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USC Viterbi // Engineer

THE CHANGING FACE OF ENGINEERING

ROMANCING KIDS WITH ROBOTS // MANY LIVES OF ENGINEERS
THE WiSE WOMEN OF ENGINEERING

USC Viterbi // Engineer

FALL 2011

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FALL 2011

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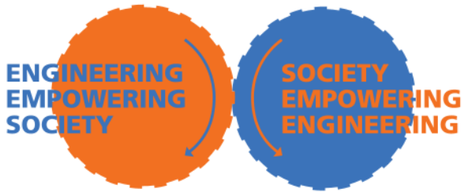
The Changing Face of Engineering

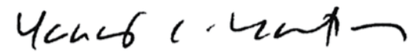
We live in an unprecedented era. In his address at the USC-hosted National Summit on the Engineering Grand Challenges last October, President Chuck Vest of the National Academy of Engineering called it "the most exciting era for engineering and science in human history." The noted computer scientist and futurist Ray Kurzweil attributes it to the exponential pace of technology, whether info-, nano- or bio, which, fueled by Moore's Law is leading to startling discoveries. We witness a powerful new phase, where engineering in its broad sense—tools and devices, thinking methodologies and ways of solving problems under constraints, whether political, social, financial or environmental—has become a true enabler of other disciplines and the key to innovation and economic prosperity of the nations. We have coined a phrase for it: **engineering empowering society.** But more remarkably, and in a wonderful, virtuous feedback loop, we can also claim: **society is empowering engineering.** Through open collaboration, the instant diffusion of information, the democratization of knowledge and the distribution of innovation power across the world, society participates in discovery and innovation as never before. I use the simple schematic below to illustrate the point. Setting this circle in motion and cranking it at increasing speeds will most certainly dictate our economic future and our well-being as a nation.



Inexorably, therefore, the new phase of engineering is leading to a new face of engineering: naturally, spontaneously, irreversibly. Today's engineering is not your father's engineering—more than ever before it relies on the creation of new intellectual property for challenges and opportunities which are global, and have a strong societal importance. Consider the NAE Grand Challenges, of which our own Viterbi School has been a strong advocate. Summarized in the four general categories of sustainability, security, health and the joy of living, almost all address societal and global issues. Meeting them will not be only an inspiration for technologists. It will motivate and attract younger generations of innovators, across the human spectrum. Indeed, the new face of engineering is not that of "Dilbert" in the cartoons. It is the face of bright women and men, spanning societal, racial and ethnic divides. Technology has demolished barriers to access; it has empowered society. And innovation flourishes—it empowers engineering when diverse ideas and disruptive concepts spring about from a wide spectrum of talented hearts and minds. In this view, therefore, diversity is not a political slogan, it is an essential ingredient. The chain of innovation, from seeding new research in disruptive technologies, to creation of start-ups, to the development and mentoring of the talent needed, must be continuous, dynamic and well-oiled.

I have good news in this area, at least from my own school. The face of USC engineering is that of very bright and multi-talented kids, more than one-third of whom at the undergraduate level are women; more than 15 percent from under-represented groups. I am also very pleased to say that with the help of programs such as WiSE (Women in Science and Engineering) at USC, the number of our female faculty has grown by a factor of seven in the last 10 years. While the same cannot be said of the national average, which for undergraduate engineering women has hovered around 18 percent, the realization is urgently emerging of the need to engage all of our talent pool. Only this will successfully power the circle of innovation and economic prosperity into a vibrant motion. It is only our future that depends on it.

The changing phase of engineering, the changing face of engineering: entangled and self-enforcing.



Yannis C. Yortsos
Dean, USC Viterbi School of Engineering

Restoring Memory, Repairing Damaged Brains

BIOMEDICAL ENGINEERS ANALYZE—AND DUPLICATE—THE NEURAL MECHANISM OF LEARNING IN RATS


Theodore Berger

Scientists have developed a way to turn memories on and off—literally with the flip of a switch.

Using an electronic system that duplicates the neural signals associated with memory, they managed to replicate the brain function in rats associated with long-term learned behavior, even when the rats had been drugged to forget.

"Flip the switch on, and the rats remember. Flip it off, and the rats forget," said Theodore Berger of the USC Viterbi School of Engineering's Department of Biomedical Engineering.

Berger is the lead author of a recent article in the *Journal of Neural Engineering*. His team worked with scientists from Wake Forest University in the study, building on recent advances in our understanding of the brain area known as the hippocampus and its role in learning.

In the experiment, the researchers had rats learn a task, pressing one lever rather than another to receive a reward. Using embedded electrical probes, the experimental research team, led by Sam A. Deadwyler of the Wake Forest Department of Physiology and Pharmacology, recorded changes in the rat's brain activity between the two major internal divisions of the hippocampus, known as subregions CA3 and CA1. During the learning process, the hippocampus converts short-term memory into long-term memory, the researchers prior work has shown.

"No hippocampus," says Berger, "no long-term memory, but still short-term memory." CA3 and CA1 interact to create long-term memory, prior research has shown.

In a dramatic demonstration, the experimenters blocked the normal neural interactions between the two areas using pharmacological agents. The previously trained rats then no longer displayed the long-term learned behavior.

"The rats still showed that they knew 'when you press left first, then press right next time, and vice-versa,'" Berger said. "And they still knew in general to press levers for water, but they could only remember whether they had pressed left or right for 5-10 seconds."

Using a model created by the prosthetics research team led by Berger, the teams then went further and developed an artificial hippocampal system that could duplicate the pattern of interaction between CA3-CA1 interactions.

Long-term memory capability returned to the pharmacologically blocked rats when the team activated the electronic device programmed to duplicate the memory-encoding function.

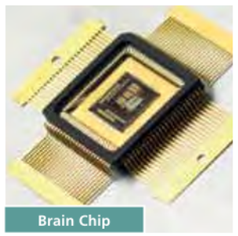
In addition, the researchers went on to show that if a prosthetic device and its associated electrodes were implanted in animals with a normal, functioning hippocampus, the device could actually strengthen the memory being generated internally in the brain and enhance the memory capability of normal rats.

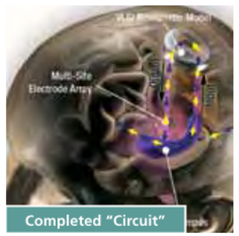
"These integrated experimental modeling studies show for the first time that with sufficient information about the neural coding of memories, a neural prosthesis capable of real-time identification and manipulation of the encoding process can restore and even enhance cognitive mnemonic processes," says the paper.

Next steps, according to Berger and Deadwyler, will be attempts to duplicate the rat results in primates (monkeys), with the aim of eventually creating prostheses that might help the human victims of Alzheimer's disease, stroke or injury recover function.

The paper is entitled "A Cortical Neural Prosthesis for Restoring and Enhancing Memory." Besides Deadwyler and Berger, the other authors are, from USC, BME Professor Vasilis Z. Marmarelis and Research Assistant Professor Dong Song, and from Wake Forest, Associate Professor Robert E. Hampson and Post-Doctoral Fellow Anushka Goonawardena.

Berger, who holds the David Packard Chair in Engineering, is the director of the USC Center for Neural Engineering. //


Brain Chip



Completed "Circuit"


Hippocampus

MIT's TR35 List: Viterbi Adds Two More Faces

USC ONE OF ONLY TWO UNIVERSITIES IN THE WORLD WITH MULTIPLE NAMES AMONG WORLD'S TOP INNOVATORS


Jernej Barbic


Bhaskar Krishnamachari

USC Viterbi School of Engineering faculty members Jernej Barbič and Bhaskar Krishnamachari have been named among the world's top innovators under the age of 35 by *Technology Review* magazine.

The publication listed 35 scholars working in energy, medicine, computing, communications, nanotechnology and other emerging fields. In a global list that includes Yahoo!, Microsoft and Groupon, only USC, Stanford University and IBM have two honorees.

The honor previously went to USC faculty members Michelle Povinelli (2010), Andrea Armani and Ellis Meng (2009).

Barbič, an assistant professor of computer science, was selected for developing a way for computer simulations to run in real time. Krishnamachari, an associate professor of electrical engineering systems, was selected for his work on algorithms for next-generation wireless networks.

Both professors were chosen by a panel of judges and the editorial staff of the magazine, which evaluated more than 300 nominations.

"Technology innovation is key to driving growth and progress in the areas of research, medicine, business and economics," said Jason Pontin, editor-in-chief and publisher of *Technology Review*. "This year's group of recipients is driving the next wave of transformative technology and making an impact on the way we live, work and interact."

In his computer graphics research at USC, Barbič is tackling interdisciplinary problems in animation, simulation and haptics (the study of the sense of touch). His overarching scientific goal is "to approximate complex physical systems with simpler, yet principled models, for interactive simulation and control in computer graphics and engineering."

Speedier modeling and control are aimed at enabling more immersive medical training, more entertaining computer games, and faster and more reliable computer-aided design and computer-aided manufacturing.

Krishnamachari's research focuses on designing algorithms for next-generation wireless networks to improve their efficiency and to enable their use in new applications such as in smart buildings and vehicular networks.

"Increasingly, wireless networks form the main fabric of communication that weaves together human interactions with each other and with the environment," Krishnamachari said. "As a society, we are starting to rely on omnipresent wireless connectivity not only for voice communications and entertainment, but also in other settings such as industrial sensing, smart buildings and intelligent vehicles."

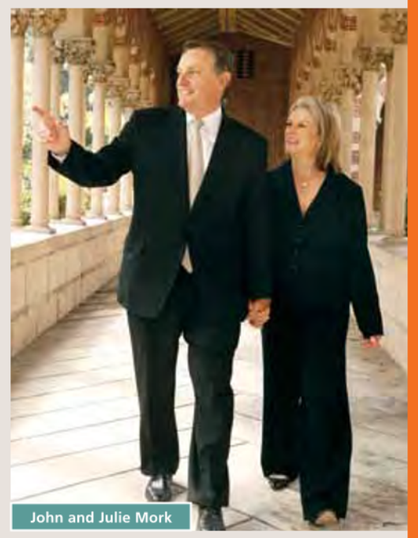
The USC faculty members will discuss their achievements with other honorees in Cambridge, Mass., on Oct. 18-19. This year's TR35 winners also will be featured in the September/October issue of *Technology Review*. //

MORK FAMILY GIVES HISTORIC GIFT OF $110 MILLION TO UNDERGRADUATE SCHOLARSHIPS

USC has received $110 million—the single largest gift in the university's history for undergraduate scholarships and one of only seven gifts to USC of $100 million or more - from USC supporters and devoted philanthropists Julie and John Mork (BSPE '70).

"The gift forever changes the educational landscape at USC and will help us attract the most talented and deserving students," said president C.L. Max Nikias.

The gift to create the USC Mork Family Scholars Program will support undergraduates on full tuition, four-year scholarships with additional $5,000 living stipends per year. This comes five years after the Mork family contributed $15 million to the USC Viterbi School of Engineering that resulted in the naming of the Department of Chemical Engineering and Materials Science after the Mork family. //


John and Julie Mork

Two Viterbi Faculty Win MURI Awards

TWO PROFESSORS RECEIVE HIGHLY COMPETITIVE AND SOUGHT-AFTER FIVE-YEAR GRANTS FOR INTERDISCIPLINARY BASIC RESEARCH

Daniel Lidar and Milind Tambe both won Department of Defense Multidisciplinary Research Initiative (MURI) support to lead multi-institutional efforts in their respective fields. USC joined M.I.T. and Stanford in the elite lineup of institutions receiving two 2011 MURIs.

