin

Bart Kosko

We often call the era we live in the "information age," but it could equally well be called the "age of noise." This is the premise of a stimulating new book by Viterbi School polymath Bart Kosko, a professor of electrical engineering who recently added a law degree to existing credentials in philosophy, economics, mathematics and, of course, electrical engineering.

Kosko's look at what Ambrose Bierce called "undomesticated music; a stench in the ear, the chief product and authenticating sign of civilization," illustrates just how far-reaching the issue of noise is. He finds paradoxes in noise. He even finds the good side of noise; indeed, he speculates noise may have been the energy that started evolution.

Kosko opens by serving as an eloquent guide to the epochally important work by Claude Shannon in defining information in his classic 1948 paper, "A Mathematical Theory of Communication," which involves a rigorous rethinking of the definition of noise into an "unwanted signal." What had been a general and open-ended term for unwelcome sound suddenly became a precisely formulated concept that could be quantified, analyzed and understood.

With this as the background, all kinds of other familiar problems of modern life pop into unexpected focus. "Your signal is my noise" becomes a continuing thread in the discussion. Kosko examines what can and cannot be done about noise under the legal system, how too much noise can damage hearing and even health in a text full of striking examples. (Perhaps the most striking: an estimate that a single motorcyclist with a faulty muffler can wake up 200,000 people in a single late night ride through Paris.) A wonderful sidetrack explores the wartime work of Hedy Lamarr in patenting 'frequency hopping,' a way of sending signals that sounded like noise to listening enemies.

Kosko also covers the subject he has been researching: the beneficial or useful effects of noise. An intriguing chapter visits "stochastic resonance," a paradoxical effect in which background noise functions as an energy source that some systems can use to power the reception of messages, an effect that Kosko speculates may have been instrumental in the development of life: "Biochemical evolution appears to have adapted to the constant assault of thermal noise by using it to build motive structures."

Noise is great accompaniment to a quiet afternoon.

Putting a Fingerprint on Electrical Engineering

The Historical Naming of the Viterbi School's Renowned Electrical Engineering Department

by Diane Ainsworth

On the threshold of a new century of engineering, 100 years after USC offered its first engineering class, which was in electrical engineering, the Viterbi School is naming its largest department the USC Ming Hsieh Department of Electrical Engineering.

Ming Hsieh (BSEE '83, MSEE '84), is co-founder, president, CEO and chairman of the board of Cogent, Inc., one of the top providers of fingerprint identification systems in the United States. His generous gift of $35 million is the largest ever to name an engineering department in the United States. His endowment will set the course for electrical engineering's continued expansion into new realms of human invention. As the field continues to grow, so too will the quality of its academic standards and the ability of its graduates to meet the challenges of tomorrow's global community.

Hundreds of faculty, staff, students, alumni and campus luminaries joined Dean Yannis Yortsos and USC President Steven B. Sample on October 23 to honor Hsieh, whose entrepreneurial ingenuity has helped to make the world a safer place. The timing of the gift could not have been better, Yortsos told the audience. Hsieh's contribution caps the Viterbi School's centennial celebration and pushes its $300-million fundraising initiative nearly to the top.

Hsieh photo by Philip Channing

"One hundred years ago, USC offered its first engineering courses in electrical engineering. It is only fitting that Ming Hsieh, an electrical engineering alumnus, is launching the second century of USC engineering with a magnificent gift. I am looking forward to working with him more closely in the coming years to build our electrical engineering curriculum into a program that will meet the challenges and demands of global engineering in the 21st century," said Yortsos. "I am grateful to the Viterbi School's loyal alumni. Their support is the most important key to raise the School's endowment and to help our continuing ascent to national and global prominence in an environment that grows more competitive each day."

"Ming's name adds luster to a department that is already highly distinguished. He is a great Trojan who cares deeply about educating future engineers, and we are grateful that he is investing not only in his alma mater but ultimately in this nation," said USC President Steven B. Sample, who, as an electrical engineer, is also a tenured faculty member in the department.

The gift will be used to strengthen the School's ability to recruit and hire world-class faculty, as well as attract top graduate and undergraduate students. Part of the naming gift will be set aside for scholarships to build on USC's reputation for excellence in research, education and community service.

"We are so fortunate to have an engineer of Ming's caliber on our team," says Daniel Dapkus, chair of the electrophysics half of the USC Ming Hsieh Electrical Engineering Department. "Ming's knowledge of massively parallel computing architectures, high data flow management and biometric computing will have an important impact on our department and faculty, and add impetus to the directions we are headed academically in the next few years."

"I second that sentiment," adds Alexander "Sandy" Sawchuk, chair of the systems half of the USC Ming Hsieh Electrical Engineering Department. "The students, faculty, staff and alumni of the department join me in gratitude to Ming Hsieh for his very generous naming gift. I know this gift will greatly benefit our academic and research programs, enhance our visibility and raise our stature to even higher levels, energizing many new activities. We thank Ming for his faith and confidence in making a tangible investment in the future of electrical engineering here at USC."

Roots of an Entrepreneur

The man responsible for this $35 million gift is a self-made entrepreneur from China who co-founded Cogent some 16 years ago. His life in this country began with a dream, planted long before he ever left his mainland China hometown of Shenyang, in the northeastern province of Liaoning. The dream was to seek a better education and make a difference in the world.

That realization came early in Ming's life. In 1966, at the age of 10 and the beginning of China's Cultural Revolution, Ming and his family were forced to leave the city and go to a small village near Panjing. His father, a well-educated man, was considered part of China's upper middle class, as were other intellectuals, all of whom were sent to the countryside to be re-educated.

"After that, I didn't have much of a formal education for the next 10 years," Hsieh remembers.

In the countryside, and after school, Ming would join his father, Baoyan, who was an electrical engineer, as the senior Hsieh constructed a crude power system to bring electricity to the village. Ming was quick to learn electrical engineering and his parents noticed his keen interest in technology, so they gave him a transistor radio to tear apart and reassemble. It was not long before he was repairing TV sets, radios and anything else electronic he could get his hands on. He realized at that moment that destiny had come knocking.

His uncle, P.Y. Hsieh, had left China and earned an M.S. in mechanical engineering at USC in 1952, fueling Ming's aspirations to follow. In 1980, after two years of college at the South China Institute of Technology, now known as the South China University of Technology, in Guangzhou, Ming Hsieh used the inheritance that his grandparents in Taiwan had left him to emigrate and enroll in USC's engineering program. He was a 24-year-old transfer student.

Electronics 201

Sitting in his first electronic circuit design class at USC — Engineering 201 — Ming Hsieh remembers John Choma, former chair of electrophysics in the electrical engineering department. Choma was a sharp-tongued, exacting professor who had difficulty, nonetheless, pronouncing Hsieh's name. Each time he called on Hsieh, Choma would spell out his name.

"What do you think about this, Mr. H-S-I-E-H," he would roar across the classroom. Ming Hsieh would answer in his usual soft-spoken voice, a bit unsure of how Choma would react, but confident that whatever he said, this crusty engineer knew a lot more about electronics than he did.

"I knew he didn't know how to pronounce it," laughs Hsieh good-naturedly during an interview in the South Pasadena offices of Cogent. "It didn't matter. I wanted to learn. But that was a very difficult class and he was one of the very best teachers. On our midterm, he gave us five questions to answer and I only finished one and a half. I think I went home and cried all day about that."

Twenty-five years later, Choma still remembers the student who exhibited so much determination and creativity.

"Mr. Hsieh is a paradigm of the academic excellence my colleagues and I work very hard to foster in Viterbi School students," Choma says. "The legacy of his excellence does not stem merely from his ability to provide USC electrical engineering with the generous

"We are so fortunate to have an engineer of Ming's caliber on our team."

—Daniel Dapkus

Dapkus photo by Philip Channing

financial support for which we shall be eternally appreciative. Rather, it stems from the fact that as a diligent student, he mastered very fundamental, and often theoretically dry, concepts, gained an insightful understanding of these fundamental issues, and later used his assimilated understanding to innovate new technologies that have redefined the state of the engineering art, in this case, in the arena of massively parallel computing architectures.

"In effect, Mr. Hsieh reaffirms a personal belief I have had for much of my professional career: that the reputation of an academic department is sustained, not so much by old codgers like me, but by the creativity of the students we produce."

Hsieh did well as an undergraduate, making friends with his classmates and building a network that proved invaluable to his later success. He was excited about using computers for the first time, but frustrated at how slow they performed. He caught on to the exam-taking with lightning speed and earned his B.S. degree in electrical engineering in 1983. One year later, he completed his M.S. degree. His parents, Baoyan and Sun, who stayed in China, wanted him to continue on for a Ph.D., but Ming knew it was time to get a job and learn more about engineering in the real world.

"They never forgave me for not finishing my Ph.D.," he laughs, "but I thought that after I learned all of my courses and learned some engineering techniques, I would go into industry and understand more about how things worked and what field I wanted to go into."

He appeased them at first by promising to return to graduate school a few years later, after working for a while. After interviewing for several positions, he landed a job at International Rectifier, based in El Segundo, Calif., and went to work as a circuit designer for a leader in power management technology.

The Young Apprentice

Hsieh wanted to learn digital circuit design from start to finish. "That is how you transfer your theoretical training into management," he explains. "Because the company was mid-sized (in the 1980s), you literally had to do everything yourself if you were a design engineer, so I had to follow the entire process and learn to design circuits all on my own."

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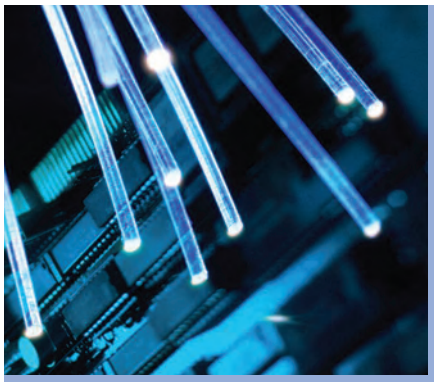

USC Electrical Engineering: A History of Innovation

With 54 tenured or tenure-track faculty, the USC Ming Hsieh Department of Electrical Engineering is the Viterbi School's largest, and one of the largest of its kind in the nation. It is distinguished by 11 faculty who are members of the National Academy of Engineering, three of whom are also members of the National Academy of Sciences and the American Academy of Arts and Sciences. Four have received the Claude Shannon Award, the Institute of Electrical and Electronic Engineers' most prestigious award in information theory.

The very first engineering courses taught at USC during the 1905-06 academic year were in electrical engineering and the department began with an educational, rather than a research focus. However, by the end World War II, the emphasis had begun to change. In the 1960s, the charismatic EE chair who eventually became dean, Zohrab Kaprielian, decided USC should concentrate on promising new areas. The roll call of ensuing innovation and excellence that resulted speaks for itself. Here are some highlights, in alphabetical order:

Communication networks: A large group performing research in collaboration with the USC Information Sciences Institute. The networks have made many contributions to the control procedures for the Internet for almost 40 years.

Deep space communications: NAE members Solomon Golomb and William Lindsey published pioneering work that has defined the subject.

Electronic logic chips and testing: Melvin Breuer and Sandeep Gupta pioneered ways to make circuit chips test themselves.

Error-correcting codes: Audio, video and data reproduced from scratched compact disks and DVDs is error-free, thanks to fundamental work on error-correcting codes by Irving Reed. Building on this work by Reed and others, Vijay Kumar's work on new quaternary error-correction is now embedded in cell phone systems.

Fuzzy logic: Bart Kosko's control algorithms enable machines to respond effectively to uncertain or noisy signals. *(See review of Kosko's new book Noise on page 13 of this issue).*

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The hours were grueling, he remembers, but the training was absolutely essential. The skills he had acquired as a boy alongside his father and his uncle, who was now an engineer at TRW, came in handy. But after two and a half years at International Rectifier, it was time to strike out on his own.

"USC instilled an entrepreneurial spirit in me," he says. "That is one of the greatest, most unique aspects about the Viterbi School. There is a heritage of entrepreneurship there that you don't find at other universities. Our engineering courses really brought students together, so that we could talk about our ideas and brainstorm about innovative ways of doing something better. I met a lot of students with that entrepreneurial drive and I learned how to start a business from them while I was still in college."

Using those USC connections, Ming Hsieh formed his first company in 1987, AMAX Information Technologies, with several USC classmates: Jason Lo (BSEE '83), Jonathan Jiang (BSEE '83), who had been designing ASIC (application specific integrated circuit) chips at TRW, and Archie Yew, another USC graduate. The company specialized in servers, storage systems and other hardware, but it was not long before Ming realized that, in addition to hardware and software, he needed to develop a product in order to become a commercial success.