"For the first time, USC has been awarded two grants simultaneously under this very important and prestigious program," said USC Vice President for Research Randolph Hall. "This attests to our growing success as a major research institution, and the work to be supported on game theory and quantum computing will greatly increase our leadership position in these scientific areas."

"This award spotlights two important and long-standing achievements within USC Viterbi—our transformative faculty and our interdisciplinary mission," said Yannis C. Yortsos, dean of USC Viterbi. "Professors Tambe and Lidar epitomize transformative faculty, and the awarding of the MURIs, with focus across the university and across the nation, is a demonstrative endorsement."

After discussions with the Department of Defense and analysis of funding areas, the USC Office of Research Advancement was instrumental in identifying and guiding the principal investigators through the application process, including careful review of grants by editors trained in the sciences.

"In this increasingly competitive funding environment, it's clear that universities need to have a strategic approach to large initiatives such as this one," said Steven Moldin, executive director of the USC Washington, D.C., Office of Research Advancement. "That's the approach we took here, and we are really pleased with our success."

"We are extremely proud of Professor Tambe and Lidar for their successes," said Viterbi School Vice Dean Maja Matarić. "Both have been working on their collaborative, interdisciplinary efforts for some time, bringing relevant faculty investigators together across USC. It is wonderful to see that they have now taken their efforts to the national level, assembling multi-university teams that have each been selected for highly competitive MURI awards. We look forward to their progress on the two innovative research projects." //

MILIND TAMBE

Milind Tambe, a professor in the Department of Computer Science, will direct a six-university initiative building on his successful efforts to make airport operations more secure by making them more unpredictable.

Tambe-led research teams at USC have created an impressive roster of recent projects that law enforcement agencies, including the Los Angeles International Airport, the Transportation Safety Administration, the Federal Air Marshals and most recently the U.S. Coast Guard now employ. These make it impossible for observers to detect patterns in the activity of patrol units, while still maintaining high standards of coverage.

The focus of the new five-year effort, "Scalable, Stochastic and Spatiotemporal Game Theory for Real-World Human Adversarial Behavior," will try to expand the field through basic research in the relevant areas of game theory.

The key, says Tambe, is robust mathematics that effectively analyzes not only threats from rational, cooperating, coordinated adversaries, but also threats from scattered hostile groups of competitive rivals with differing agendas. "In Star Trek parlance," wrote the scientist, "we are not facing a Vulcan adversary, but instead a Klingon-Romulan horde."

The theoretical attack will be in three areas—first, to build in bounded adversary irrationality; second, to build in adversary multiplicity of motives and means; and third, to spread the application of these first two elements effectively over space and time.

Rajiv Maheswaran of the Viterbi School's Information Sciences Institute will work on the project. USC will segment the three elements and collaborate with five other schools: UCLA, UC Irvine, Stanford, Duke, and C.S.U. Northridge on the project.

DANIEL LIDAR

Daniel Lidar, a professor in the Ming Hsieh Department of Electrical Engineering and the Department of Chemistry, will be the leader of an advanced effort that will include four other U.S. universities attempting to realize the promise of direct quantum control for quantum systems.

Quantum physics research has revealed a rich but to laymen utterly bewildering universe of interactions between subatomic particles in which the particles affect each other's states. This quantum world is very different from the ordinary classical world to which we have access through our senses.

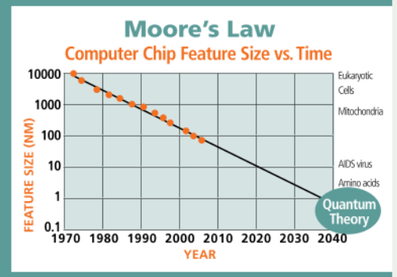
For decades, physicists have proposed—and, increasingly, have demonstrated—that quantum systems can process information. Microscopic quantum systems play a role analogous to transistors on classical computer chips (each of which holds a single bit, or "yes/no" value). Quantum systems could function more quickly and efficiently than any classical system by exploiting quantum effects such as superposition and entanglement. However, quantum systems are also extremely fragile: the slightest stray interaction could completely derail a quantum control process.

The problem, says Lidar, is performing robust quantum control. Numerous physical processes can create or break quantum interactions—but inserting classical intermediaries slows and complicates the system. The ideal is to have the quantum systems control themselves, with the results of quantum processes feeding directly as quantum signals directly back into the system: "coherent feedback control."

This idea has been in circulation for a few years, but the Lidar effort, conducted with seven USC specialists, in addition to faculty at other schools, will make a multi-pronged attack on the problems involving some critical new insights.

One thrust will deal directly with theoretical quantum computing issues, trying to ascertain the feedback ground rules—what theoretically might or definitely would not work for such controls. How can the controls be best fitted to the system that is being controlled?

The problem: these theories are hard to demonstrate in the laboratory. "Experiments on quantum control are in general far behind the theory," says Lidar, "so it would be unrealistic to plan experimental verification of all the theoretical elements we envision within the work's five year time frame."



But the MURI effort will try to bridge the gap. "One of the goals will be…an experiment clearly demonstrating quantum feedback even if imperfect." Another will be "semiconductor systems…showing elements of continuous quantum monitoring, as a first step toward full quantum feedback." These would be the first implementations of quantum feedback in solid-state systems, he says. //

Viterbi Software Will Plot Possibilities for F6 Satellite

ROESLER AND HOCHBAUM WILL WORK WITH LOCKHEED MARTIN ON DARPA'S 'FRACTIONATED' ORBITER

The USC Viterbi School of Engineering has been selected to develop the design software for the F6 satellite.

The F6 is a project of the Defense Advanced Research Projects Agency (DARPA). It is "fractionated"—that is, it is not a single satellite, but a cluster of modules orbiting the earth together. The modules communicate with one another like computers on a network.

The Viterbi School's Information Sciences Institute (ISI) has partnered with the Lockheed Martin Corporation on a 2 ½ year, $5 million effort to develop software to guide directions for designs, missions, and components for its revolutionary concept.

Gordon Roesler, a center director at ISI, is the principal investigator. He says he is no stranger to designing unusual satellites. Years ago, while working at DARPA, he developed a satellite that had robotic arms—a "tow truck in space." Its mission was to move satellites between different orbits to keep them useful longer. It was displayed on the cover of the magazine Aerospace America in 2006.

"The F6 program will lead to a whole new approach to exploring and using space," Roesler said. "Our society gets many benefits from satellites today—GPS, HDTV, Google Earth, weather, climate monitoring. Why can't a satellite be several free-flying modules instead of a single object? It gives more flexibility in how the system is launched into space. It allows you to add functionality any time you want. It lowers costs and makes the system more robust."

The software that will form the core of the F6 design software uses artificial intelligence to sort through the many choices that designers have to make. Its inventor is Tatiana Kichkaylo, a computer scientist at ISI. A specialist in automated planning and scheduling, her work is finding numerous applications in the engineering of very complex systems, like F6.

ISI already conducts both R&D and educational programs on space vehicles. Its Space Engineering Research Center (SERC), co-managed with the Viterbi School Astronautics Department, trains students in the design, assembly and operation of small satellites. The Space Exploration Corporation, or SpaceX, located nearby in Hawthorne, launched one of SERC's satellites, called CAERUS, into space earlier this year. Another SERC satellite will be delivered in December and launched in 2012. One of the SERC graduate students, Lucy Hoag, helped to develop the software. She will be a key player in the F6 project.


Artist's Conception

Co-PI of the F6 team is operations research expert Professor Dorit Hochbaum of the Viterbi School Department of Industrial and Systems Engineering. She will address the optimization of the allocation of the functions to the small satellites. She will study scheduling of the mission launches to minimize costs as well as ways to improve the supply chain and production processes of the satellites. Hochbaum will also conduct fundamental studies of the economics and best approaches for building them.

ISI was awarded a second contract for the F6 program as well, to develop the information architecture that lets the free-flying modules talk to each other. Leader of the F6 architecture project is Joe Touch, an expert in networks and satellite communications who is also a research associate professor in the Viterbi School.

"With USC's expertise and with our team member Lockheed Martin, the F6 team will help DARPA achieve a very challenging schedule to build and launch F6," said Roesler. "It will provide another application for ISI's advanced design software. And there will be new opportunities for students to learn the space business, which is entering a new phase of growth and innovation." //

Interdisciplinary Team Wins Prestigious Coulter Grant

THE FIVE MILLION DOLLAR PROGRAM WILL DEVELOP BIOMEDICAL ENGINEERED SOLUTIONS THAT WILL SAVE, EXTEND, AND IMPROVE PATIENT LIVES

Dr. Norberto Grzywacz

The USC Viterbi School of Engineering, Keck School of Medicine of USC, the USC Stevens Institute for Innovation, and the Los Angeles Basin Clinical Translational Science Institute (CTSI) have been selected to participate in the exclusive Coulter Translational Research Partnership Program.

Announced by the Wallace H. Coulter Foundation, the prestigious program awards pioneering institutions that are fostering tomorrow's translational technologies and innovations in biomedical health care. The Coulter Foundation invited the USC Department of Biomedical Engineering (BME) to apply based on its number of successful applicants to the Coulter Translational Research Awards. After an arduous application process, only six departments of BME from across the country were invited to attend the launch of the program in Las Vegas this past February. Finally, Coulter selected the USC team to participate in the program based on its performance at the launch.

"We are very excited to have you as a partner in this challenging but most rewarding endeavor," read the Coulter announcement, "as we embark together in the journey of accelerating the translation of biomedical innovations to benefit patient care."

For its operations, the program will have $1 million each year for a period of five years, with $667,000 a year from the Coulter Foundation augmented by $333,000 of contributions from the USC Viterbi School of Engineering, the CTSI, and the USC Stevens Institute for Innovation. The Coulter Foundation will form a working partnership with USC to promote translational research. The new program will promote increasing the number of effective collaborations between biomedical engineers and clinicians. The Coulter grant targets and fosters promising technologies that will translate into direct clinical application. The ultimate goal of this partnership is to focus on outcomes that will save, extend, and improve patient lives. The foundation's broad mandate addresses suffering from any disease or condition, in any size market, in any discipline, in any country around the world.

Professor of Medicine, Obstetrics and Gynecology, Associate Dean of Clinical Research at the Keck School of Medicine, and Director of the CTSI, and Krisztina "Z" Holly, Vice Provost for Innovation and Executive Director of the USC Stevens Institute for Innovation. The team also included Dr. Richard Hull, Senior Director for New Ventures and Alliances at the USC Stevens Institute for Innovation.

"This program harnesses critical gap funding, expertise, and focus to move USC's breakthrough biomedical engineering ideas into positive societal impact." said Holly. "We are thrilled to be working with the Coulter Foundation; this partnership is a key new piece of our interdisciplinary approach to innovation here at USC."

Co-PI Buchanan adds, "This is an outstanding opportunity to create the new interdisciplinary research teams to develop new approaches to diagnose and treat human disease. CTSI was designed

> **"We are thrilled to be** working with the Coulter Foundation; this partnership is a key new piece of our interdisciplinary approach to innovation here at USC."