One of his USC friends who had gone back to China after graduation returned to the U.S. and approached him with an idea to put thousands of fingerprints on a computer chip. At the time, computerized fingerprint identification was a specialized and limited field. Three companies dominated the market, but they only offered semi-automated systems. Hsieh knew that he would have to design a fully automated, high-speed system and customized software to match.

In 1990, Hsieh and Archie Yew co-founded Cogent, Inc., and within six months, had signed their first contract — a $16 million, four-year contract — with the Los Angeles

"WHAT AN AWESOME GUY!"

Nearly a thousand faculty, students, staff, alumni and VIPs crowded into the Ronald Tutor Hall Courtyard October 23 to celebrate the naming of the Viterbi School's storied electrical engineering department, 100 years after engineering began at USC.

Following a short video on the history of USC's electrical engineering triumphs, the Trojan Marching Band led the donor, the president and the dean into the courtyard. The speakers addressed the crowd in front of a large screen flashing colorful high-tech electrical engineering graphics.

"I came to USC as a foreign student and USC opened the door for me to look more into America," said the overwhelmed donor, Ming Hsieh, an alumnus who is co-founder, president, CEO and chairman of the board of Cogent, Inc. "I was able to learn about technologies that enabled me to...succeed."

USC President Steven B. Sample, an electrical engineer who is a faculty member in the newly named USC Ming Hsieh Department of Electrical Engineering, called Hsieh "a great Trojan who cares deeply about educating future engineers and who cares deeply about helping his alma mater continue its dramatic ascent into the top tiers of the world's engineering schools."

Dean Yannis Yortsos said Hsieh was "leaving an indelible fingerprint on electrical engineering at USC and on the world at large...His is a statement of faith and confidence in this university that transcends time, distance and culture."

Dwight "Jim" Baum, chair of the Board of Councilors, and Andrew J. Viterbi (Ph.D. EE '62), who named the Viterbi School in 2004 and who is also an electrical engineering alumnus and faculty member, offered brief remarks.

Among the luminaries present at the event were USC Provost and former engineering dean, C. L. Max Nikias, all of USC's senior vice presidents, more than a dozen members of the Viterbi School's Board of Councilors and a lively contingent of journalists from the Asian media.

So many people were present that there were not enough Hsieh department T-shirts for everyone.

One undergraduate, Elliot Lee, recounted in his blog that he mustered up the courage to meet Hsieh and then mentioned the T-shirt problem. To his amazement, Hsieh handed him the shirt that he had received during the ceremony, saying he would get another one.

"What an awesome guy!" wrote Lee.

County Department of Social Services and EDS to develop a high-speed biometric fingerprint identification system to prevent welfare fraud.

A Breakthrough in Technology

In the mid-1990s, Cogent reached a technological breakthrough by applying data flow computing for high-speed biometric comparisons. The technology relied on proprietary fingerprint biometrics software and programmable matching accelerator servers. Cogent's technology got the attention of law enforcement agencies and governments, and the company picked up contracts to develop real-time ID systems for immigration, voter registration, asylum, citizen benefits/rights, citizen identification, driver's licenses and criminal investigations.

Today, Cogent is one of the world's premier providers of automated fingerprint identification systems (AFIS) for law enforcement, civil and governmental agencies and commercial applications worldwide. The company went public in 2004 and provides the technology used by the U.S. Department of Homeland Security for real-time identification to expedite the entry/exit process for travelers around the world

Ming Hsieh at the Cogent Systems listing on the NASDAQ National Market, September 24, 2004.

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USC Electrical Engineering: A History of Innovation

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Image processing, compression and pattern recognition: The familiar JPEG format for image compression and MPEG format for video compression were pioneered at the department's Signal and Image Processing Institute (SIPI). SIPI is also recognized for work in pattern recognition and computer vision systems that recognize shapes and objects. Faculty members such as Antonio Ortega, Jay Kuo and Alexander Sawchuk continue research in these fields.

Sawchuk

Laser technology: Two NAE members, Robert Hellwarth and P. Daniel Dapkus have made fundamental contributions. Hellwarth was an early inventor and developer of "giant pulse" lasers and fundamental studies of laser-induced effects in materials. Dapkus pioneered semiconductor lasers, including quantum well nanoscale devices.

Nanophotonics: John O'Brien's work with Anthony F.J. Levi and Dapkus on design and creation of photonic devices at the scale of individual photons using photonic crystal lasers with quantum dot emitting elements is highly influential.

O'Brien

Nanotubes: In this burgeoning new field, new work by a young USC researcher, Chongwu Zhou, on ways to shape and control the growth of single-atom-thick carbon cylinders, has attracted wide attention.

Nonlinear optics: Hellwarth's laser studies provided the foundation for exploration of materials in which high-intensity pulses of laser light produce drastic and often useful changes in the material's electronic characteristics.

Optical and photonic computing and interconnections: Sawchuk and B. Keith Jenkins created one of the first all-optical photonic digital computing systems. William Steier has been a leader in creating devices that translate signals between electronic and digital forms.

Willner

Optical communications: Alan Willner is known for his pioneering work in optical networks and fiber-optic communications.

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USC Electrical Engineering: A History of Innovation

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Plasma research: Tom Katsouleas was the first to demonstrate a basic prediction of relativity — refraction of particles — in the Stanford linear accelerator. Hans Kuehl did basic research in plasma waves, including single waves ('solitons') that propagate without changing their shape.

Pseudorandom numbers: Golomb's work in number theory is now part of communication and cryptographic systems all over the world.

Pulsed power: Martin Gundersen has been a leader in utilizing extremely short-duration, high-intensity bursts of energy for applications ranging from pollution control to cancer therapy.

Quantum computing: *(See feature story on this subject on page 25 of this issue)*

Speech recognition, generation and modeling: Shri Narayanan has made fundamental advances in computer algorithms for speech processing.

Three dimensional and biomedical imaging: Richard Leahy's Biomedical Imaging Research Lab created now widely-used "Brainstorm" software, and has adapted 3D imaging techniques to non-biomedical applications.

Ultra high fidelity sound: Chris Kyriakakis has created techniques to record and reproduce audio with unprecedented accuracy, making listeners feel that they are immersed in an audio environment that duplicates reality.

Ultrawideband: A technology in which very weak, very wide-spectrum signals have uses ranging from wireless data links to position location, was pioneered by Robert A. Scholtz.

Scholtz

Viterbi algorithm: The Viterbi Algorithm is an essential part of communications systems, cell phones, magnetic data storage and many other devices. It was developed by Andrew Viterbi, USC alumnus, entrepreneur, and NAE/NAS/AAAS member, who together with his wife Erna made the naming gift for the Viterbi School of Engineering in 2004.

who are entering the U.S. This system evolved from an initial border control system in the mid-1990s to supporting all visa searches from embassies and consulates worldwide, as well as all air, land and seaports in the United States.

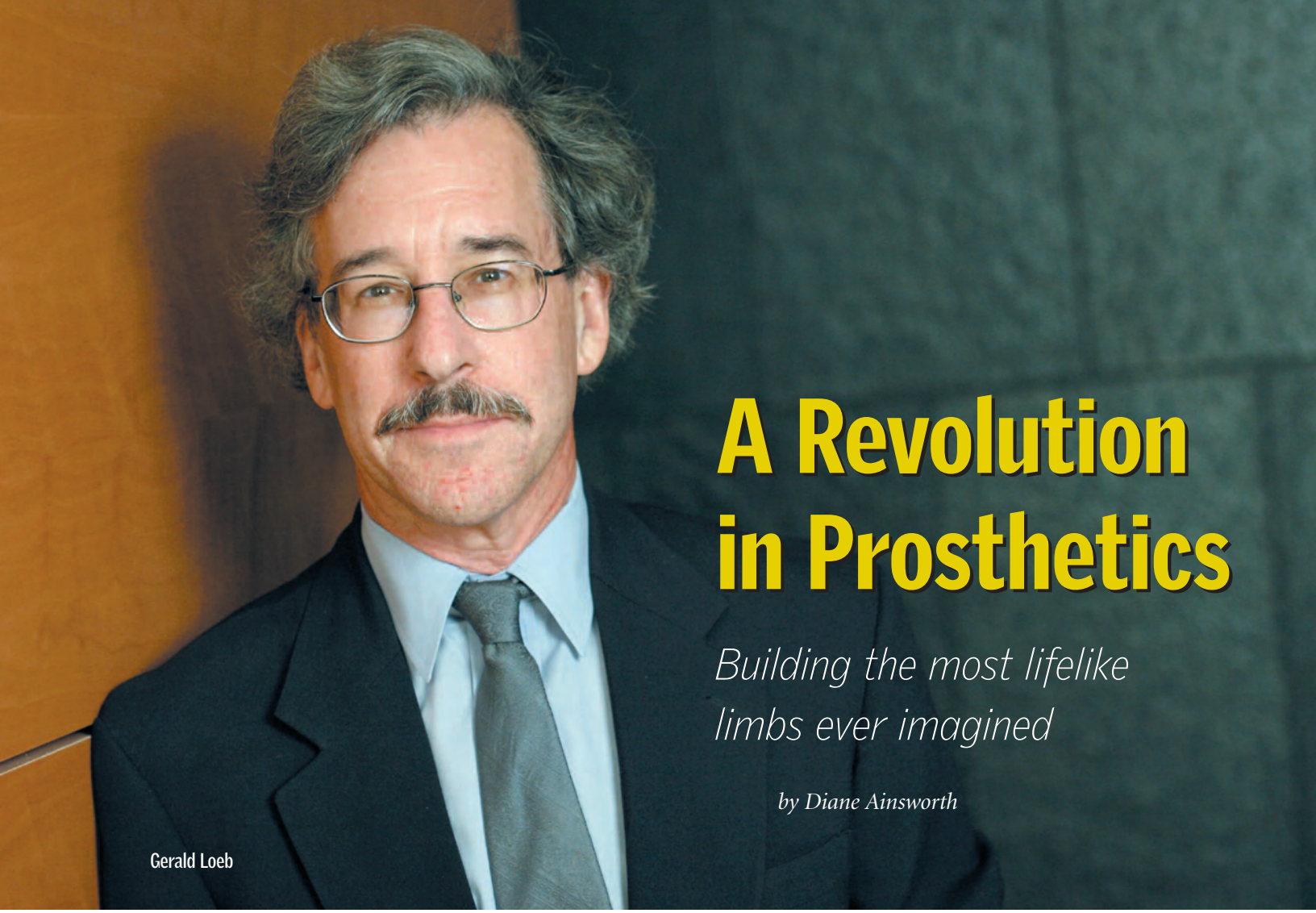
Cogent has become the leader in real-time biometric identification providing a voter identification system for Venezuela in 2004, whereby identity was determined in real-time at more than 12,000 polling locations across the country. In 2005, the Royal Canadian Mounted Police selected Cogent to provide its new real-time identification system to support criminal, civil and border control identifications. For the County of Los Angeles, Cogent also created an AFIS that provides 88 cities within the county with booking identification, crime scene identification and mobile identification capabilities. This system has become a model for law enforcement agencies worldwide.

Cogent has begun to enjoy some national exposure in recent years. *Business Week* magazine ranked it number one in its "Best Small Companies 2005" special issue. Hsieh was in the spotlight last year, too, as a national finalist in *Computer World's* Honors Program in the category of Business and Related Services. Earlier this year, Ming Hsieh also won Ernst and Young's Young Entrepreneur of the Year Award for greater Los Angeles in the category of technology and services. The Viterbi School also presented him with a Distinguished Alumni Award at its annual awards luncheon last spring.

Hsieh makes his home in Pasadena, near Cogent headquarters. He travels extensively to company offices in the U.S. and worldwide, but still finds time to enjoy his family. His parents live nearby and often visit Hsieh, his wife and their youngest daughter, Tiffany, 15, who attends Westridge High School. his oldest daughter, Pauline, 18, is a freshman at Carnegie Mellon University in Pittsburgh.

As he looks ahead to the future of his company, Ming Hsieh sees a broader range of applications for his technology and many more challenges.

"The world is changing and it's even more important today to have automated ID systems," he says. "The company is headed in a new direction right now with ANP Technologies, Inc., which wants to develop a low-cost biological detection system. It's an interesting departure from our previous contracts, but it's the ultimate results that we take pride in. I sleep easier at night knowing that Cogent is making the world a safer place to live in."