"This award is a testament to the national leadership of our Biomedical Engineering Department in Translational Biomedical Engineering Research," said Yannis C. Yortsos, Dean of the USC Viterbi School of Engineering. "The program will contribute to solving pressing societal health issues. It also fits well with the strategic plan of our BME Department, the Viterbi School of Engineering and complements the university's vision to support interdisciplinary and translational research."

Dr. Norberto Grzywacz, Professor and Chair of the Viterbi School's Department of BME led the collaborative effort as its principal investigator (PI). The co-PIs were Thomas A. Buchanan, MD, to do just that. We are both proud and excited to be part of the USC partnership that won this prestigious award."

The first co-Directors of the Program are Mr. Juan Felipe Vallejo, Director of Innovation Development at the USC Stevens Institute for Innovation, and Ms. Christine Matheson from the CTSI Center for Scientific Translation. The grant will be administered by the USC Viterbi BME Department.

"This important award is another example of the value of the collaboration between our schools," said Keck School of Medicine of USC Dean Carmen A. Puliafito, M.D., M.B.A. "The synergy of ideas made possible by this award has the potential to be of significant benefit to patients." //

Video Game Programs Help Propel USC's #1 Princeton Review Ranking

MIKE ZYDA'S GAMEPIPE LABORATORY COMBINES COMPUTER SCIENCE AND INTERACTIVE MEDIA

USC was voted the #1 game design school in North America for its graduate and undergraduate degree programs by the Princeton Review and GamePro Media for 2011. This distinction was jointly awarded to the School of Cinematic Arts' Interactive Media Division and the Viterbi School of Engineering's Department of Computer Science.

"In the short span of five years since its inception," commented Viterbi Dean Yannis C. Yortsos, "the USC GamePipe program has become the national leader in education and professional game development. It is a testament to the program quality, its leadership and the interdisciplinary strength at USC, which combines computer science, cinematic arts and fine arts in a unique partnership."

The Princeton Review list, "Top Schools for Video Game Design Study for 2011," salutes 30 institutions in all (15 undergraduate and 15 graduate) for their outstanding game design education programs.

The Princeton Review statistics note that 90 students are currently enrolled in the Viterbi program offering an M.S. in computer science with concentration in game development, including multiple courses in areas such as serious games (games meant to teach, rather than to entertain), cognition and games, game infrastructure, and immersive environments. Viterbi also offers B.S. and Ph.D. degrees in the field. Since submission of the figures, the program has grown: more than 125 undergrads are currently in the Viterbi's B.S. in CS/Games degree program; more than 100 are working toward M.S. degrees in CS/Game Development.

The GamePipe program supplements rigorous academic requirements with learn-by-doing efforts by teams, including team members from other schools. "Game development requires design, artistry and engineering—you sew all of those together and you get USC's program," said Michael Zyda, who heads USC's GamePipe Laboratory. "It's the joint nature of the program between Cinematic Arts'

Mike Zyda

Interactive Media Division, GamePipe and the Computer Science Department at the Viterbi that makes it so special."

GamePipe stages two "Demo Days" per year, at the conclusion of fall and spring semesters, events at which Zyda entertains a capacity audience of representatives from the games industry and talent agencies.

Some 70 representatives from companies including Disney Interactive, Sony, LucasArts, MTV Networks, Electronic Arts, Activision, Nokia Research, Zynga, Intel, Mozaic, Applied Minds, Naughtydog, THQ, Aielo, Creative Artists Agency, Blizzard, Zynga, and Happynin Games were on hand. "Every seat a was filled," said Zyda "and we had students sitting in the aisles. I couldn't be happier with the level of innovation displayed with the student projects, and the amount of positive feedback I received from industry execs."

For the reps from Happynin Games, it was a return to the alma mater: the company is a spinoff formed by former USC students.

Even non-alums were enthusiastic. "Pretty much every game we've seen here has been unique," industry executive, Giacomino Veltri told the Los Angeles Daily News. "We talked to some of the students during the lunch break and exchanged information. If they want to do an internship or, if they're graduating, apply for a job, they can."

Demo Day is not the only place that USC games have shone. The 2009 award for "Next Great Mobile Game" went to "Reflection," built by a group of USC students, now being commercially marketed.

""The joy of a professor," commented Zyda at the time, "is to see your students start out from nothing and then get to the point where they are actually doing just phenomenally great work," he said. //

China Meets Taiwan in Viterbi's "No Distance" Classroom

IMAGINE TOP STUDENTS WITH TOP FACULTY—CONNECTED AROUND THE WORLD UNDER VITERBI'S IPODIA TECHNOLOGY. STEPHEN LU ALREADY HAS

Professor Stephen Lu calls it "no distance learning."

This, of course, despite the fact his spring 2011 class used the USC Viterbi Distance Education Network's telepresence capabilities to deliver content to undergraduate students spanning one island, two continents and three globally renowned universities. Lu's iPodia class taught principle and practice of global innovation to students simultaneously in real-time at three prominent engineering schools to unite disparate learning groups in engineering collaboration in a way not previously possible.

Launched and led by Lu in spring 2010 as a joint venture between the USC Viterbi School of Engineering and Peking University (PKU) College of Engineering, iPodia now includes a third partner—National Taiwan University (NTU). Lu is succeeding where politicians have often stumbled bringing together young learners from both China and Taiwan to solve real world problems, while considering ways to explore cultural diversity to improve innovation. USC Viterbi Dean Yannis Yortsos and PKU Engineering Dean Shiyi Chen agree that such education collaboration is both unprecedented and promising.

> **"We bring together** top students from some of the best universities to take on a cutting edge topic taught by the best professor in the subject matter."

"Shiyi's willingness to work with USC is a key enabling factor in iPodia's success," Yortsos recently commented during a visit to PKU's campus. Another key enabler is an anonymous donor, a Taiwanese native with a keen interest in both engineering and improved ties between China and Taiwan. His generous gift of $1 million underwrote start-up and operational costs associated with running the program, delivering the course and hiring teaching assistants.

While in Beijing last May, Yortsos was able to witness firsthand the end of semester project interaction in which USC and NTU students come to PKU to finish their semester-long collaboration—an intense three week in-person innovation lab. Although the NTU students had not yet arrived, the dean witnessed a late night USC-PKU project session held in an off-campus innovation studio setting, an office high-rise adjacent to the PKU campus.

The innovation studio space provided a haven in which student teams were free to innovate outside of traditional engineering classrooms and lab spaces. Twenty USC students were collaborating late into the night with 20 PKU students to create innovative ideas that could improve the lives of college students through novel improvements to various processes governing life on campus. An additional 20 NTU students arrived a few days later to bring the effort to a climactic finish.

"I arrived after 10 p.m. on a Tuesday evening," Yortsos noted, "and it seemed they were just getting started for the evening. The experience seemed to encompass the best features of both a kindergarten and Google—playful and innovative. Student cohorts were brainstorming and writing down their ideas on the studio walls and windows, while they sat on beanbag furniture and shoveled pizza. I have not seen such a burst of creative energy among our young students, except on very rare occasions."

The following day, Yortsos attended a mid-morning iPodia class in PKU's digital education facility. The subject for this session was transforming the current customer needs to the emerging market wants, and Lu was challenging his students from all three schools to "learn to view everything from the viewpoint of the customer, not your own preconceived point of view."

"The concept of iPodia is simple, yet profound," Lu explained. "We bring together top students from some of the best universities to take on a cutting edge topic taught by the best professor in the subject matter. Using telepresence technology we eliminate for the very first time both political borders and physical distance. We also get away from the institutional boundaries between universities and remove the distance that hinders interactive learning among students. It is borderless 'no distance education.'"

Lu acknowledges that he is merely the first professor in what he hopes will be a long line of world-class professors teaching iPodia-style courses. He envisions a coming era in which the best students from a wider set of universities can be brought together by telepresence with the best professor qualified to teach the class with a new pedagogy.

"We are enthusiastic to expand iPodia next year and hope to include the Korea Advanced Institute of Science and Technology (KAIST), Korea's finest engineering school, and Technion, Israel's top engineering school, among a field of other globally renowned universities," Yortsos noted during his visit to PKU.

"Imagine being at USC, one of the world's best engineering schools, but also being able to take classes from some of the world's best professors and learn together with the brightest youngsters at other collaborating iPodia schools worldwide. Then you can grasp the full potential of iPodia and 'no distance learning,'" Lu muses. "This capability is a hallmark of Viterbi's globalization efforts and will definitely assure our engineering students receive the world-class education we promised them." //

Deep Impact

REPORT ON MATERIALS SCIENCE PLACES VITERBI AMONG WORLD'S BEST

According to a recent Thomson-Reuters' study, USC Viterbi's Mork Family Department of Chemical Engineering and Materials Science ranks seventh among global academic institutions in citation impact in materials science research.

The Global Research Report, based on some 11,500 publications from 2001 to 2011, analyzed output, citations, and citation impact of materials science research from countries and institutions around the world. The report reviewed materials science and technology, a core area of research of profound interest in most economies because of its potential contribution to manufacturing processes and innovative products.

Said Steve Nutt, M.C. Gill Professor and Chair, Mork Family Department of Chemical Engineering and Materials Science, "The impact factor is the most important metric of scholarship quality, reflecting the recognition of a group's research in the academic community and the high frequency with which our publications are cited by other groups. USC's materials science program, while small relative other schools, has a disproportionate impact on the community because of the high quality of the research produced here. The top ten ranking in impact is achieved because of the consistently high quality of materials research performed at USC."

TOP 20: RANKING OF INSTITUTES AND UNIVERSITIES FOR MATERIALS SCIENCE RESEARCH*

RANK	INSTITUTION	IMPACT SCORE
1	University of Washington	30.41
2	University of California Santa Barbara	27.41
3	University of California Berkeley	26.58
4	University of Groningen	25.07
5	Harvard University	24.46
6	Massachusetts Institute of Technology	21.61
7	**University of Southern California**	**21.11**
8	University of California Los Angeles	19.23
9	Stanford University	18.34
10	University of Minnesota	17.35
11	Max Planck Society, Germany	17.31
12	Georgia Institute of Technology	17.02
13	Northwestern University, USA	16.39
14	Cornell University	16.06
15	University of Michigan	15.70
16	University of Massachusetts	15.62
17	Drexel University	15.53
18	Eindhoven University of Technology	15.29
19	University Pierre & Marie Curie	14.96
20	Rensselaer Polytechnic Institute	14.71

**Indexed in Web of Science, 2001-2011 by Thomson Reuters*

Faculty Accolades

AWARDS AND ACHIEVEMENTS


Murali Annavaram


Maged Dessouky


Alex Dimakis


Martin Eskijian


Leana Golubchik


Norberto Grzywacz


Malancha Gupta

Murali Annavaram of the Ming Hsieh Department of Electrical Engineering (EE) received the USC Stevens Institute's Innovation Inside Curriculum Award for his new graduate course in energy efficiency and reliability in cloud computing.

Maged Dessouky of the Daniel J. Epstein Department of Industrial and Systems Engineering (ISE) received the Orange County Engineering Council's Distinguished Engineering Educator Award, for promoting student excellence in industry.

Alex Dimakis of EE received a five-year NSF CAREER Award for research in novel use of network coding for significantly improved reliability and cost of modern distributed cloud storage systems.

Martin Eskijian of the Sonny Astani Department of Civil and Environmental Engineering (CEE), received the 2011 Charles Martin Duke Lifeline Earthquake Engineering Award from the American Society of Civil Engineers.

The Women's Transportation Seminar (WTS) has named **Leana Golubchik** of the Computer Science Department (CS) and EE its 2011 Diversity Leadership Award winner.

Neuroscientist and chair of the Department of Biomedical Engineering (BME) **Norberto Grzywacz** was elected secretary of the Council of Chairs of BME and Bioengineering. The top-ranked organization convenes to discuss problems of undergraduate administration and to lobby for the two burgeoning fields.

Malancha Gupta of the Mork Family Department of Chemical Engineering and Materials Science (CHEMS), was awarded a three-year NSF Innovation grant.

Andrea Hodge of the Department of Aerospace and Mechanical Engineering (AME), was awarded a three-year Alexander Humboldt Foundation Research Fellowship. Hodge's research in nanomaterials will be carried out at the Institute of Nanotechnology at the Karlsruhe Institute of Technology in Germany.

Kai Hwang of EE and CS won the 2011 Founders Award of the International Parallel and Distributed Processing Symposium.

Bhaskar Krishnamachari of EE and CS received the 2010 Eta Kappa Nu Outstanding Young Electrical and Computer Engineer Award.

Jay Kuo of EE and CS was appointed editor-in-chief of the Institute of Electrical and Electronics Engineers Transactions on Information Forensic and Security for 2012-2014.

Terence Langdon of AME was elected a Fellow of the Materials Research Society. Langdon also received the NanoSPD Achievement Award at the 5th International Conference on Nanomaterials by Severe Plastic Deformation.

EE's **Daniel Lidar**, also of the USC Dornsife College chemistry faculty, was elected vice-chair of the American Physical Society's Topical Group on Quantum Information.

The International Council on Systems Engineering presented its top Pioneer Award to ISE's **Azad Madni**, for his critical work to advance the ISE theory, tools, and products required for the future of the profession.


Andrea Hodge


Kai Hwang


Bhaskar Krishnamachari


Jay Kuo


Terence Langdon


Daniel Lidar

Media commentary on nuclear safety was provided by **Najmedin Meshkati** (CEE and ISE) nearly 24 times during the aftermath of the Japan earthquake and nuclear disaster. Meshkati was also a key NAE-committee examiner analyzing causes of the Deepwater Horizon oil spill.

Renowned wireless theorist and EE Professor **Andreas Molisch** was elected to the Austrian Academy of Sciences, was named co-recipient of IEEE's Donald G. Fink Prize Paper Award, and was selected winner of the James Evans Avant Garde Award of the IEEE Vehicular Technology Society.

Vice Dean and ISE Professor **James E. Moore, II,** and ISE colleague **Maged Dessouky,** are both executive board members of METRANS Transportation Center, the USC/Cal State Long Beach collaborative that was named 2011 Organization of the Year by the California Transportation Foundation.

Donald Paul, executive director of the USC Energy Institute, and research professor of engineering, earth sciences and policy, planning and development, was named winner of the Society of Petroleum Engineer's 2011 Management and Information Award, a top international honor.

The Vietnam Education Foundation named **Cyrus Shahabi** of CS a visiting Faculty Scholar for 2011-2012. Grantees will engage in academic activities in Vietnam, and are considered ambassadors who will "represent with pride" their country and culture.

John Brooks Slaughter of EE and the Rossier School received an honorary doctorate from Howard University, bringing his total of such degrees to nearly 30.

Milind Tambe of CS and ISE won the David Rist Prize of the Military Operations Research Society, his third honor this year. Members of Tambe's TEAMCORE Research Group and members of USC Viterbi's National Center for Risk and Economic Analysis of Terrorist Events also received a best paper award for their Game-Theoretic Unpredictable and Randomly Deployed Security system.

Costas Synolakis, civil engineering professor and director of the USC Tsunami Research Center, has been a vital presence in the media following the natural disasters in Japan and around the globe. He has covered topics in tsunami causes and prediction, tools and improved warning systems, and overall characteristics and impact of tsunamis.

Theodore Tsotsis was named recipient of the 2011 President's Award of the Orange County Engineering Council. His efforts have led to many student-driven scientific achievements with industry applications.

Michael S. Waterman of USC Dornsife College and CS, known for his work on the Human Genome Project, received an honorary doctorate from Tel Aviv University.

Internationally acclaimed optics and photonics innovator **Alan Willner** of EE received the 2011 IEEE Photonics Society's (IPS) Engineering Achievement Award.

Dean Yannis Yortsos was elected an honorary member of the Society of Petroleum Engineers, the highest international acknowledgement of a select group of its members. Yortsos was also appointed to a two-year term on the Engineering Deans Council (EDC) Executive Board of the American Association for Engineering Education.


Azad Madni


Najmedin Meshkati


Andreas Molisch


James E. Moore, II


Donald Paul


Cyrus Shahabi


John Brooks Slaughter


Milind Tambe


Costas Synolakis


Theodore Tsotsis


Michael S. Waterman


Alan Willner


Dean Yannis Yortsos

ON CAMPUS

Adventure Is, Indeed, UP There

TEAM FROM USC WINS $3,000 IN DISNEY DESIGN COMPETITION.

Jannae Fong remembers the first time she saw the castle.

A princess lives there, she said to herself. Fong was only three years old then, but she was a fairly good judge of princess castles. She wanted to live in one herself, and Disneyland Park's "Sleeping Beauty Castle"—all 77 feet of it at the heart of Main Street, U.S.A.—did not disappoint.

Today, the 20-year-old Fong just wants to design the places that enchanted her three-year-old self, except as a Disney Imagineer.

Last June, Fong and her fellow USC students, Molly Martens and Joe Rothenberg made a good start of it, winning the 2011 Disney ImagiNations competition with their vision for Disneyland Shanghai: "Adventure is UP There." Their winning design, a balloon cart ride through the jungles of South America, inspired by the 2009 Disney Pixar smash "Up", bested some 500 college students for the $3000 grand prize in the prestigious design competition.

The three seniors—Fong and Martens of Viterbi Aerospace and Mechanical Engineering and Rothenberg of USC's John C. Hench Division of Animation and Digital Arts—joined forces to create a ride "with the flying elements of 'Peter Pan' and the experience and adventure of 'Indiana Jones.'" Macaroni and cheese-fueled brainstorming sessions at Rothenberg's apartment followed, with Fong and Martens describing the look and technology, and Rothenberg furiously sketching the ideas in real time.

An elephant graveyard ride from "The Lion King" was briefly considered and abandoned. Finally, after a deep video reconnaissance of the Disney library, "Up" was seized upon as the perfect blend of immersive storytelling—from the perspective of Junior Wilderness Explorer, Russell—and technology—a swiveling robotic arm plunges the audiences through canyons and into the mist and foliage of the jungle itself. The ride enlists the audience on a rescue mission of one of the film's popular characters, a flightless bird named "Kevin", culminating in a lightning streaked showdown with a zeppelin and dog fighter planes.

Martens spent her spring semester abroad in Singapore and drew extensively from conversations with her Chinese roommates, seeking to blend Chinese tradition with Pixar fantasy.

Said Martens, "We looked at luck numbers, like the number eight; we tried to find ways to incorporate that into the attraction. We also played with the five Chinese natural elements—earth, fire, wood, water and metal."

From initial concept meetings in September 2010 to their final presentation to over 100 Walt Disney Imagineers in Glendale last June, the team's adventure-based ride was possibly only rivaled by the adventure of the planning itself. It was the exhaustion of late nights making a conceptual scrapbook—similar to the one in the movie—erupting into impromptu sing-a-longs from "Mary Poppins" and "The Lion King." It was four research visits to Disneyland, as Fong said, "just to try and figure out how they designed everything."

But mainly, it was the memory of standing in the blazing, hot sun, dressed in their best clothes, watching a limousine sliding down Figueroa Street.

Fong, Martens and Rothenberg were feeling hot and foolish. They had been waiting and waiting, clutching their luggage. Waiting for a shuttle or a taxi to take them to the most important five-day interview of their lives.

A limo is not an uncommon sight in Southern California. Surely, Martens thought, this was not for them.

Finally, the driver's window came down. "Are you with Disney ImagiNations?"

There was no balloon ride to Paradise Falls, but in the manner of all adventures, theirs now had a first act. //

Disney ImagiNations 2011 winners: from left to right, USC seniors Molly Martens (Viterbi Aerospace and Mechanical Engineering), Joe Rothenberg (John C. Hench Division of Animation and Digital Arts) and Jannae Fong (Aerospace and Mechanical Engineering).

33rd Viterbi Awards Banquet Honors Three Extraordinary Trojans

ORNA BERRY, RONALD TUTOR AND CHENGYU FU: A TRINITY OF ENTREPRENEURSHIP WITH ENGINEERING EXCELLENCE

An impressive gathering of the Trojan Family last April 5th honored three extraordinary Trojans—Orna Berry, Ronald N. Tutor and Chengyu Fu—at the 33rd annual Viterbi Awards Banquet.

Hosted by Viterbi School of Engineering dean, Yannis C. Yortsos, in the company of his predecessor, USC President C.L. Max Nikias, the group of more than 300 distinguished well wishers that filled the California Club included senior USC officers and trustees, members of the Viterbi School Board of Councilors and school namesake, Andrew J. Viterbi.

Yortsos explained how "since it began in 1978, this occasion has become our signature annual event, our way to celebrate engineering and to honor outstanding engineers."

The first honoree, computer scientist Orna Berry (Ph.D. '86) stepped onto the stage to receive the Mark A. Stevens Distinguished Alumni Award, named, as Yortsos noted, for "a distinguished engineer, entrepreneur, venture capitalist and USC engineering alumnus."

The awardee brought with her a similar resume, one Yortsos called "astonishing." Berry has been a researcher, inventor, entrepreneur, policy maker, investor, advisor, senior executive, educator and for three years, the first female Chief Scientist of the State of Israel. Co-founder of ORNET Data Communication Technologies Ltd, Berry is now vice president and general manager of EMC Corporation's Center of Excellence.

A widely known and sought-after speaker, she gave an enthusiastic and eloquent acceptance speech. "My business," she declared, "is leveraging human minds." She paid tribute to minds that had leveraged hers: those of her family. Her parents, she said, provided examples of "entrepreneurship and daring, and taught me the importance of doing, and doing with love."

The name of the 2011 recipient of the Daniel J. Epstein Engineering Management Award is written all over the USC campus, at the Viterbi School's Ronald N. Tutor Hall, and at the recently opened Ronald N. Tutor Campus Center. The prize is for leadership in industry and management—and the chairman and CEO of Tutor-Perini Corporation has offered evidence of these skills in his firm's rise to the ranks of the nation's 10 largest infrastructure and private works construction companies.

Tutor, who was also 2010 Walt Disney Man of the Year, said, "This has been a love affair between USC and Ron Tutor for an awful lot of years. I was fortunate enough to work with Dr. (former dean Leonard) Silverman at a time in which we were struggling to get young engineers out of high school into the university."

"The transformation," said Tutor, "has been truly remarkable."

President Nikias presented the evening's third honor, the Global Leadership in Engineering Award, to China National Offshore Oil Corporation President Chengyu Fu, only a few days before the announcement that Fu would be stepping down at CNOOC, which he had quintupled in size during his tenure, to assume the leadership of China Petroleum and Chemical Company—Asia's largest refiner.