Gerald Loeb

A Revolution in Prosthetics

Building the most lifelike limbs ever imagined

by Diane Ainsworth

Loss of a limb is devastating to individuals and their families, and learning to use a prosthetic device may take years. Today's prosthetic arms and legs, while impressive, provide a limited range of movement and only a primitive ability to grasp objects. But at Gerald Loeb's Medical Device Development Facility in the basement of USC's Denney Research Building, a hotbed of novel technologies promises to make new artificial limbs more lifelike than ever imagined.

Loeb is the inventor of BIONs™, tiny injectable neurostimulators shaped like a grain of rice. BIONs™ activate weak and paralyzed muscles, bringing them back to life, but they are not the first bionic technology that he has developed. Loeb was also one of the inventors of the cochlear implant, used to restore hearing to the deaf. He started working on a visual prosthesis while still in medical school in the 1960s, an application now being pursued by Mark Humayun and colleagues in USC's Engineering Research Center for Biomimetic MicroElectronic Systems (BMES), where Loeb is deputy director. BMES is uniquely focused on neural rehabilitation. Launched in 2003 as a collaboration between the Viterbi School and the Keck School of Medicine at USC, as well as UC-Santa Cruz, the center now has partnerships with 14 companies and 10 universities, including Caltech.

"Bionic is the word Hollywood invented to explain the 'Six Million Dollar Man' in the 1970s," says Loeb with a smile. "But today, biomimetic systems are able to restore lost function to complex neural systems. We use them to restore the electrical signals that are normally sent out from the motor neurons to different parts of the body. Cochlear implants are the most successful biomimetic systems to date, but we hope to use similar biomimetic technology in retinal implants to restore partial vision, and in patients who are paralyzed from a stroke or suffering from memory loss."

Industry Interest

The Department of Defense is keen to develop this rehabilitative technology for soldiers who have lost their arms or legs in combat. Consequently, Loeb's lab in the Alfred Mann Institute for Biomedical Engineering at USC has been named one of several major subcontractors in a $30.4-million contract for the Defense Advanced Research Projects Agency (DARPA) to start Phase 1 of a program called "Revolutionizing Prosthetics 2009." The four-year program aims to develop a next-generation mechanical arm that will look, feel and behave just like one in the flesh.

The contract grows out of an increasing number of U.S. soldiers who are losing their limbs in the Iraq War. Despite the many advances in body armor and helmets, more than 450 U.S. soldiers have lost an arm or leg in Iraq or Afghanistan.

DARPA's new prosthetics program is the first step in a long-term effort to give injured military personnel the most advanced medical and rehabilitative care possible. USC is part of the effort, which will be led by Stuart D. Harshbarger at Johns Hopkins University's Applied Physics Laboratory (APL). An

Loeb photo by Brian Morri

impressive list of subcontractors, including USC and other top-notch universities, government agencies and private firms in the U.S. and Europe, are also part of the multi-phase, multi-year project.

"Understanding the biological principles of limb control for coordinated, complex movement has the potential to not only help prosthetic limbs, but also, in the future, to reanimate paralyzed limbs," says Mark Humayun, director of BMES and a professor of ophthalmology, biomedical engineering and cell and neurobiology at USC.

"The DARPA award will fuel a whole new generation of novel neurotechnologies and innovative engineering applications that are ripe for implementation," Loeb adds. "And DARPA's overall objective is equally exciting: to design a prosthetic device that can be connected directly to the peripheral and central nervous system so that amputees can regain nearly natural use of their artificial arms."

A Tall Order to Fill

That's a tall order to fill, but today's technologies are a good starting place. For example, myoelectric arms currently give users a limited range of motion — about three degrees of freedom — and the ability to perform one arm or hand motion at a time. The control systems are operated with deliberate flexing of a muscle or through mechanical movement.

DARPA wants to increase that range of movement to 22 joints, just like a normal arm and hand. As APL's Harshbarger described it, the team will design an arm that can move at "strengths, speeds and angles with 22 degrees of freedom, including the shoulder, to match the performance of the human arm while maintaining the person's ability to control the arm." The lucky recipients will be injured soldiers who are recuperating at two Department of Defense centers dedicated to amputee care. One is located at Walter Reed Army Medical Center in Washington, D.C.; the other is located at Brooke Army Medical Center in San Antonio, Texas.

Loeb and his biomedical engineering team received a $1.5-million slice of the contract for the first year of the project. His role will be to build a sophisticated control system that will replace parts of the nervous system and allow the user to operate the artificial limb neurally, just by thinking about it.

"A person probably takes in more information about physical objects through his or her fingertips than any of the senses."

While Loeb is busy developing the control system and modeling arm performance in a virtual reality environment, other biomedical engineers in BMES will be developing state-of-the-art neural implants for the brain and the central nervous system. Collaborative investigations such as Ted Berger's experimental work with silicon chip brain implants will contribute to the Biomimetic Center's overall effort to replace parts of the nervous system that must be bypassed to restore useful function. Berger is a professor of biomedical engineering at the Viterbi School.

The Modeling Center: Where It All Begins

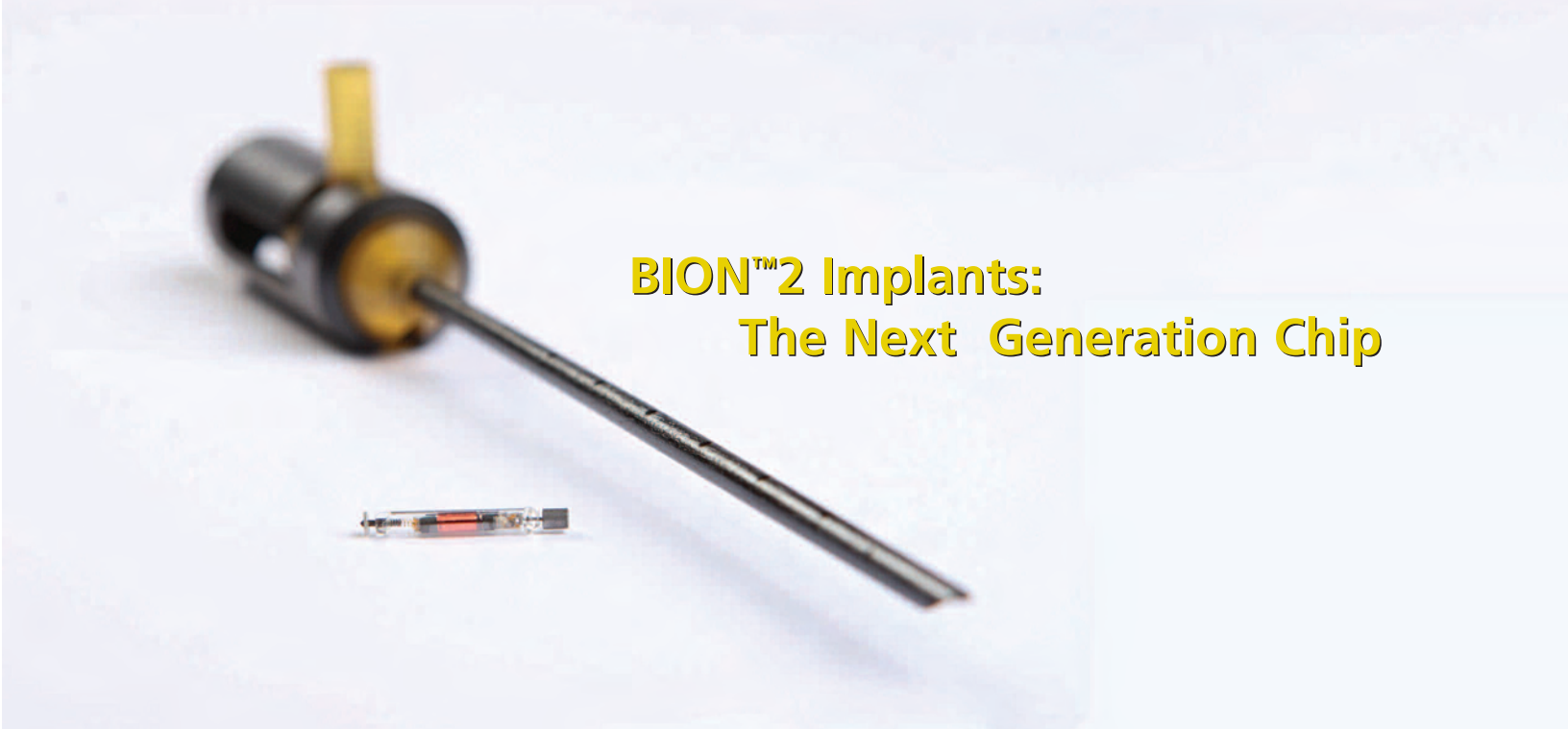
Loeb's work begins in a modeling center adjacent to his BION™ Fabrication Laboratory, where a team of biomedical engineers and graduate students develop computerized models of the musculoskeletal system to mimic movement in the human body.

Before prosthetic systems are built, Loeb's team wants to know if patients can actually control them. Using unique modeling software and virtual reality simulations, the team, which is led by Viterbi School biomedical research assistant professor Rahman Davoodi, can spend weeks crunching data and modifying algorithms to render a simulation of the way an arm swings, or how much force is needed to reach for an object on a table. The modeling

continued on page 24

This artist's rendering of a next generation prosthetic arm shows a cutaway of the elbow joint and hand. These devices are expected to be so sophisticated and lifelike that soldiers will be able to return to active duty and perform jobs requiring a variety of precision hand and arm movements.

JHU/APL image



BION™2 Implants: The Next Generation Chip

Loeb's BION™ technology has an important role in prosthetics development. Along with his colleague Todd Kuiken of the Rehabilitation Institute of Chicago, the researchers are already testing neurally controlled prosthetics on injured patients. BION™2, Gerald Loeb's next generation implant, will be able to stimulate the muscles near a wound site enough to make the prosthetic arm move just as a biological arm would have moved.

"Kuiken took advantage of the fact that peripheral nerves actually re-grow," Loeb says. "They want to grow out and innervate muscles but, of course, the muscles they used to innervate do not exist anymore. So the idea is to remove the nerve supply to some big muscles that are not doing anything anymore, such as the pectoralis muscle, and stitch in the nerve ends that used to go to the amputated arm. When the patient thinks of moving his fingers or his forearm, some part of that re-innervated muscle is activated, producing a relatively large and easily recorded EMG (electromyographic) signal."

Kuiken spent years working out the surgical techniques in animals. Now he is mapping out all of the activation spots on the chest walls of patients who have undergone re-innervation. He correlates specific patches to specific movements the patient is trying to imitate. The EMG signals are then used to operate a custom-built motorized prosthesis, a still-primitive prototype of the arms and hands that will be built through the DARPA program.

Before, such a prosthesis had to be driven by a very cumbersome switching system that prevented patients from making more than one rather jerky movement at a time. Now the systems can control all of the patient's movements at the same time when the individual thinks about the task.

One of the limitations right now is that EMG signals have to be recorded by many small electrodes that have to be stuck on the skin in just the right place every day.

"Our BION™2 implants can sense muscle electrical activity as well as stimulate it," Loeb says. "This should make the command signals much more reliable and solve the problem of interference between the electrodes and the rest of the prosthetic system."

Radio Frequency Chips

A simple form of this input-output communication already exists in radio frequency identification (RFID) chips, which Loeb also helped to invent, but the existing technology is not capable of transmitting more than a small amount of data.