Earlier in the day, at a press conference attended by representatives of Agence France Presse, Reuters and other media, Fu paid tribute to some of his Viterbi professors, including Iraj Ershaghi and George Chilingar, plus the late Lyman L. Handy.

TOP: President C.L. Max Nikias, Ron Tutor, Orna Berry, Chengyu Fu and Dean Yannis C. Yortsos together at the 33rd Viterbi Awards. BOTTOM: Over 300 distinguished alumni and guests, including senior USC officers, trustees and school namesake Andrew J. Viterbi, filled the California Club last April.

"I am very thankful to the Viterbi School for honoring and inviting me. With this award the school is honoring all students of international heritage—in this case Chinese, in particular—who have attended USC or are on their way to this world-class institution. I am fortunate to have been a student at USC 27 years ago."

Said Fu, "My education here steered me on to lead CNOOC from a small company into a competitive international energy company. To take those actions requires knowledge and talent, and USC is a place that supplies both." //

Guide Vests—Robotic Navigation Aids for the Visually Impaired

USC ENGINEERS IMPROVING HIGH-TECH HELP FOR BLIND AND PARTIALLY BLIND PEOPLE LONG DEPENDING ON WHITE CANES AS THEIR ONLY AID IN GETTING AROUND. *by Robert Bradford*

For the visually impaired, navigating city streets or neighborhoods has constant challenges. And the reality is that a significant number of such people still must rely on a very rudimentary technology—a simple cane—to help them make their way through a world filled with obstacles.

A group of USC Viterbi School of Engineering researchers is working to change this by developing a robot vision-based mobility aid for the visually impaired. A design first shown a year ago is now being further developed.

For the Viterbi team, the need is clear. According to the World Health Organization, 39 million people worldwide are totally blind and a much larger number, 284 million, are visually impaired. In the United States, according to the American Foundation for the Blind, 109,000 visually impaired people use long white canes to get around. Guide dogs? About 7,000 nationwide.

"There are many limitations to canes for the visually impaired, from low hanging branches to large objects." according to Gérard Medioni, a professor in the Institute for Robotics and Intelligent Systems at USC Viterbi. "We wanted to build an effective system that would provide new opportunities for the visually impaired."

Medioni and his colleagues, including James Weiland, a Viterbi School associate professor of biomedical engineering who is also a professor of ophthalmology at USC's Doheny Eye Institute, and Vivek Pradeep, a recent Viterbi Ph.D who is now at the Applied Sciences Group of Microsoft, have developed software that "sees" the world and linked it to a system that provides tactile messages to alert users about objects in their paths. Pradeep won the 2010 USC Department of Biomedical Engineering Grodins Graduate Research Award and a USC Stevens Institute "most inventive" award for his contributions to the project.

The system uses Simultaneous Localization and Mapping (SLAM) software to build three-dimensional maps of the environment and identify a safe path through obstacles. The route information is conveyed to the user through a guide vest that includes four micro motors located on an individual's shoulder and waist that vibrate like cell phones.

For example, a vibration on the left shoulder indicates a higher object to the left, such as a low-hanging branch, and the individual can in turn use that information to take a new path. Medioni said that canes have clear limitations with larger objects, from walls to concrete structures, and the technology will enable users to avoid falls and injuries.

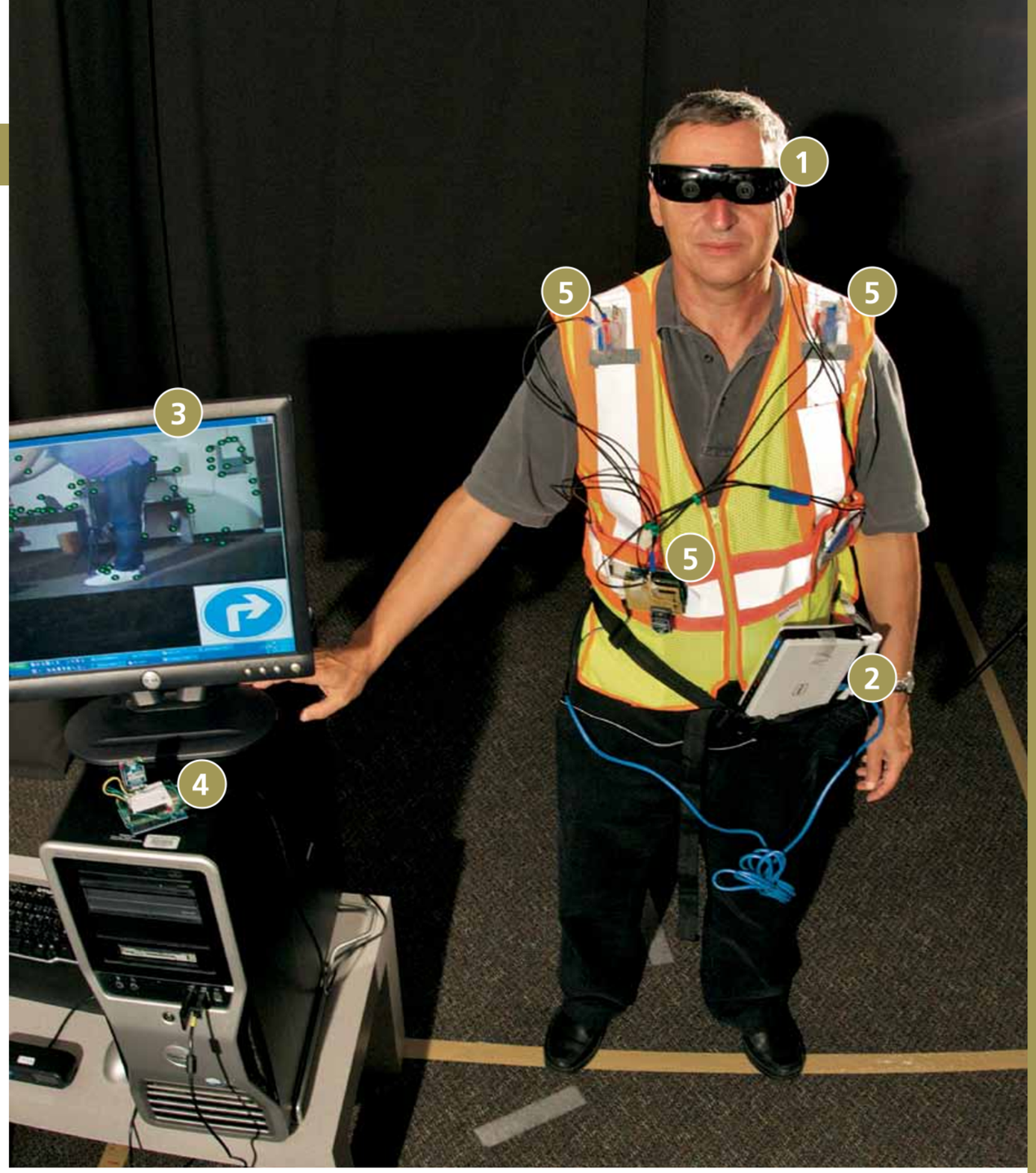
The USC team tested the system on blind subjects at the Braille Institute. The users there "like the system, and they feel it really helps them," Medioni said.

"We greatly appreciate the cooperation and help of the Institute and the test subjects," added Weiland.

Medioni is pleased with the prototype of the system presented at the 2010 International IEEE Engineering in Medicine and Biology Society (EMBS) Conference, and more recently, May 1 at the 2011 meeting of Association for Research in Vision and Ophthalmology. But he and the team are now working to improve it. The current head-mounted camera is bulky, and the team is now working on a micro-camera system that could be attached to glasses. The goal is to have a new system in place by the end of 2011, Medioni said.

The National Science Foundation and the U.S. Army funded the research, which will be used to help veterans who have been blinded during their service in the military, along with the W.M. Keck Foundation. //

Seen here in 2008, Professor Medioni's (center) three-decade work in computer vision has manifested in everything from 3D karaoke to today's robot vision-based mobility aids for the blind.

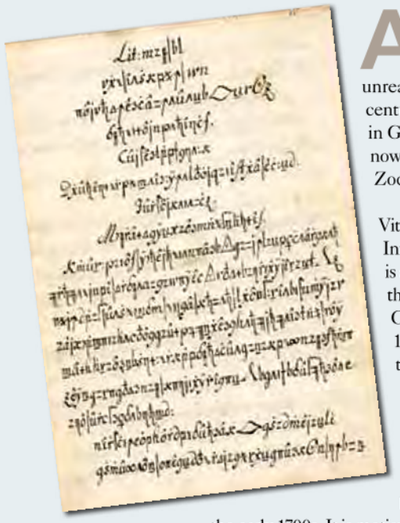


HOW IT WORKS—GUIDE VESTS FOR THE BLIND. 1 Some fancy glasses—the Vuzix WRAP 920 AR—see the world. Eye mounted cameras capture two separate images. 2 The images from the glasses are transmitted to the computer via wireless hub. 3 A computer fuses the two separate images together to create 3D information. A special algorithm—Simultaneous Localization and Mapping (SLAM)—is used to interpret the image, identifying a safe path through potential obstacles. 4 Based on this, the controller (atop the computer) sends a signal to the vest's wireless receiver. 5 The wireless receiver talks to one of the vest's four micro-motors (similar to cell phone buzzers), mounted on the shoulders and hips. If a shoulder- mounted motor vibrates—user should sidestep in that direction. If a hip mounted motor vibrates—user should change angle of their direction. If all four motors vibrate, that signals the user to turn around and go somewhere else.

Translation Expert Cracks Centuries-Old Code

KEVIN KNIGHT DECIPHERS A MYSTERIOUS MANUSCRIPT FOUND IN GERMANY AND FINDS INSTRUCTIONS FOR INITIATION INTO A SECRET SOCIETY

by Eric Mankin



A USC computer code-breaking system has deciphered long unreadable rules written down centuries ago by a secret society in Germany. The same system is now attacking the San Francisco Zodiac Killer's fourth message.

Kevin Knight of the USC Viterbi School of Engineering's Information Sciences Institute is a lead author of a paper on the decoding of "The Copiale Cipher," the code encrypting a 105-page manuscript found in the East Berlin Academy.

This document is labeled "Copiale 3" in plain text, along with a name and date, "Philipp 1866," though a historian who has examined it believes it is much older, from the early 1700s. It is meticulously handwritten in a mysterious code, half Latin alphabet letters, half strange abstract symbols.

Knight has been working in the field of machine translation of written languages (English-Chinese, English-Arabic, etc) for decades, and is now also attacking the related but quite distinct problem of decryption.

Modern machine translation relies on purely statistical analysis of "parallel texts," cross-comparing tremendous volumes of human-translated material published in digital form online. Massive computer power finds recurring associations between groups of words in the two languages virtually without reference to grammatical or linguistic structures and shuffles these to create translations.

Decoding involves a very different approach, one that focuses on linguistic structures, essentially bringing computer power to bear on the familiar strategies long used by human codebreakers such as using letter distribution patterns and other clues to seek patterns.

The Copiale code is considerably more sophisticated than a simple one-symbol equals one-letter cryptogram—and the researchers began without knowing what language was coded.

The first step was to transcribe a machine-readable version of the text, creating standardized digital alphanumeric equivalents for all of the 90 or so different letters and symbols in the text. The next step was entering them by hand on a keyboard. Knight and linguists Beáta Megyesi and Chritiane Schaefer digitized 14 pages of text, containing some 10,840 characters.