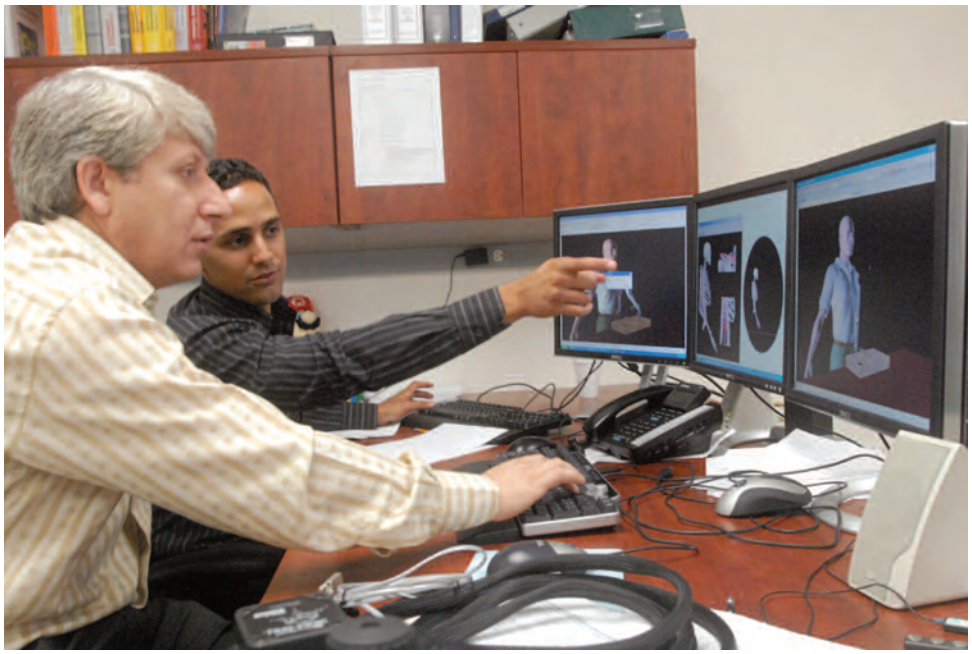
"Bionic chips will have to transmit large amounts of continuous EMG data, so we are working on developing a much higher speed data link that will send this information back out," Loeb says. "And we will also have to make some very specialized microelectronic circuits that can record all of these electrical signals, amplify and digitize them and telemeter them out to the prosthetic arm."

The task seems daunting, but Loeb and his team are busy developing, testing and modifying the technologies. In the long run, Loeb says the devices will transmit data to an external controller, which will then adjust the level of stimulation in a muscle, acting just as the spinal cord and brain act to adjust muscle activity in healthy people.

"It's really just a bunch of integrated circuit functions, none of which is terribly demanding," he quips, "it just takes a long time to get it all done."

But the work will mean much more to the men and women who have lost their limbs in the line of duty. To them, Loeb's masterful prosthetics promise to give them a lifelike limb and a new lease on life.

Bion photo by Brian Morri



software and virtual reality environment were developed by Davoodi, Mehdi Khachani, a biomedical engineer, Markus Hauschild, a biomedical engineering graduate student, and USC computer programmers.

"Once we have an accurate model of the human or prosthetic limb, we are able to study its movement under various prosthetic control strategies and external forces, such as those from gravity or interaction with the environment," Davoodi explains.

"In our simulation environment, a patient produces command signals by voluntarily contracting his or her intact muscles, or moving intact joints, to control the movement of the virtual prosthetic limb," he says. "As the patient does that, he/she watches the arm's motion in 3D stereoscopic goggles. If the simulated motion is not satisfactory, the patient learns, by practice, to change his/her command signals until the prosthetic limb can be controlled effectively."

Prosthetic Simulators: A New Tool

Using such patient-in-the-loop simulations, engineers can test and refine the design of prosthetic limbs before they are built and patients can learn to operate them before receiving them. "Really, what we're doing is developing an affordable tool for engineers to design and test new prosthetic systems and a safe environment to train the patients to operate them," Davoodi says. "This is similar to the use of flight simulators, where the pilot can safely try different strategies, including those that are novel or even dangerous, until they are ready to fly the real plane."

In addition to greater arm movement, DARPA wants to add sensory perception to the prosthetic hands, so that users will be able to feel and manipulate objects, lift up to 60 pounds, and conduct normal, everyday tasks, even in the dark. Loeb says that will truly revolutionize prostheses.

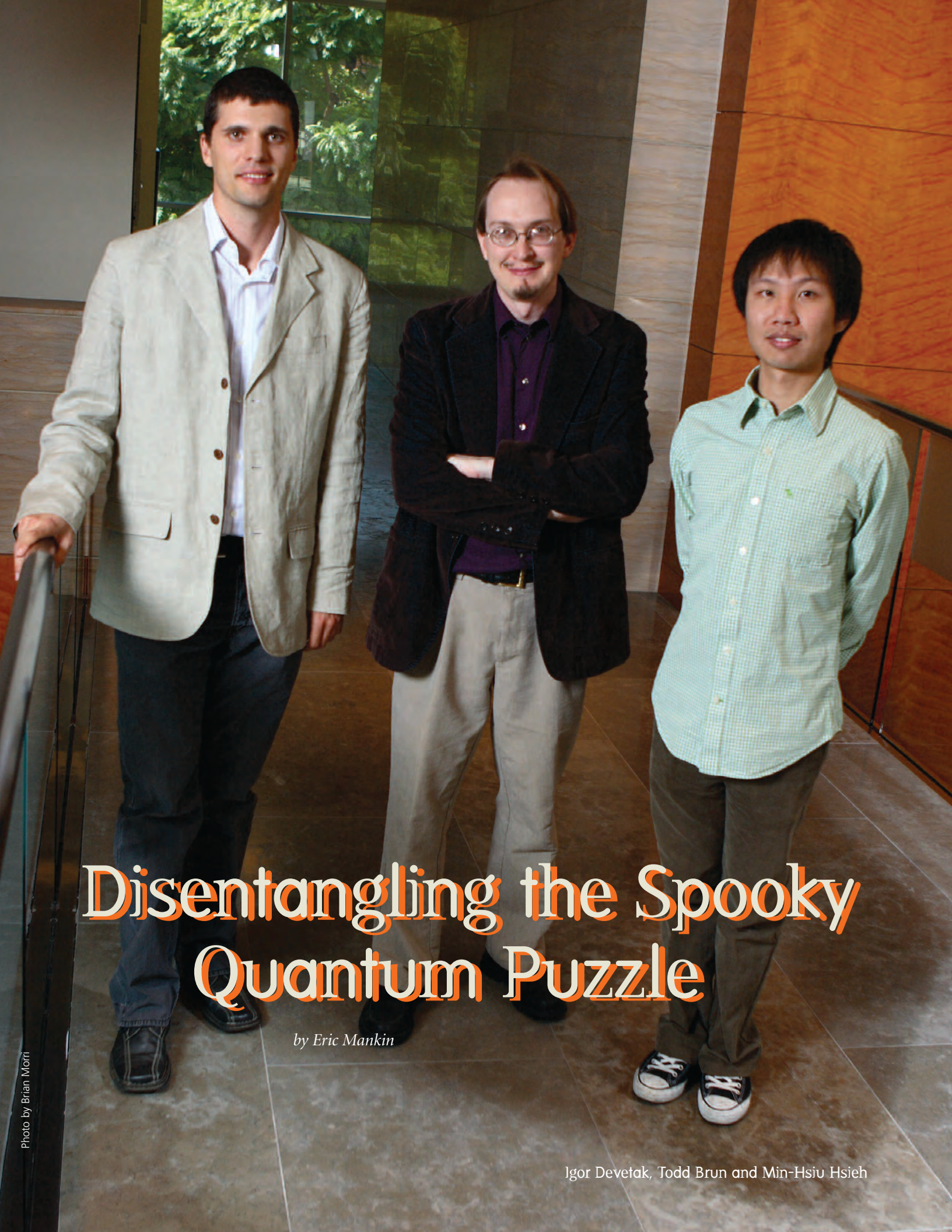
"A person probably takes in more information about physical objects through his or her fingertips than any of the senses," Loeb says. "The fingertips are highly evolved and contain many features that are designed to enhance their sensitivity and the quantity of information they can provide to the central nervous system."

Loeb and his team have a plan to imitate the structure and mechanical properties of the human finger, combining a rubbery skin, a spongy pulp, a rigid bone at the core and an overlying stiff fingernail.

"These features appear to be important in the way that contact with objects affects touch sensors," says Loeb, whose team has already come up with a simple and robust way to build a similar set of distributed sensors in an artificial fingertip. "Now it's time to take that to the next level."

Top: Biomedical research assistant professor Rahman Davoodi, foreground, works with fellow biomedical engineer Mehdi Khachani to refine arm movements in the simulation environment.

Bottom: Davoodi watches the movements of his own hand, wrist and forearm using 3D goggles to create a model of the prosthetic arm.



Disentangling the Spooky Quantum Puzzle

by Eric Mankin

Photo by Brian Morri

Igor Devetak, Todd Brun and Min-Hsiu Hsieh

Daniel Lidar, Sloan Fellow '93, is in his office struggling to explain his work in quantum computing. Concepts that are clear in the equations do not fit easily into words. When asked if there is a metaphor, something to compare it to that people would understand, he pauses, thinks and shakes his head, no.

The discussion is not academic. The concepts may be hard to express in words, but their promise is clear. Quantum computing is emerging as the key to the next generation of machines, and a diverse group of USC researchers, most of them from the Viterbi School's newly named USC Ming Hsieh Department of Electrical Engineering, *(see cover story on page 14)* is beginning the second century of USC engineering with a strong bid for pre-eminence in the new field.

"Computer chips have been doubling in density every year or so, following the well-known Moore's Law that has been the engine of the information era," Lidar writes in the prospectus for a new research unit, the USC Center for Quantum Information Science and Technology. "Unfortunately, this will soon end, as individual electronic components shrink to the atomic scale in the coming 10-20 years. This is exactly the domain where the mysterious and fantastic laws of quantum physics take center stage."

"The current challenge in the field," Lidar continues, "is to realize hardware that behaves almost purely quantum-mechanically, discover new ways to organize and operate such quantum resources and develop new algorithms and applications of this future information processing capability."

This challenge is as challenging as challenges get. The "hardware" consists of individual atoms, molecules and photons. At this atomic scale, matter behaves according to the rules of quantum mechanics.

And these rules are deeply counter-intuitive and ineradicably strange: "For instance," Lidar continues, "quantum bits (qubits) can maintain both state 0 and 1 simultaneously, and when many qubits are considered together, they allow unparalleled storage capacity. Consider that with merely 300 atoms, the resulting memory is more than could be possible even if every atom in the universe were part of a conventional computer."

"The outstanding feature of a quantum information processor is entanglement, what Einstein termed 'spooky action-at-a-distance.' Entanglement is a subtle and strange concept, and it is not even clear how to quantify entanglement for more than a few qubits."

Daniel Lidar

As one observer commented seeing similar evidence, "we're not in Kansas anymore."

Beyond Human Intuition

While the mathematical theory is well established, that is only a beginning. The design of real-world working devices by engineers has traditionally relied in substantial measure on human intuition, on a feeling for what is happening in fluid flows, computer circuits, metallic behavior and other realms. Humans look for and find patterns and symmetries that suggest approaches. But at the quantum level symmetry can mislead, the pattern is no pattern and very little human experience is of any use.

Viterbi engineers are finding ways to negotiate this strange terrain. The English-born Anthony F. J. Levi, who came to USC from Bell Labs in 1993 as a full professor of electrical engineering at the age of 34, has been focusing explicitly on the mismatch of human experience with the quantum world for the past six years.

"You have a vast array of alternative ways to do the same thing at this level," he says. "Nanoscience gives you too many degrees of freedom. Human minds work by looking for symmetry, by identifying patterns. But in nature, you can often get better performance by breaking symmetry."

Levi has an introduction to his method, including some test examples, on his quantum engineering web page, http://www.usc.edu/alevi. It is dramatic break from classic chip design methodology, which he says has proceeded in what he calls an ad-hoc manner — a seat-of-the-pants intuitive process, which follows what has worked satisfactorily before, without ever considering that something entirely different might work better.

While human minds can not deal with 20 or 50 degrees of freedom, appropriately constructed computer searches can, says Levi. "You input a physical model that embodies the behavior of the system. That behavior is controlled with parameters, as many as 50 or 100. The machine then tries to change the parameters to find an optimal response."

Levi and Stephan Haas, a professor of physics and astronomy in the USC College, are using this design process to create new species of multi-layered semiconductor devices, "varying the semiconductor composition throughout the material, layer by layer." Two more professors of mathematics from the College, Chunming Wand and Gary Rosen, are also part of the team.

The resulting devices literally defy human understanding. "You can't make sense of it by looking at it," Levi says. But it works.

And the design tools themselves, as they evolve, carry the knowledge, not their human users. "It used to be," says Levi, "that people died, but their knowledge was recorded in books. Now, it's in the tools. You encode what you learn into the design tool."

Quantum Circuits

Levi's efforts are part of a broad effort in the Hsieh Department. Other researchers are addressing the issue of creating quantum circuits that can be used to solve real problems. Humans may not be able to intuit exactly how quantum level physical structures work, but they must be able to visualize the circuits in order to design them. And for this, Massoud Pedram, a Hsieh Department NSF PECASE (Presidential Early Career Award for Scientists and Engineers) winner, recently found a method that has the potential to

Photo by Brian Morri

drastically simplify the process.

"The key milestone achieved so far is the … development of a canonical and concise representation of quantum logic circuits in the form of quantum decision diagrams (QDD's)," says Pedram. These diagrams allow engineers to visualize information flows through the system — that is, to apply the expertise they have in silicon circuit design to the quantum world, accurately and rigorously.

"Preliminary experimental results show that the QDD-based functional decomposition approach speeds up the synthesis of quantum logic circuits by orders of magnitude compared to the best known quantum synthesis techniques."

Pedram's is not the only recent USC breakthrough. At the far theoretical end, Lidar has just developed a new way to use Einstein spookiness to drastically speed up the process of debugging a new quantum computer design — a critical step in which all possible inputs are put in, to see the range of observed outputs.

Lidar created the method with his former graduate student Masoud Mohseni (now at Harvard). "Through the strange features of entanglement, the correlation between the two qubits at the output contains more information than if an unentangled qubit were fed to the machine. Thus each time a qubit pair is measured at the output, a bit more information is gained than would be possible classically." The bottom line is that quantum debugging looks possible using a fraction of the trials that would be necessary for a conventional, electronic design.

Other Hsieh Department theorists are also quantum standouts. In fall 2006, Todd Brun and Igor Devetak published a paper in *Science* on a major advance in error correction coding for quantum computing.

Error correction coding is a fundamental process that underlies all of information science, but the task of adapting classical error correction codes to quantum computing has long bumped up against an apparently fundamental limitation.

Irving Reed, a USC emeritus professor and National Academy of Engineering member was co-creator of one of the most widely used of these codes, the Reed-Solomon codes. Those error-correcting codes make possible error free sound emanating from scratched compact disks and clear faxes sent through less than perfect telephone circuits. Reed discusses their importance to computer science and electronics in general in his 2005 memoir, *Alaska to Algorithms.*

"The human mind is capable by the use of context and language redundancy to intuitively perform error-correction," he writes. "But electronic equipment is extremely fussy: it demands a perfection that isn't found in the noisy real world. Error coding permits these fastidious machines to function as part of real world systems, in real time."

Brun says quantum computing systems processing quantum data as qubits carried on single photons, are even more fastidious than electronic ones, making error codes even more necessary. But the peculiar physical laws governing quantum messages have long created a problem. In the process of decoding, the most efficient error codes look for tell-tale signals of errors but this process itself creates new interference errors.

Brun, Devetak and graduate student Min-Hsiu Hsieh found that adding a dose of entangled qubits to the message resolved the paradox and allowed the use of ultra-efficient turbo codes, a step whose importance was signaled in *Science* by an interpretive article accompanying the paper.

USC Quantum Fingerprints

Quantum computing is still in its cradle. But the very first useful devices are starting to emerge in the field of cryptography, Lidar says. In this area, the "spooky" entanglement feature provides a remarkable benefit. It is not just that the message is encrypted using advanced high-security techniques. It is that any attempt to read the message by anyone is immediately detected.

Actual quantum computing devices are still far away, but USC, because its faculty is rich in exactly the expertise needed for this daunting challenge, is riding the crest of the first quantum research wave.

In Lidar's proposal for the Center for Quantum Information Science and Technology (CQIST), he notes "the unique strength of the University of Southern California" in the necessary skills, and he says: "When quantum information devices are ultimately realized, they will have University of Southern California fingerprints."

The Lidar proposal identifies 10 faculty members for the center, including fiber optics specialist and PECASE winner Alan Willner and Stephen Cronin from the Viterbi School, in addition to Levi, Brun, and Devetak, plus physicists Hans Bozler, Jia Grace Lu and Paolo Zanardi.

And the web already extends further. John O'Brien, another PECASE winner who recently became Viterbi's senior associate dean for academic affairs, is the lead investigator on an NSF-funded $1.3 million Nanoscale

Anthony F. J. Levi

Interdisciplinary Research Team (NIRT) project to build a device that will carry signals on individually generated and controlled single photons, one after another, each one generated by a single electron.

The effort involves work by Levi, Brun and Willner, plus signals specialist William Lindsey and optical device expert P. Dan Dapkus, all of them faculty in the Hsieh Department.

"This is an ambitious project that requires an exceptionally broad range of expertise in numerous electrical engineering disciplines," commented Viterbi School Dean Yortsos. "Swift success in a project this bold is never guaranteed, but I am extremely proud we have been able to assemble an in-house team that has the background to even attempt it."

Photo by Brian Morri

Searching for Grandeur

by Bob Calverley

> The search for truth is in one way hard and in another easy for no one can master it fully nor miss it wholly. Each adds a little knowledge to our nature, and from all things assembled there arises a certain grandeur. —Aristotle

Tzung "John" Hsiai and his friends are beginning to see some grandeur arising from sensors that are so tiny they are roughly one-tenth the diameter of a strand of hair, or the same size as the elongated vascular endothelial cells lining the inner walls of blood vessels in which the devices will be placed.

Hsiai and a host of other researchers at USC are the first to apply MicroElectroMechanical Systems (MEMS) technology to the study of vascular biology and they are gaining new insights on how arterial plaque develops in people.

Atherosclerosis, or hardening of the arteries, is the single largest underlying cause of cardiovascular disease, long an insidious killer disease in the United States, and one that is rapidly emerging as a global health crisis.

"The integration of biomedical engineering and oxidative biology, as well as the testing of hypotheses with dynamic models, strengthen our cross-disciplinary research," says Hsiai. "Ultimately, our goal is to develop micro- and nano-sensors that will enable prediction, early detection and prevention of acute coronary disease."

Hsiai is the Robert G. and Mary G. Lane assistant professor of biomedical engineering in the USC Viterbi School, a biomedical engineer, a board-certified internist and cardiologist who works as a voluntary attending cardiologist at the Los Angeles County Hospital/USC Medical Center. He is the specialist patients see when they arrive suffering from heart attacks.

"They come in with an acute heart attack and that might be their first symptom," says Hsiai. "They either die or survive with debilitated lifestyle. Often these are very busy and successful individuals."

Hsiai has always had one foot planted firmly in engineering and the other in medicine. He embraces collaborative research working with the USC School of Pharmacy, the Keck School of Medicine at USC, departments of preventive medicine and of cardiothoracic surgery, the Institute for Genetic Medicine, Good Samaritan Hospital and colleagues in the Viterbi School.

Growing up in Toronto, Canada, Hsiai accompanied his physician father on missions to the Andes Mountains bringing medical care to the aboriginal inhabitants. He graduated with honors and distinction

Photo by Brian Morri

in bioengineering at Columbia University, attended medical school at the University of Chicago, trained in Internal Medicine at UCLA and was selected from over 500 physician applicants for the UCLA Star Fellowship in Cardiology. He earned his Ph.D. at UCLA in 2002, focusing on MEMS, picking up a National Institute of Health (NIH) National Research Service Award. He joined the Viterbi School's department of biomedical engineering in 2002 and in 2003 he received an NIH Career Award to support his cardiovascular research.

He has just received a $2 million NIH grant to examine how biomechanical and biochemical factors initiate atherosclerosis. It is Hsiai's first NIH RO1 grant as principal investigator, but his two co-principal investigators, Enrique Cadenas, of the USC School of Pharmacy, and Howard Hodis of the Keck School, have had consecutive NIH funding for their work for more than 15 years.

"Dr. Hsiai's engineering and medical backgrounds offer a distinctive approach to heart disease, a tremendous complement to the perspectives offered by Dr. Hodis' and my groups," says Cadenas.

Hodis heads the Keck School's atherosclerosis unit, which has been a cohesive interdisciplinary research group for 40 years, and he thinks the timing of the collaboration is particularly good.

"This project provides especially unique cardiovascular research as it studies the molecular and signaling processes involved in response to flow dynamics in the arteries," says Hodis. "We're moving into in-vivo (whole animal) models, and then into humans. It may take a couple of funding cycles but we hope to develop a mechanism to determine which lesions are ready to rupture and cause a heart attack."

Using photolithography technology, Hsiai's team has been building MEMS devices that are in the range of 20 by 100 microns. They contain a heated wire doped with phosphorous. When an electric current passes through this element, it measures the shear stress from the fluid surrounding the device as it flows. As the heated wire sensor comes close to the blood vessel wall, the surface begins to affect its sensitivity, but the devices are far more sensitive than any other method of examining blood flow. In addition to building the devices, Hsiai cultures blood vessel cells in his laboratory.

Normally, the liver removes cholesterol, which is a lipid, from the blood. But sometimes the lipids oxidize, the liver cannot recognize them and so they stay in the blood. Over time, the oxidized lipids form plaque inside blood vessels and the vessels themselves become stiffer and then brittle. This is classic atherosclerosis.

"Plaque tends to form in the coronary arteries (and other areas) where there is complicated geometry such as sharp turns and where blood vessels branch," says Hsiai. "Blood flow is different and much more complex in these areas. There are many places where it flows more slowly and where you have vortices, or little whirlpools."

Disturbed blood flow modulates the formation of plaque, says Hsiai.

"Exercise changes the molecular profile of the surface of the blood vessel wall. With increased blood flow, the walls become less sticky so that lipids are less likely to attach," he says. The mechanical force of blood flowing past the molecules making up blood vessel walls appears to induce a chemical change as well. The blood vessels begin to produce anti-oxidants, which can possibly eliminate those plaque-forming oxidized lipids. "You can change the profile of the wall through diet, medication, by stopping smoking, and of course, with exercise."

Hodis says that today it is dogma that if patients lower cholesterol it not only stops the progression of atherosclerosis, but can at times reverse it. "We can take a 50-year accumulation of 'rust' and in two years, turn it in a different direction."

So far, Hsiai's devices are "in vitro," that is they are being used in the laboratory and not in animals (in vivo). But Hsiai is about to begin working with another collaborator, Robert Kloner, a cardiologist at Good Samaritan Hospital and professor of medicine at the Keck School, with an animal model. It is an essential next step towards the development of his sensors for use in human patients.

Hsiai is striving to make the catheters smaller and sees them as one of the significant engineering challenges. It is not only because they affect the blood flow that the devices are supposed to sense, but because of the daunting prospect of trying to intricately thread his devices through the convoluted geography of ever-tinier coronary blood vessels to precise locations. But Kloner is less worried.

"People undergo cardiac catheterization all the time," he says, growing more excited. "Someday soon we can put in nano sensors, find out that someone is developing atherosclerosis and then treat them with high doses of statins delivered to exactly the right place."

Tzung "John" Hsiai

Tzung Hsiai also collaborates with the following researchers at the Viterbi School: Fred Browand, professor of aerospace and mechanical engineering; E. S. Kim, associate professor of electrical engineering; Chongwu Zhou, associate professor of electrical engineering; Ellis Meng, assistant professor of biomedical engineering; and Juliana Hwang, research assistant professor of pharmacology and pharmaceutical sciences.

Left: Hsiai's graduate researcher team (clockwise from top left) Hongyu Yu, Dane Lee, Takumi Takahashi, Anna Paraboschi, Lisong Ai and Mahsa Rouhanizadeh.

Photo by Brian Morri

Attn: Alumni *Get involved!*

The University of Southern California Viterbi School of Engineering Career Services office serves as a liaison between employers and technical students, developing events and programs designed to connect outstanding engineering students with industry leaders!

USC Viterbi Career Services

Recruiting Events and Involvement Opportunities

Engineering Career Fairs

The Engineering Career Fair provides an excellent opportunity to increase your company's visibility among our top engineering students. The Engineering Career Fair is attended by 75-100 top engineering employers and approximately 1500-2000 of our students.

Register by visiting our website at http://viterbi.usc.edu/careers or giving us a call at 213/740-9677.

Spring Career Fair: Thursday, February 22nd

Information Sessions

Many employers also choose to offer an evening presentation to students outlining the benefits of employment opportunities at their company. They are useful for companies wishing to increase awareness of their organization or provide interviewing students with basic information prior to the actual interview.

Engineering Career Conference

The Engineering Career Conference is offered each fall to undergraduate engineers. This one-day event, coordinated by Viterbi Career Services and the Center for Engineering Diversity, brings alumni and industry representatives on campus to present workshops on various career related topics, conduct mock interviews, and provide resume critiques.