Knight attacked this corpus by using the computer to test a series of hypotheses about the text suggested by his linguist colleagues. The first was the theory that the Latin characters in the text were a simple cryptogram substitution cipher from German, English, Latin, or another of 40 candidate languages, while the symbols were meaningless nulls.

This had no success, nor did an alternate attack that assumed that the code used multiple equivalents for the same original text letter, to avoid obvious letter frequency patterns.

The next step was more complex, starting from the hypothesis that the encoded language was German, and guessing that five characters sharing one common characteristic represented the same letter.

After testing and confirming more hypotheses, followed by close examination of the text by proficient German speakers, a translation emerged. It contained instructions for the initiation of a new apprentice into a secret society, the identity of which will be a challenge for historians, but may emerge with the translation of the balance of the text.

The work, says Knight, began when "I gave a talk on decipherment in Uppsala [Sweden]. A professor there had a copy of this book, which she could never read, which her professor had given her." The original is now in Uppsala, sent by its German owner, and it was upon this that Knight turned his tools.

Did the situation remind him a little of the "The Da Vinci Code"? "I should read that book," said Knight, "so I know what to look out for."

Meanwhile, Knight is continuing his cryptography. With ISI colleague Sujith Ravi he is attacking coded messages sent in the 1960s by San Francisco's Zodiac Killer. Human codebreakers have decode the first three of these. Knight and Ravi duplicated that feat with their software, the first program to do so.

But the still undeciphered message four, says Knight, "looks a lot tougher."

Codes are not the only targets. Knight and Ravi hope to use the decryption tools they are developing to attack natural human language, treating Spanish, for example, as encoded Russian, a task that Knight acknowledges will be a lot tougher than Zodiac number 4. //

gesetz buchs
der hocherleuchte ◇ e ⊚
geheimer theil.
erster abschnitt
geheimer unterricht vor die gesellen.
erster titul.
ceremonien der aufnahme.
wenn die sicherheit der △ durch den ältern
thürheter besorget und die △ vom dirigirenden 人
durch aufsetzung seines huths geöffnet
ist wird der candidat von dem jüngern
thürhüter aus einem andern zimmer
abgeholet und bey der hand
ein und vor des dirigirenden 人
tisch geführet dieser frägt ihn:
erstlich ob er begehre ◇ zu werden.
zweytens denen verordnungen der ⊚
sich unterwerffen und ohne wiederspenstigkeit
die lehrzeit ausstehen wolle.
drittens die ⅄ der ⊚ gu verschweigen
und dazu auf das verbindlichste sich
anheischig zu machen gesinnet sey.
der candidat antwortet ja.

First lawbook
of the ◇ e ⊚
Secret part.
First section
Secret teachings for apprentices.
First title.
Initiation rite.
If the safety of the △ is guaranteed,
and the △ is opened by the chief 人,
by putting on his hat,
the candidate is fetched from another room
by the younger doorman
and by the hand is led in
and to the table of the chief 人,
who asks him:
First, if he desires to become ◇.
Secondly, if he submits to the rules of the ⊚
and without rebelliousness suffer
through the time of apprenticeship.
Thirdly, be silent about the ⅄ of the ⊚
and furthermore be willing to offer himself
to volunteer in the most committed way.
The candidate answers yes.

Welcome to a Secret Society: The original code (top left), found in a mysterious 105-page manuscript in the East Berlin Academy, was translated by Knight's team into German and English (above).

The Man Who Declared War on Waste

INSPIRED BY THE TOYOTA-MODEL, DAVID BELSON IS TRAINING TODAY'S MEDICAL LEADERS TO RE-THINK THE COUNTRY'S 'MOST WASTEFUL, INEFFICIENT ACTIVITY.'

by Adam Smith

David Belson once watched a CT-scan technician reading a novel with a waiting room full of patients.

It wasn't necessarily the tech's fault—he was just following the process, waiting for someone to be sent in. Meanwhile, the nearby waiting room patients were doing their part, too, playing the role the room required.

In Belson's mind, sharpened by 10 years consulting for hospitals, destroying procedural bottlenecks, the question had to be asked:

What would Toyota do?

"They would have put screaming red lights on the exam machines, " Belson laughed. "Something that would let everyone see, hey, this room is idle—let's go do something."

Using a recent grant from the California Hospital Association, Belson, a professor in USC Viterbi's Department of Industrial and Systems Engineering, has borrowed lessons from Toyota—lessons in lean management that exploded a small Japanese car company to the world's largest automaker—to improve the efficiency of over 30 of California's rural, "safety net" hospitals.

In the battle to reduce a national health care bill in excess of $2.5 trillion, eradicating waste and inefficiency may be "the low hanging fruit" of cost savings—in this case, as Belson and his students have identified: "moving patients through a hospital more quickly and efficiently."

This past summer, CEOs, nurse managers and doctors from Shasta to San Diego County immersed themselves in the study of lean management tools: "The Five Whys" spaghetti diagrams and *genchi gembetsu*—literally "go to the place and observe." Belson's grant combined interactive video training through the USC Viterbi Distance Education Network (DEN) with actual site visits and implementation.

Each hospital had specific problems—problems, it turns out, an industrial engineer like Belson is admirably equipped to solve: *How can I reduce clinic patient post registration wait time to no greater than 15 minutes? How can I increase patient volume by five percent? How can I improve co-pay collection by ortho clinic receptionists from 10 to 25 percent?*

Belson likes to begin by observing the steps—the five or six major steps in a broken process. It's not uncommon to see nurses marshaling battle formations of yellow Post-it notes—"one of the greatest inventions of all time"—on a blackboard, depicting all the steps in a particular sequence, such as discharging a patient, getting a room ready for surgery or waiting for CT scans.

For Viterbi student Auroop Roy, a Master of Health Systems Management Engineering major, "it's important to see all the steps, to ask, 'what is the value of this step?' If somebody was looking at this and paying for every step, what steps would they actually want to pay for?"

As Belson observes: "Hospitals do not do cost economics. They can't really tell you what a surgery costs—they can only tell you what they bill for."

Working directly with Belson in hospitals all over Los Angeles, Roy has seen the efficiency gospel in action: "Efficiency equals lower costs, absolutely. Just as an example, Medi-Cal/Medicare has something called denial of payment. You come into an inpatient or ER, and you're given a diagnosis. Each diagnosis has a corresponding ICD coding system that says how long Medi-Cal believes that patient should be in the hospital. But say you've got pneumonia and you're there five days—the longer you stay, there's a higher probability that reimbursement won't happen...So when you consider a CT scan that takes 72 hours to be read when maybe it should take 24, or a neuro-ICU bed that costs $12,000 a day, efficiency starts to make a big difference."

Professor David Belson confers with USC Viterbi graduate students Juan Robles and Ankit Bhargava on new ways to improve efficiency at St. Francis Medical Center.

Belson has seized upon those inefficiencies in the health care system to achieve massive productivity gains—doubling the number of daily mammograms at one Inland Empire hospital without adding new personnel or equipment. As he notes, in any other industry, even a five percent improvement is fantastic. "This is like shooting fish in a barrel," Belson said. "Health care may be the most inefficient, wasteful activity in the whole country."

Despite this, changing the culture of an entire hospital is not done overnight.

Said Ankit Bhargava a graduate student in Viterbi's Department of Industrial Systems Engineering (ISE), "When you try to shadow a nurse who's been doing things a certain way for 20 years, they're going to be wary of you. I thought it was funny—I had to remind a nurse that I had no bearing on her job. We're just looking at the processes and learning from them."

"No one really sat down and designed health care, " said Belson. "It kind of evolved over time. Doctors are not systems engineers."

Admittedly not, but with Belson's training, they may start to think like one. //

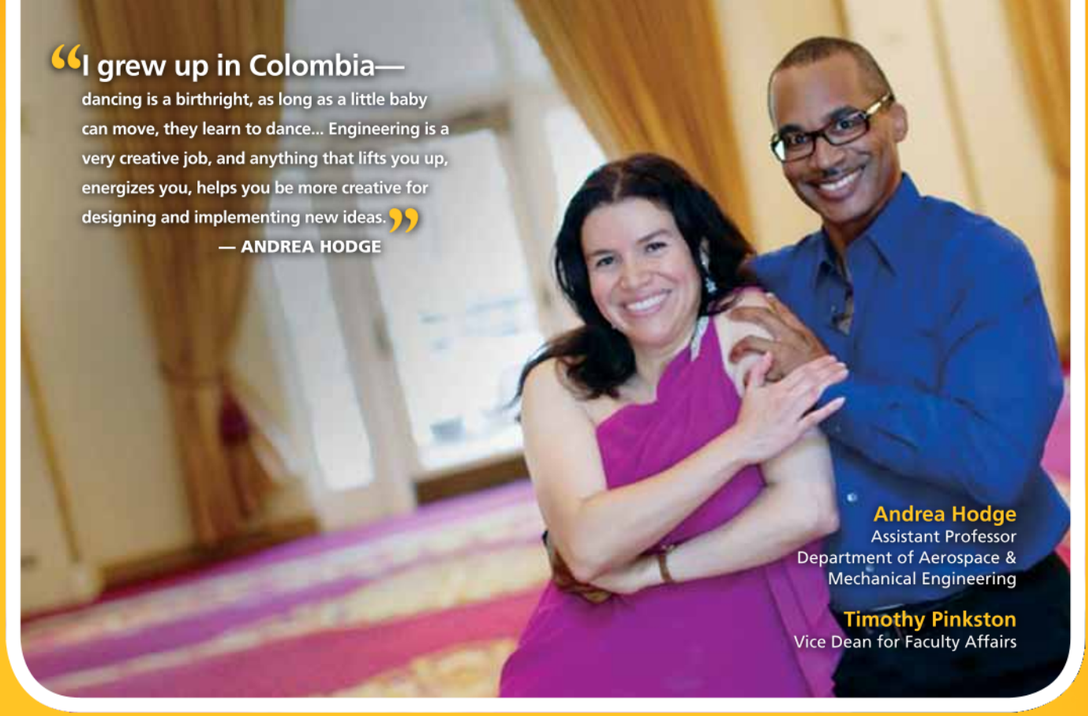
THE MANY LIVES OF Engineers

"I have learned that 'bending it like Beckham' takes more than understanding the aerodynamics of the soccer ball."
— YANNIS C. YORTSOS

Hossein Hashemi
Associate Professor,
Ming Hsieh Department of
Electrical Engineering