On-Campus Interviews

On-Campus Interviews allow you to efficiently conduct screening interviews for internship, co-op or full time positions here at USC. Career Services will work with you to set a date for your interviews, then post the job description along with the specific requirements that you provide.

Workshops

If you are interested in presenting a workshop on resumes/cover letters, interviewing, the job search process, or some other career-related topic, please contact us to set up a date and to publicize the event. Industry perspectives on these issues are highly valued by our students.

Viterbi Career Services looks forward to helping you connect with our outstanding students, so please do not hesitate to contact us!

Stay involved!!

USC Viterbi School of Engineering
Career Services

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USC Viterbi
School of Engineering

Yi Wang, MS CSCI '06 *A Distant Trojan*

Yi Wang is the proud holder of an M.S. in computer science from the USC Viterbi School of Engineering, but he's never actually set foot on the USC campus. In fact, the most he's ever seen of California is the security line at LAX. Wang's USC educational experience revolved around a 17-inch flat-screen computer monitor.

Wang earned his degree through the Viterbi School's Distance Education Network (DEN) using technology that allows full-time working professionals to earn degrees entirely online. A senior software manager at Motorola, Wang was halfway through a master's program in computer engineering at the University of Illinois when he saw a magazine advertisement for USC's DEN.

"Had I known about DEN earlier, I wouldn't have wasted so much time on commutes to downtown Chicago," says Wang. "Viterbi is a leader in software engineering and DEN made it possible to get high quality education without quitting my job. Deciding to enroll in DEN was a no-brainer."

Wang, however, proved he had more than enough brains by completing his degree with straight A's. His wife, Hong-Hsi, was instrumental in providing an environment that allowed Wang to focus on his studies.

"My wife was very supportive of me… I was relieved from house chores when I was studying or watching lectures," Wang says fondly. "Of course, life has returned to its old mode after my graduation."

Wang's education at USC helped him transition within Motorola from engineering to the Intellectual Asset Management team. He attributes obtaining this promotional transfer to the education he received from the Viterbi School. "It gave instant credibility to my ability and potential," he says.

In addition to his regular position at Motorola, Wang became a DEN ambassador. His positive experience as a DEN student was constantly a conversation piece with fellow colleagues who expressed the desire to pursue further education.

"Even before I was formally appointed by DEN as a DEN ambassador at Motorola, I had been actively advocating for DEN. If I knew that any of my co-workers or friends were interested in a degree in engineering, I'd tell them that Viterbi via DEN is the best choice," Wang shares. "I'm planning on doing more to increase DEN's visibility in Motorola and help secure DEN as the program of choice when it comes to graduate education in engineering."

Wang is especially proud of his role in bringing about DSA, the DEN Student Association. Surprised that there was no student organization for the hundreds of registered students and DEN alumni all over the country, Wang contacted DEN suggesting formation of a DEN student group. Through Wang's pro-activity and the help of Cami Lee, DSA advisor, a group of enthusiastic DEN students willed DSA into existence.

"I felt that we ought to have our own community in which we can share our experience, form study groups, make new friends, network and have some fun together," says Wang.

Wang also started a university and high school relations group for his company. As part of Motorola's Asian Business Council, Wang conceived and planned the execution of a tutoring program where over 50 Motorola employees tutored high school students with math homework in local libraries. He started the program in 2003 at the Schaumburg Township District Library, and it has expanded since then.

The group now helps students at all three library branches in Schaumburg and at another library in Gurnee, Illinois. And Wang's group is in touch with Motorola employees outside of Illinois with the goal of establishing programs in each of the communities where Motorola has a significant presence.

"We've had parents come to thank us for all we have done, and teachers tell us that we helped a student graduate," he says proudly. Wang's team was named Volunteer Organization of the Year by the Village of Schaumburg in 2006 and received the Motorola CEO Volunteerism Award this past month. "I like teaching. To me, it's also a way of learning."

Currently, the most enjoyable thing in Wang's life is being father to his four-month-old daughter, Ivy. Wang has been enjoying every minute since Ivy's arrival, and he has been motivated to work even harder.

Yi Wang (third from left) started a team at Motorola to tutor high school students. This team was named Volunteer Organization of the Year in 2006 by the Village of Schaumburg, and also, received the Motorola CEO Volunteerism Award.

"I don't have any specific dreams for her yet," Wang says of his baby daughter. But if he were to imagine a particular university in little Ivy's future, "I would certainly like her to go to my alma mater," says the Trojan at heart.

—Sharon Hong

Zach Basford, BSAME '97 *Inside Iraq*

Sitting in an electrical engineering class one day, Zach Basford remembers the professor asking why they were learning this material, besides trying to pass the next test.

"Because when you are career engineers, you won't be intimidated by these seemingly difficult problems," the professor explained.

Basford was not intimidated. He got his B.S., joined the Army, tested high on his aptitude and language tests, as well as physical fitness tests, and sailed effortlessly through ROTC. Then it was time for a real challenge — the Army's elite Special Forces. Only 18 percent make it through the physical, intellectual and language tests, and a mere three percent ever become Special Forces personnel. Basford is one of them.

The Viterbi School alum, now a Captain in the U.S. Army Special Forces, has been fulfilling his second Iraq tour of duty and began a journal of his adventures.

"Recently, I have been meeting with a lot of key individuals: commanders of different units, Iraqi military leaders, sheiks and important people that have to do with special projects," he writes in his first letter. "We are building relationships and figuring out how we are all going to work together and what our relationships will be. We have just finished our transition with the guys we replaced. They have done a lot of good things here, and now I not only must fill their shoes, but take what they have done to the next level."

Basford was living "a pretty rustic life" on a small base near the Syrian border, west of Mosul in northwestern Iraq. His mission was to train, advise and assist Iraqi security forces, including the Iraqi Army and police forces, to conduct counter-insurgency operations. He conducted numerous combat patrols as well as gathering intelligence.

"Because my commander trusted us more than anyone else, he rewarded me and my team with the hardest mission in the most remote area under his command," Basford writes.

Above: Basford stands in front of a deserted Iraqi mosque in the heart of a small town abandoned after an attack by U.S. soldiers. Left: Basford, center, talks outside with Iraqi Army officials during a U.S. Special Forces meeting with the Iraqis.

Unlike some Special Forces teams, who live in opulent Ba'ath palaces with large swimming pools, he and a dozen others were sleeping on cots in a tent in a decrepit warehouse.

"If I have one team out in the hinterlands and I lose communications with them, I want it to be you and your team," Basford's commander said.

Basford was there to keep the peace and safeguard the region from insurgents. "The Iraqi leaders know that we are not 'normal' U.S. soldiers," he writes. "They think we are CIA, or something similar, and very dangerous. We get a lot of respect. I am secretly amazed at how much influence I have."

He is also amazed that a mechanical engineering degree could serve him so well.

"Eighty percent of all engineering students change their majors before graduating, so I knew that you had to love it to stick with it," he says. Later, as a Special Forces officer, he realized that his work with the Iraqi community was just as challenging as any job in mechanical engineering.

Basford writes mostly about life on the compound — poignant descriptions of the Iraqi landscape, the people, the food, the villages, the customs and the tragedy of war. He describes driving through "wastelands of burnt earth" and villages where people "looked like they didn't want you to be there, or other times, you just knew the guy you were looking at or his cousin had set up some IEDs (Improvised Explosive Devices) — roadside bombs to kill U.S. or Iraqi soldiers."

Garbage litters streets of ramshackle houses and open-air food markets. An absence of running water has created huge sanitation problems for the Iraqis, but they fail to realize it. "Most villages have a well or two that they draw water from. Other villages get water from one of the many aqueducts. On our outpost base, we live side by side with an Iraqi army battalion. We have hired a local man to fill up a water truck from the nearby aqueduct daily and replenish the water tanks for our latrines and the Iraqi's latrines right next to them," Basford writes.

"The running water amazes them, but I don't think they fully understand it," he

continued on page 35

Robyn Strumpf, Class of '09 *Books and Blankies*

USC Trustee Scholar Robyn Strumpf was 12 years old when she gave away her first basket of books and a "blankie," a hand-made quilt she had sewn herself, to children who were eager to learn how to read.

Today, that simple gesture has turned into an extraordinarily successful literacy program, called *Project Books and Blankies,* which provides baskets of books and a quilt to needy schools and homeless shelters throughout California. In seven years time, *Project Books and Blankies* has given away more than 18,000 books and raised more than $120,000 in grants and donations of books, fabrics and supplies.

Strumpf, 19, has a challenging double major in mechanical engineering and political science, but still finds thousands of hours to promote literacy and make colorful quilts. Among those who have received these gifts are Friends of the Family, Project Head Start, Schools on Wheels, Haven Hills, Boys and Girls Clubs sponsored by the Los Angeles Public Library Literacy Council, after-school literacy programs at several Hollywood middle schools and O.N.E, which stands for Organization for the Needs of the Elderly.

Last spring, USC's family of five elementary schools, all located in the neighborhoods around campus, were the lucky recipients of *Project Books and Blankies.* Strumpf gave baskets of books and quilts to Foshay Learning Center, Lenicia B. Wemmes Elementary School, Vermont Avenue Elementary School, Norwood Street Elementary School and 32nd Street School.

"My parents really helped me when I was struggling with reading by having me sit down with a book and a cozy quilt and just get comfortable with the whole thing," she said. "It worked. Today I love to read, and I want kids to know that if they do the same thing and stick with it, they'll learn to read."

Overcoming Her Own Reading Problems

Strumpf, who grew up in the San Fernando Valley, struggled with reading until she was in third grade. Her first "books and blankie" donation was to Head Start, using books she had persuaded Borders Books in Valencia, Calif., to donate. She remembers the very first boy she ever helped.

"His name was Joel and he was in preschool, but he was so excited to be able to hold a book and read out loud," Strumpf said. "When I gave him a book, he held it up every which way but the correct way, and then he began to pretend he was reading.

By junior high school, she was beginning to give books away to kids who had trouble reading or who simply lacked resources and positive role models. She devoted weekends, summers and semester breaks to making book baskets and quilts. At Viewpoint School in Calabasas, she recruited some of her friends to help with the baskets. By her senior year, the baskets had become such a hot item that she secured a pro bono attorney to set up *Project Books and Blankies* as a tax-exempt 501(c)(3) nonprofit organization.

The requests for book baskets and quilts started flooding in as word spread. The USC undergraduate was contacted by an international relief organization in South Africa, which wanted to distribute books through the Nelson Mandela Children's Fund. Since that initial inquiry, she has donated "well over 1,000 books internationally."

In 2004, Strumpf received the 2004 National Caring Award, which gave her an opportunity to visit Washington, D.C. and be inducted into the Hall of Fame for Caring Americans in the Frederick Douglass Museum. And in 2005, Bank of America named her a Local Hero for her literacy work in the greater Los Angeles area.

Strong Academic Record

Strumpf's strong academic record and phenomenal success with *Project Books and Blankies* earned her admission to USC and a trustee scholarship. With longstanding interests in "building things" and in American politics, she chose a double major in mechanical engineering and political science. One of her passions, she said, is to be able to design and build science exhibits "like the ones you see at the California Science Center" across the street from USC.

In addition to taking a full load of classes this semester, she partnered with USC ReadersPlus in September to sponsor an International Reading Festival on the USC campus to spread cultural awareness and literacy.

The budding engineer has been written up in *Points of Light: A Celebration of the American Spirit of Giving,* by Robert Goodwin and Thomas Kinkade (Warner Books, 2006), which features exceptional volunteers across the country who have accomplished amazing feats. If her name is familiar, it's because she's also been written about in many newspapers and magazines.

For more information about Project Books and Blankies, visit Strumpf's website at www.booksandblankies.com.

Catching Up with Jim Baum

As chairman of the School's Board of Councilors, Dwight J. "Jim" Baum has a unique perspective about everything USC and all things Viterbi. He is not an alumnus but a parent who early-on became very involved in his kids' engineering education at USC. Now as he enters his third year as chairman and the School enters its second century, *USC Viterbi Engineer* sat down with Jim to discuss how the School has changed over time, and how we are poised for future explorations.

Q: *Now that you have been chair of the BoC for two years, (and an important year— the School's 100th), what are your thoughts about where the Viterbi School is now and where it is headed?*

It definitely has been an exciting year. When Dean Nikias first recruited me for the chairmanship we didn't know he would soon be tapped for the Provost position. Fortunately we had on the faculty someone who was ready and able to pick up the reins on short notice. What could have been a rough transition year went smoother than I could have hoped, and the momentum that Max had started just grew exponentially under Yannis. We have a very rich past but thanks to the assets and foundations in place the future will be even better. The real strength of the School is its ability to change and grow to the needs of our profession. It is that ability that has put us on top and will keep us there.

Q: *How do you view your role on the Board of Councilors?*

I feel strongly that the School has several distinct stake holders — students, faculty, alumni, industry and society as a whole. Thus I see my job as representing the BoC both in conversations with the administration and faculty, and at the many gatherings and presentations we have during the year. I encourage the board members and any other interested parties to use me as a conduit and I certainly have found the administration more than receptive.

Q: *What do you personally hope to accomplish as chair of the BoC? What would you like to see this important group do for the School?*

The BoC has an unbelievable wealth of expertise and enthusiasm. If I can just increase a little bit the use of these assets in the evolution of the School I will have something to point at with pride.

The board is certainly a great role model for engineering students. Many board members have expressed an interest in mentoring students and we certainly would like to give more feedback to the School as to what works from the undergraduate educational experience once the student gets into industry. And while many board members have been in the forefront of contributing the funds needed to build this School, we certainly can do more, both on the personal level and also in the recruitment of outside funds.

Q: *What makes Viterbi attractive for donors and supporters like you? Why get involved both financially and with your time and efforts?*

First of all this is a fun place to be around! The enthusiasm of the students, the faculty and the staff are contagious. It makes any contribution of time or money seem so worth it. In most of the institutions I have been involved with, the donor's role is simply to write the check. At the Viterbi School it is much more of a partnership between the donor and the School. As a result it is a more rewarding experience for the donor.

Q: *Do you think an engineering education is a foundation that can serve someone in almost any other field?*

There is no question in my mind that an undergraduate engineering education is the best possible base for any endeavor. The discipline, hard work, scientific method reasoning, creative approaches to problem solving, team projects and working with others are all tools you learn in engineering school that are directly related to superior performance in any field. And no one teaches these better than a good engineering school like Viterbi.

Q: *What makes Viterbi a destination for top-notch students?*

It's a great campus with terrific students and caring faculty and staff. The ability to design an individual program without the strict constraints prevalent at so many institutions has got to intrigue the brightest kids. Also, the students are supported, we have student-oriented facilities and university programs, like the Arts and Humanities Initiative, all contribute to an unbelievable environment suited for a truly exceptional student.

Q: *What are your opinions about undergraduate education at our School?*

This is a subject dear and close to my heart. I really got interested earlier I really got interested in USC engineering because of feedback from my kids when they were here. And I will tell you a lot of that feedback was not always good. I think we have come a long way in a few short years. The math program is now much more responsive to the needs of our students, we are working hard to improve the quality of life for the undergrads, and the KIUEL project is so unique we are only starting to understand where it will take us. The entire

attitude of the School has really changed regarding the importance of the undergraduate experience. Obviously our success in attracting the best of the best and retaining them is proof positive that we are doing something very right.

Q: *How do think your gift for the Baum Student Center has enhanced the undergraduate experience at the Viterbi School?*

This is one best answered by the students themselves. However, it is rewarding to see hardly an empty seat when I walk by. Thanks to Ron Tutor's wonderful building, the impact of our gift was greatly multiplied. It certainly has brought the students closer together and given them a sense of belonging to a group at engineering.

Q: *What kinds of things do you hope to accomplish with our new dean, Yannis Yortsos?*

First of all let me say how happy I was when Yannis was named permanent dean. The dean has made eloquently clear his priorities both in his appearance before the selection board and in his communications since his selection. I support them fully and stand ready to help him realize these goals in whatever way he thinks will help. I will of course continue to work on my pet concerns of undergraduate life and maintaining the momentum of our gifting program. Hopefully the first years of the second century of the School will be as defining as the first 100.

Q: *Even though you are a Cornell grad, do you consider yourself a Trojan now? And what does that mean to you?*

From the first time my wife Judy and I attended a Trojan event we felt at home. Trojans are the most natural, hospitable and truly friendly group I have ever met. You made us want to be a part of this family. This also means I get to cheer for a real football team — something very foreign to an Ivy Leaguer! But more than that it means we are a part of a real winning team — a university that is really making a difference for its students, its community and our nation.

Zach Basford *continued from page 32*

Left to right: Zach Basford, Sheik Nah Ils, and Jimmy, a Special Forces interpreter.

continues. " They don't understand that it can run out. They will often turn on a faucet and leave it on even after they leave. They will wash their feet five times a day. They will turn on a fire hose-size spigot full blast to wash their clothes. The water in the tank will run out and they do not understand why."

To meet with Iraqi VIPs, the Special Forces units have to drive through town, which meant driving fast and aggressively, Basford notes. "The Iraqis respect aggression…They pull off the road for all U.S. convoys." But it's also safer to drive fast because it gives insurgents less time to correctly time the detonation of a roadside bomb.

Meetings were never less than three hours long — that is considered short in Iraq, Basford notes — and the meals were always the same: sheep or goat meat served on a platter of rice.

"They bring in huge plates, two feet in diameter, of rice, with about half a sheep on it.…They don't use utensils or napkins; people eat with their fingers…You have not fully become friends [with the Iraqis] until you have eaten with them."

Basford's unit practices combat maneuvers, firing a variety of foreign and domestic weapons, each week. They also receive extensive combat trauma medical training, learning to administer IVs under the most extreme conditions. They practiced with night-vision goggles in blackout conditions after the men had sprinted several hundred meters or finished an obstacle course, Basford says. "That's the condition someone will be in when they need an IV."

Despite the gravity of his situation, Basford discovered some of the simpler pleasures in life — such as adopting a stray puppy — and a lighter side to the Iraqis as time went by. Comically, when a cell phone rings, everyone jumps to answer it.

"It's the most important thing in the world," Basford writes. "No matter what you are doing, the cell phone takes priority. You could be in a heated conversation with a sheik or Iraqi military commander, but if his cell phone rings, he will always answer it."

In July, the USC engineer took a leave of absence to return to Tacoma, Washington, where his wife, Heidi, gave birth to their first child. Chances are that little Claire, born July 24, will soon be jumping to the jingle of her mom's cell phone.

snapshots

USC Viterbi School of Engineering Events
Summer & Fall 2006

BoC Chair Jim Baum and Dean Yortsos welcome parents to the Viterbi School at the annual move-in day reception.

PARENTS RECEPTION

On August 16th, while new engineering students were moving onto campus, the Viterbi School hosted their parents in the quad for a special reception. The casual gathering gave new parents a chance to meet Dean Yortsos, engineering faculty and staff, as well as other parents. Board of Councilor Chair and former Viterbi parent Jim Baum gave a short speech welcoming the parents to the Trojan family.

Parents of the Viterbi School's incoming class listen as Dean Yortsos welcomes them to the School.

Trojan Marching Band Director Dr. Art Bartner celebrates the Trojan spirit with Dean Yortsos at the 4th annual Hollywood Bowl event.

HOLLYWOOD BOWL

On August 19th, the Viterbi School hosted its fourth annual "Evening at the Hollywood Bowl." Prior to the concert, 125 alumni and friends of the School gathered at the Bowl's Museum Garden for a reception and dinner. They were treated to a presentation by USC band director Dr. Art Bartner before enjoying the "Tchaikovsky Spectacular" with a special appearance by the Trojan Marching Band.

USC alumni (left to right) Michael Fay, Eric Stratmoen, Nate Barrett and Justin Wong celebrate Trojan football at the first ever Viterbi tailgater.

TAILGATE SERIES

The Viterbi School launched its first-ever pre-game tailgate series this fall. Alumni, parents, students, faculty and staff returned to the engineering quad each Saturday prior to a home football game to celebrate Trojan football. Guests feasted on hot dogs, chili, French fries and beer while keeping up with college football scores on flat-screen televisions.

Dean Yortsos handing Chairman Fu of CNOOC some of his old homework from his days as a student at USC.

TRAVELS WITH THE DEAN

At the beginning of November, shortly after the announcement establishing the new USC U.S.-China Institute, Dean Yannis Yortsos and a group of USC deans and other leaders, visited China. Yortsos visited the campuses of two top Chinese universities, Peking University, sometimes called the Harvard of China, and Tsinghua University, sometimes called the MIT of China, to explore possible academic collaborations and/or student exchanges. He also met with alumnus Chengyu Fu (MSPTE '86) who is chairman and CEO of the China National Offshore Oil Corporation. Fu expressed his support for the USC U.S.-China Institute saying it will help correct misperceptions about the U.S. and China that exist in both countries. During the visit, Yortsos presented Fu with an old homework paper to remind him of his days as a USC student.

Dean Yortsos at Peking University's old Beida Gate, Beijing, China.

Viterbi parents Randy and Yvette Royce, Dean Yortsos and William Likens (MSSM '84) enjoy the Computer History Museum at the Bay Area Weekender.

BAY AREA WEEKENDER

On November 3rd over 100 alumni, parents and board members came together for the annual Northern California Weekender the night before the USC vs. Stanford game. Held at the Computer History Museum in Mountain View, alumni and friends had the opportunity to tour the museum and network with other Viterbi engineers. Dean Yortsos was also in attendance and gave a short overview about the School. The Trojans went on to squash The Cardinal 42-0 the next day.

Vanessa Martinez (BSEE '95) and her family celebrate Homecoming at the Viterbi picnic.

Alumnus Richard Wood (MSEE '62) and his wife Marilyn enjoy the evening at the Viterbi Homecoming picnic.

HOMECOMING

Over 400 alumni and friends came back to campus on November 11th for the annual Viterbi School Homecoming Picnic. Guests mingled with other alumni and friends while enjoying delicious barbeque and drinks. The popular raffle was a success with one lucky alumnus taking home the grand prize of a signed Matt Leinart football jersey. The Viterbi spirit carried over to the football game where the Trojans went on to beat the Oregon Ducks 35-10.

Viterbi Storybook

Submitted by:

Robin Underwood Doty (MSENVE '90, MBA '01)

"My fondest memory was my study groups. They were so diversified and I believe not only was I the only female, but the only student from America. After studying for finals, because I shared all my notes, and was able to get a few past exams, the group bought me a Chinese tea set. I still have it and will cherish it forever. I also miss my favorite professors Dr. Devinny and Dr. Pirbazari! I work at the USC Marshall School of Business now, but a piece of my heart will always remain at Viterbi!"

Visit http://viterbi.usc.edu/alumni/storybook/ to add your favorite memory today!

Alumni news & notes

Fall 2006

1952

Herbert W. Hoeptner, Jr. (BSAE) spent his pre-college years working on the ranch to round up, inoculate and brand cattle while also breaking wild horses. He served 3 1/2 years in the Army Air Corps and then received an AA in Math & Physics from LA City College. In 1950, he transferred to USC where he joined Phi Delta Theta fraternity and received a BS degree in mechanical engineering-aeronautical sequence. After graduating, he worked in the aerospace industry for the 16 years, during which time he was awarded three US patents. In later years, he joined the US Masters Swimming organization and during his competition in 1992, at the age of 70, he was ranked third in the world in his age group for the 1500 meter freestyle swim. Married in 1951, he and his wife enjoy spending time with their three sons and extended family.

1971

Michael Martorano (MSEE) is the Navy Aegis Ballistic Missile Defense Program Manager/Lead Test Engineer at the Naval Air Warfare Center, Pt Mugu, California.

1982

John Latas (BSISE) is a Captain on the Hawker 400XP business jet for Netjets, Inc. He lives in Cape Coral, Fla., with his wife Kristen.

1984

Stephen Monarque (BSME) worked as a nuclear engineer at Mare Island Naval Shipyard in the San Francisco area from 1987 to 1994. Later he became an environmental engineer for the Marine Corps base in Barstow, CA. During this period he obtained his professional engineering license in mechanical engineering. Since 2000, he has been working as a project engineer for the U.S. Nuclear Regulatory Commission in Washington D.C.

1990

Shannon (Davis) Clark (BSAE) and her husband Al Clark are pleased to announce the birth of twin daughters Alison Rose and Sarah Louise, on May 13, 2005. They join sister Emily Michelle.

1991

Judith Redpath (BSAE) and her husband Steven Redpath are happy to announce the birth of a son, Etienne Francis, born June 4, 2006. Etienne joins big sister Veronica and big brother Carlton.