Yannis C. Yortsos
Dean

Gérard Medioni
Professor, Department of
Computer Science



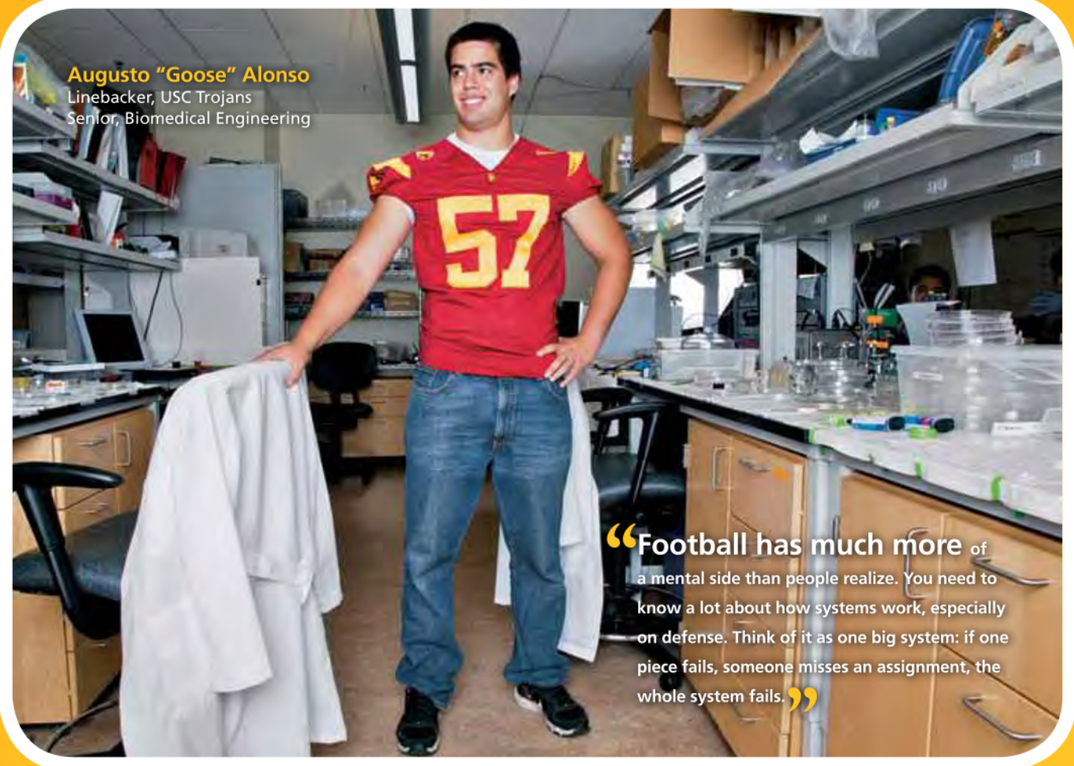
"I grew up in Colombia—dancing is a birthright, as long as a little baby can move, they learn to dance... Engineering is a very creative job, and anything that lifts you up, energizes you, helps you be more creative for designing and implementing new ideas."
— ANDREA HODGE

Andrea Hodge
Assistant Professor
Department of Aerospace &
Mechanical Engineering

Timothy Pinkston
Vice Dean for Faculty Affairs

"My very first National Science Foundation grant was in music. I'm simply drawn to both worlds—I still practice every day. The Indian veena is a mythological instrument. Even Shiva was a veena player. For any pleasant sounding thing, they always say, 'it sounds like a veena.'"

Shri Narayanan
Professor, Ming Hsieh
Department of
Electrical Engineering



Augusto "Goose" Alonso
Linebacker, USC Trojans
Senior, Biomedical Engineering

"**Football has much more** of a mental side than people realize. You need to know a lot about how systems work, especially on defense. Think of it as one big system: if one piece fails, someone misses an assignment, the whole system fails."

Elaine Chew
Professor, Epstein Department of Industrial and Systems Engineering

Carl Kesselman
Director, Center for Medical Informatics, ISI
Professor, Epstein Department of Industrial and Systems Engineering

"**In engineering,** you're always striving for that beautiful, elegant solution. The same aesthetic that makes for a good artist—but particularly a good musician—makes for a good engineer. You must have technical excellence and taste."

— KARL KESSELMAN

Francisco Valero-Cuevas
Professor of Biomedical Engineering
Associate Professor of Biokinesiology and Physical Therapy

"**In Mexico,** we have volcanoes that go well above 17,000 feet. Some of the largest cave systems in the world are also in Mexico. When I was in high school, my friends and I would go into the jungles with lots of rope and food—looking for caves deeper than 3,000 feet. We'd rappel deep into these caves, spending three or four days deep underground."

EDITOR'S NOTE: HAVING SCOURED ARCHIVAL BLACK AND WHITE IMAGES FROM VITERBI'S 107-YEAR-HISTORY, WE WANTED TO CREATE A SENSE OF VISUAL CONTINUITY BETWEEN THE SCHOOL'S PAST AND PRESENT. IN THIS CASE, IT MEANT RE-STAGING THE LIGHTING AND ANGLE OF THE ORIGINAL PHOTOS, JUXTAPOSING MODERN FACULTY, STUDENTS AND PROPS WITH THEIR MONOCHROME PREDECESSORS.

THE CHANGING FACE OF ENGINEERING

"The new face of engineering is not that of 'Dilbert' in the cartoons. It is the face of bright women and men, spanning societal, racial and ethnic divides..."

—Dean Yannis C. Yortsos

The WiSE Women of Engineering

DIVERSIFYING THE FACULTY RANKS—AND REAPING THE REWARDS

by Lenora Chu

THE MENTORS: LEANA GOLUBCHIK (CENTER), THE CURRENT WISE PROGRAM DIRECTOR, PROFESSOR OF COMPUTER SCIENCE AND ELECTRICAL ENGINEERING, AND URBASHI MITRA (RIGHT), FORMER VITERBI WiSE FACULTY CHAIR AND PROFESSOR OF ELECTRICAL ENGINEERING, HAVE EMERGED AMONG THE PROGRAM'S STRONGEST CHAMPIONS.

In today's global economic competition, American research universities need all the brainpower they can get. In 2000 there were only three women faculty across Viterbi's eight departments. Today, 10 years after launching a steady campaign to diversify the faculty ranks and continue to draw the best and brightest to USC, the School is reaping the rewards in the form of increased research power and a greater awards tally.

After nanophotonics expert Michelle Povinelli completed her postdoctoral work in 2008, the tenure-track faculty job offers began rolling in. In all, she received seven offers from top 20-ranked electrical engineering departments at major research universities. She chose USC.

Biophotonics expert Andrea Armani was recruited by five other universities. Nanomechanics specialist Andrea Hodge interviewed at 12 universities and also got multiple offers. Both also decided to become Trojans.

> "Today, a decade after WiSE came to USC, the Viterbi School boasts 21 women in tenured and tenure-track positions—a seven-fold increase."

Attracting highly sought after faculty recruits can be as competitive as the NBA draft. The reasons these women chose southern California are varied, and include everything from research opportunities to family geography to the availability of state-of-the-art lab equipment.

But there is a common thread in why USC sealed the deal for them: all three credit the Women in Science and Engineering (WiSE) program at USC and a community outreach effort by Viterbi faculty and staff that included phone calls and a warm welcome mat.

"WiSE factored into my decision to come to USC from multiple angles," says Armani, citing research fellowships, travel grants and other support available to women faculty through WiSE. "Many of their programs also support many of my personal goals, such as encouraging more female undergraduates to pursue Ph.D.s."

Hodge says that in visiting a dozen universities she did not find any other school with a similar program for women in engineering. Through the WiSE network, she found women mentors inside and outside of USC; one of her inspirations today is a world-renowned professor emeritus at Northwestern University, with whom she is working on a publication about nanotwinned copper.

"She always reminds me to be strong, aim high and get my hair done by a good stylist," Hodge says, with a smile.

It's been long known that both industry and academia suffer from a dearth of women in science and engineering. Rectifying the problem has been a driving concern for policymakers and educators, and the momentum to tackle the issue at USC came in 2000 with an anonymous donor's $20 million gift for the establishment of WiSE, which supports women scientists and engineers.

The WiSE endowment—and its interest income—gave USC the financial means to pursue its goals. Meanwhile, the institutional support of two Viterbi deans over the last decade launched a shift in the culture of the School, without which change could not have occurred.

The history of Viterbi's campaign to recruit women faculty goes like this. In 2000, Viterbi administrators noted that there were only three female tenured and tenure-track professors across the Viterbi School's eight departments. Sometime later, C. L. Max Nikias—then dean of the Viterbi School and now president of USC—called together his eight department chairs and informed them that no new job search would be authorized until and unless the department could demonstrate it had made a serious, good faith effort to identify women candidates. He helped WiSE institute programs to support women at all stage of their careers.

When Yannis C. Yortsos became Viterbi dean in 2005, he continued the momentum and gave WiSE faculty an integral role in day-to-day school operations. Yortsos says increasing both gender and ethnic diversity is critical to ensuring the Viterbi School continues its excellence in teaching and research.

"As China and India continue to graduate top-notch engineers, we must make sure our universities utilize all our talent," Yortsos says. "The alternative is unacceptable, and it means

SPOTLIGHT: Bringing Diversity to AME

When Mike Kassner took the chairmanship of the Viterbi School's Department of Aerospace and Mechanical Engineering (AME) in 2003, he noticed something "troubling."

"There were 27 faculty, but no women, no Hispanics, and no African-Americans," Kassner says. "Which means we're not including groups that could be a tremendous source of talent."

With the support of Viterbi administration and funding from WiSE, Kassner set about bringing diversity to the department. It was no small challenge, Kassner noted—only about 10 percent of Ph.D.s awarded in mechanical engineering go to women.

His solution was to focus on expanding the applicant pool by seeking outstanding women in all places—not only in traditional pipelines for academia such as Ph.D. programs—but also government research-laboratories, industry and post-doctorate positions.

During six years of hiring, Kassner and a faculty recruitment team whittled more than 1,000 applications—including a large number of female, Hispanic and African-American candidates—down to a shortlist of finalists. Then the contest began to draw the desired candidates to USC. Securing top recruits is competitive, Kassner says, and the Viterbi School often found itself battling other top universities for candidates. Many of the female candidates had as many as ten other offers from other leading universities.

Enter WiSE. For the female candidates, Kassner was able to "sweeten the deal" with WiSE-backed initiatives such as start-up lab funds, eligibility for research support and travel grants. Kassner credits his success in recruiting women "in no small part to the aggressiveness of WiSE." While serving as AME chair from 2003 through 2009, Kassner oversaw the hiring of seven new faculty, including three women.

A Very WiSE Gift

HOW WiSE HELPS RECRUIT, RETAIN AND PROMOTE WOMEN ACADEMICS

by Diane Krieger

When USC announced in 2000 that an anonymous donor had made a $20 million gift to support women in science and engineering, the question on everyone's mind was: Who's the WiSE guy?

First of all, he is a she. Though her identity remains a secret, here's what then-program director Jean Morrison revealed about the donor: "She's absolutely delightful. She's elderly, in her 90s. She is an alumna of the university; however, she is neither a scientist nor an engineer."

Working with then-provost Lloyd Armstrong, the donor created a sort of mini-foundation within USC that could award grants to individuals in the USC Viterbi School of Engineering and the six science and math departments of USC Dornsife College.

The WiSE endowment pool generates about $1 million a year in investment income. This money fuels an array of activities: sweetened hiring packages for faculty candidates, research support, travel grants, equipment purchases, child care assistance, beefed-up stipends for graduate students and postdoctoral fellows, undergraduate research grants, salary replacement funds to departments faced with a teaching gap caused by maternity leaves, logistics for an array of women's networking groups, even help in finding soft-money jobs for a "trailing spouse." WiSE also funds a summer science camp for middle and high school girls.

WiSE was the brainchild of a USC task force that deliberated for more than a year before spending a dime. A small, grassroots group of senior women scientists took the lead on the task force, among them chemist Hanna Reisler.

Reisler discovered the university wasn't even tracking the number of female faculty it employed in 2000. So she painstakingly hunted down names and brought together these women as a network for the first time: a grand total of 15 out of more than 300 permanent faculty in WiSE-eligible departments.