1996

Hamad Mubarak Buamim (BSEE) was appointed as deputy director general of the Dubai Chamber of Commerce & Industry (DCCI). He was previously secretary general of the Dubai Council for Economic Affairs and was senior commercial manager at HSBC Bank from 2002 to 2004. He also served as a lecturer at the College of Business and Economics at UAE University from 1999 to 2002.

1997

Captain Aaron A. Tucker (BSAE) recently graduated from the U.S. Air Force Test Pilot School at Edwards Air Force Base. Students who are selected to attend this highly competitive school consider it an honor to be a graduate of the training. Graduates serve on active flying-duty status in support of important Air Force flight-test programs. During the 11-month course, Tucker received training in a variety of aircraft, including the T-38 Talon, F-15 Strike Eagle and the F-16 Fighting Falcon. The training is designed to educate pilots, navigators and engineers to fully test and evaluate aerospace vehicles and their systems.

1998

Carlos Garcia (MSCE) married fellow USC graduate Jacqueline Hernandez Garcia on April 29, 1997 and they had their first child, Carlos Jose Garcia, III, on April 21, 2004. They just moved to Oceanside, CA. Carlos has been working in the construction industry since 1998 for various top ten building companies, and has been at Richmond American Homes, Inc. in San Marcos, since October 2004.

Publish your class notes on-line!!! Share your news and photos with the USC Viterbi community.
Visit http://viterbi.usc.edu/alumni/classnotes/ and fill us in!

2002

Praveen Vettiyattil (MSME) moved to India to teach engineering and business at a leading business school after graduation. During his spare time, he continues with his passion for inventing technologies that make the world a better place to live. He has a patent for a power saving technology in street lighting and has also designed and prototyped a foot powered centrifugal pump that can pump water to a height of 8 meters at 20 liters per minute. His next prototype will be able to pump water to a height of 16 meters at 20 lpm. There is no electricity, no fossil fuel, no operating cost, no sound and no pollution. It is portable and is great exercise. It is as clean, green and healthy as it can get. His marketing slogan is "Don't just workout, pumpout." He has inquiries from water theme parks and the Indian Army and is in the process of redesigning it to suit customer requirements.

To see a video of Praveen on his pump, visit the Viterbi School Online Classnotes.

2005

Jeongmin Ahn (PhD AE) has recently been accepted for a new tenure track faculty position as assistant professor for the School of Mechanical and Materials Engineering at Washington State University.

Anita Sengupta (PhD AE, MSAE '00) was selected as the recipient of the 2006 Woman Engineer of the Year Award by the ASEI — American Society of Engineers of Indian Origin, for her accomplishments in developing propulsion technologies for space missions at NASA's Jet Propulsion Laboratory.

Swaminathan Balakrishnan (MSEE) is working as an RF Systems design engineer with Sprint Nextel in Kansas City.

In Memoriam

John Joseph Curley II (MSEE '66), 71, a resident of Chelmsford who worked at Raytheon Co. for more than two decades, died September 23, 2006. He and his wife Shirley would have celebrated their 49th wedding anniversary on Nov. 9.

Born in Portland, Maine, Nov. 28, 1934, John earned his bachelor's degree in electrical engineering from the University of Maine at Orono in 1960, and a master's degree in electrical engineering from USC in 1966. John retired in 1994, following a 27-year career as an electrical engineer at Raytheon Co. He was the author of numerous technical papers and was granted several patents.

John loved the outdoors — camping, boating and spending time at his lake house in Naples, Maine. His favorite place to be was where he was surrounded by his family, children and grandchildren.

Colonel William H. Goodwin (MSME '58), U.S. Army (retired) of Fort Collins, passed away on August 3, 2006 at the age of 81. Born in 1925 in Richmond, Va., he grew up active in sports and Boy Scouts, rising to the rank of Eagle Scout. He left home early to attend secondary school and college, eventually graduating from the U.S. Military Academy at West Point in 1949. He was commissioned as a 2nd Lt. in the U.S. Army Field Artillery with his first assignment in postwar Germany. As an ROTC instructor at Purdue University, he met and married Susan Riggs in 1954. He was actively involved in the Army's early missile development programs at sites in Texas, New Mexico and Canada. He attended the Defense Language Institute in Monterey, Calif. where he became fluent in Thai and subsequently served as an advisor to the Royal Thai Army in northern Thailand. In 1963, he served at the Pentagon in Washington, DC.

In 1967, he returned to Germany to command the 41st Artillery Pershing Missile Battalion in Schwabisch Gmund. From there, he served in foreign military assistance commands, first in Bangkok, Thailand, and then in Taipei, Taiwan. He returned to the U.S. in 1975 to command the Headquarters Battalion, Fort Jackson, S.C.

Colonel Goodwin retired from the Army in 1977 and began work as a hospital facilities services manager first at Children's Hospital, Denver, and later at Poudre Valley Hospital in Fort Collins. He retired in 1991 and remained in Fort Collins enjoying golf, sports, travel, family and grandchildren. He is survived by his wife, Susan Goodwin, his sons and grandchildren.

George A. Naumann (BSISE '53) died September 4, 2006 at age 77. He was born Oct. 9, 1928, in Los Angeles. He served in the Coast Guard before graduating from the USC. He was a manufacturing manager in Pennsylvania before moving in 1981 to Portland, where he was a self-employed consultant. In 1953, he married Maureen Day. Survivors include his wife, daughter and one grandchild.

Special Announcement

Support for Graduate Students

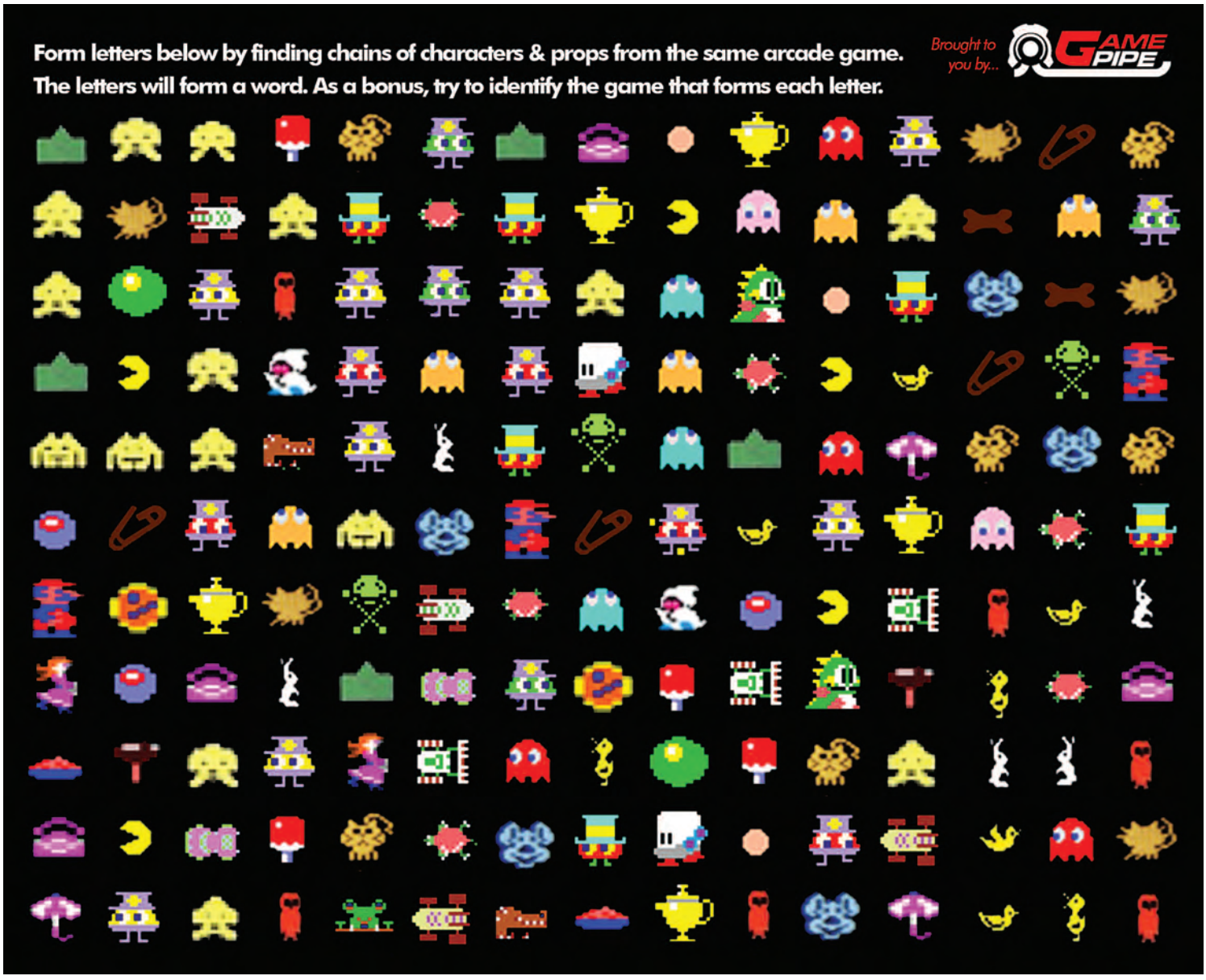
The Viterbi School is pleased to announce the launch of the new Office of Master's and Professional Programs (MAPP), designed to provide service and support to current and prospective engineering graduate students. Please visit us in Olin Hall of Engineering (OHE 106) or call 213/740-4488 for more information.

The MAPP office invites current engineering students and alumni to submit a short paragraph about your positive experience at the Viterbi School. If yours is selected, your photo and testimonial may appear on the Viterbi website or in recruitment brochures.

Contact us at viterbi.masters@ usc.edu or 213/821-1553 for details.

Puzzling with Gamepipe

Introducing the first Viterbi School Puzzler! Be the first to solve the puzzle below and win a USC Viterbi School license plate holder. Simply follow the instructions below and email your answer to viterbi.alumni@usc.edu. The answer and winner will be posted in the next edition of *USC Viterbi Engineer.*



Created by Viterbi School student Pamela Fox (MSCS '07)

The mission of the Game Pipe Laboratory is interdisciplinary research, development and education on technologies and design for the future of interactive games and their application. This ranges from developing the supporting technologies for increasing the complexity and innovation in produced games, to developing serious and entertainment games for government and corporate sponsors. GamePipe has two degree programs, the Bachelors in Computer Science (Games) and the Masters in Computer Science (Game Development). To learn more about GamePipe visit: http://gamepipe.usc.edu/

Some Important Numbers* for the Viterbi School

1011000010 1 *Average SAT scores of incoming students — an all-time record at USC*

110010 1 *Years of engineering education at USC*

11010 *Viterbi School faculty members in the National Academy of Engineering*

1001 *Rank of Viterbi School graduate programs among engineering schools in the nation*

1 *Number of gifts you can make each year to ensure excellence at your alma mater*

Of all the important numbers to the Viterbi School of Engineering, there is none more important than 1 — the number of gifts you can make each year in support of engineering excellence at USC.

As we cement our place among the elite schools of engineering in the nation, we need the continued financial support of our alumni and friends to attract world-class faculty and students, and to provide them with state of the art classrooms, labs and equipment.

Your annual gift to the Viterbi School is a tangible investment in engineering excellence at USC and makes a powerful statement about your pride as a Trojan engineer. The prestige and reputation of the Viterbi School rises with the percentage of alumni who give on an annual basis.

You can do your part, and accomplish all of this with just 1 gift.

**In binary notation*

Please contact Matt Bates today at
213/821-2730 or via email at
matthew.bates@usc.edu.

USC **Viterbi**
School of Engineering

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USC Viterbi School of Engineering

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Communications
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Email: viterbi.communications@usc.edu

Corporate Relations
http://viterbi.usc.edu/giving/corp_relations/
Email: corpeng@usc.edu

Development
http://viterbi.usc.edu/giving/

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213/740-4530
Email: Viterbi.studentservices@usc.edu

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http://viterbi.usc.edu/careers/
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Center for Engineering Diversity
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Ronald Tutor Hall 210
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OFFICE OF MASTER'S AND PROFESSIONAL PROGRAMS
http://viterbi.usc.edu/
Olin Hall 106
213/740-4488
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Distance Education Network
http://den.usc.edu/
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OFFICE OF DOCTORAL PROGRAMS
http://viterbi.usc.edu/
Olin Hall 332
213/740-6241
Email: egradaff@usc.edu

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Aerospace and Mechanical Engineering
http://ame-www.usc.edu/
Aerospace
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