The goal WiSE set for its first five years: double the number. And they did.

we continue to lose the race to attract students to engineering disciplines, graduate them with engineering degrees and send them into academic, research or industry jobs where we advance our ability to tackle the world's greatest challenges."

According to Hanna Reisler, professor of chemistry at USC, who as WiSE advisory chair worked with Nikias and Yortsos: "While he was dean, Max made it very clear to all the department chairs that this was supposed to be a top priority. Then Yannis came in and put women in senior positions, which in turn helped recruit more women."

World-renowned roboticist Maja Matarić was one of those appointees; tapped by Yortsos to serve in 2006, she is now vice dean for research.

"For our school, big things happened because of the right leadership," says Mataric, a professor of computer science and neuroscience. "At USC, the most influential advocates for women have been men—former provost Lloyd Armstrong, former president Steven Sample, Max Nikias and Yannis Yortsos—scientists all."

With the continued help of the WiSE program, the pace of success in attracting top women to the Viterbi School increased. Today, the school boasts a seven-fold increase in the number of female professors, and there is now no Viterbi department that is without women.

What's more, a decade after the diversity campaign began, the hiring dust has begun to settle, and it's clear that many of the Viterbi School's best and brightest faculty happen to be female. Their recruitment stories, accomplishments prior to coming to the Viterbi School, awards tally and research achievements altogether indicate they are a force to be reckoned with.

For starters, nearly all the junior female faculty members have won the CAREER award, the National Science Foundation's prestigious young investigator award in support of professors who exemplify the teacher-scholar role.

In the last three years, five Viterbi faculty were named to the MIT Technology Review magazine's "Top 35 Innovators Under 35" lists. Three were women. Further, Povinelli and Armani won Presidential Early Career Awards (PECASE) in 2009 and 2010; there is no higher honor for junior faculty nationwide. Before them, the last Viterbi faculty to travel to the White House to receive a PECASE was also a woman; concert pianist and industrial systems engineering professor, Elaine Chew, got hers in 2004.

STAND AND DELIVER: ASSISTANT PROFESSOR ANDREA ARMANI, NAMED ONE OF THE WORLD'S 35 TOP INNOVATORS UNDER 35 IN 2009 BY MIT'S TECHNOLOGY REVIEW, HAS BEEN A KEY AMBASSADOR TO FEMALE UNDERGRADUATES. AT OVER 30 PERCENT, VITERBI'S FEMALE ENROLLMENT IS NEARLY TWICE THE NATIONAL AVERAGE.

The women shine also in research accomplishments. Shinyi Wu last year received a $3 million grant—the size and scope being extremely rare for an assistant professor—to continue her work improving chronic illness care, particularly with depression. She came to USC from the RAND Corporation, where in 2007 she was named an individual outstanding researcher for her work applying industrial and systems engineering approaches to health care delivery. When USC came calling in 2008, RAND fought to keep her with a counteroffer, but WiSE helped lure Wu to campus, where she is continuing to rack up notable achievements.

Veronica Eliasson is a specialist in shock waves where there is a strong fluid-solid interaction. She chose Viterbi from three options and also recently turned down a prestigious Ingvar Carlsson Award, which entices Swedish scientists to return home with a large startup package and mentoring program. Currently she is working on a multi-university research alliance with the Office of Naval Research.

Yan Liu, an expert in machine learning and data mining, came to USC after earning dozens of accolades while working at IBM Research. In just the five months she's been at the Viterbi School, she's written six proposals, submitted eight papers and received outstanding teaching evaluations.

Urbashi Mitra, former WiSE chair and an expert in wideband wireless communications, says, "If you focus on building strength and have the right incentive system, you can accomplish change."

What makes the Viterbi women's achievements particularly noteworthy is that many assistant and associate professors are juggling parenting young children along with grant applications, teaching and research. Of course, the same is true for many male faculty; the Viterbi School has experienced a baby boom recently, and most professors say the university's improved family-friendly policies have helped with striking a work-family balance.

Burcin Becerik-Gerber is one of the active priority-jugglers. A civil engineering assistant professor, she had her second child earlier this year. Prior to starting a family she was able to stay at her office and work until midnight. Now her research and teaching schedule is constrained by daycare pickups and bath-time. "And after the kids go to bed I keep working," says Becerik-Gerber. "No complaints, but this is the life of a mother on tenure-track!" Still, Gerber continues to shine, pulling in major research grants from the Department of Energy, as well as commercial resources to advance informational technology for sustainability and energy-efficient buildings.

Between balancing multiple priorities, the Viterbi women are also finding time to mentor female students and underrepresented minorities. Students need role models at even younger ages if they are to be attracted to and stay in science and engineering disciplines, says Armani. And the Viterbi School's efforts to increase diversity among its student body over the last several years have paid off. In 2010, nearly 35 percent of incoming Viterbi School freshman are women, up from 28 percent in 2006. That's well above the national average.

Says current WiSE chair, Ellis Meng, "When I was a student (at CalTech), there were few fellow female engineers and even fewer female role models in the faculty. Our undergraduate population in biomedical engineering at USC is 50 percent female. It is incredibly rewarding to have women seek me out to talk about what classes to take, career advice or for research opportunities."

Today, a decade after WiSE came to USC, the Viterbi School boasts 21 women in tenured and tenure-track positions—a seven-fold increase. There are many more innovative female research and adjunct faculty in its ranks, many of whom hail from the Information Sciences Institute.

"It is true that women represent a modest percentage of the faculty in Viterbi right now," says Mitra, "however, our progress over the last decade has been truly impressive. Perhaps most impressive is the quality of research in which these new women colleagues are engaging. I'm very optimistic for the future."

With reporting by Diane Krieger.

DIFFERENCE-MAKERS: A SAMPLING OF VITERBI'S WiSE FACULTY, FROM LEFT TO RIGHT, **SHINYI WU**, INDUSTRIAL AND SYSTEMS ENGINEERING; **ANDREA ARMANI**, CHEMICAL ENGINEERING AND MATERIALS SCIENCE; **LEANA GOLUBCHIK**, COMPUTER SCIENCE AND ELECTRICAL ENGINEERING; **URBASHI MITRA**, ELECTRICAL ENGINEERING; **MICHELLE POVINELLI**, ELECTRICAL ENGINEERING; **MALANCHA GUPTA**, CHEMICAL ENGINEERING AND MATERIALS SCIENCE AND **ELLIS MENG**, BIOMEDICAL ENGINEERING.

The Many Faces of USC Viterbi

FROM LEFT TO RIGHT:

Tayeb Ayatollahy Tafti *(Ph.D. candidate, Petroleum Engineering)* and **Minoo Malek** *(M.S., Petroleum Engineering)*—husband and wife

Hometown: Tehran, Iran

"We met during a hiking program at Tochal Mountain, north of Tehran. Our first date was at USC two years later—she was visiting, asked me to introduce her to some of the professors. I fell in love. I proposed two weeks later."
— Tayeb Ayatollahy Tafti

Maryann Hiller *(Ph.D., Industrial Systems Engineering)*

Hometown: Atherton, CA

"I'm a fourth generation pilot. For my ISE senior capstone project at Viterbi, I really wanted to be around planes. We worked in FedEx's aircraft maintenance area at LAX, and it was an eye opening experience. As a systems engineer, they were so antiquated in all their legacy systems."*—Maryann Hiller*

Asma Tameem *(M.S., Computer Science)*

Hometown: Mumbai, India

"Viterbi has one of the best games programs in the country—it was extremely well suited for what I wanted to do in graphics and animation. I'd like to develop the next Maya or Photoshop. Right now, for example, we're applying the laws of physics to create better waterfalls."*—Asma Tameem*

Yin-Ray Rick Huang *(Ph.D., Signal Processing)*

Hometown: Kaoshiung, Taiwan

"When I was in Taiwan, I'd heard that (Professor) Jay Kuo's research group in signal processing is one of the best in the world. At Viterbi, my interest is getting computers to understand music content automatically. Imagine a computer that could go through all of Jimi Hendrix's songs, automatically transcribe the way he played and tell you how you made the mistakes."
— Yin-Ray Rick Huang

Romancing Kids With Robots

VITERBI FINDS INNOVATIVE WAYS TO BUILD THE STEM PIPELINE THROUGH ITS K-12 OUTREACH PROGRAMS

by Alana Klein-Prisco

KINDER, GENTLER ROBOTS: MAJA MATARIĆ, VITERBI'S VICE DEAN OF RESEARCH, SEEN HERE WITH MELISSA PASILLAS FROM SYNERGY KINETIC ACADEMY AND ALEXANDER SANTANA FROM PRAIRIE VISTA MIDDLE SCHOOL, HOSTS AN ANNUAL USC ROBOTICS OPEN HOUSE TO INTRODUCE KIDS TO CUTTING EDGE RESEARCH ROBOTS.

Louis Gavidia, a recent graduate of the K-12 Foshay Learning Center, one of "USC's Family of Schools" located in the heart of South Central Los Angeles, discovered his talent for science unexpectedly. During his first week of tenth grade, Gavidia says a "scheduling mix up" occurred that left him one class shy of a full schedule. When a coveted spot opened up in a robotics class, which was inspired by USC's nationally-recognized robotics program, Gavidia jumped at the opportunity.

In doing so, he also gained entry into one of the most sought-after, state-funded academic programs, known as MESA (Mathematics, Engineering, Science Achievement). MESA gives students the opportunity to excel in math and science and become eligible to compete for the most rigorous colleges and universities. The Foshay Learning Center represents just one of the 22 MESA schools in Los Angeles (including 14 high schools, seven middle schools and one elementary school), with which USC has partnered.

Gavidia says he never imagined that he would learn how to build life-size robots, compete in robotics competitions and develop such an affinity for science that he would set his sights on becoming an astrophysicist. "Robotics opened so many doors for me. I went into the class a shy and timid student and came out a confident leader," says Gavidia, who became captain of the FIRST robotics team during his senior year. He led a team of 40 students to win the prestigious Engineering Inspiration award at a regional robotics competition, and also took home an individual award.

But his achievements don't end there—he is also the first person in his family to attend college. He will attend UC Irvine in the fall and plans on majoring in physics. "My parents always told me they wanted me to succeed, follow my dreams and have a good life," he says. "I am taking their advice."

Students Respond to Outreach

Gavidia represents just one of the many MESA program success stories. More than 74 percent of MESA students graduate from high school, compared to 41 percent of the California student population that graduates from high school, according to 2011 statistics from MESA. In addition to increasing graduating rates, MESA is also doing its part to build the pipeline of STEM majors, as 60 percent of MESA students end up majoring in science, technology, engineering or math.

"We have two main goals at Viterbi which work in tandem—one is to get students interested in STEM and the other is to get them to college," says Larry Lim, director of pre-college programs at the USC Viterbi School of Engineering, who oversees MESA, Mission Science, an after-school, hands-on science program for elementary school students and a handful of other student programs.

Lim says that many of the students in the outreach programs feel they must prepare and plan for their education on their own. "Their parents don't always understand what it takes to go to college since many of them did not go to college or even graduate from high school," Lim says. Additionally, many students feel tremendous pressure to help support their family financially, and sometimes, that comes at the expense of their education, Lim adds. "Our programs encourage these students to believe in themselves and continue their education," he says. They also give students direct exposure to STEM professionals in both private industry and academia, through field trips to ExxonMobil, Shell, Boeing, Lockheed Martin, Northrop Grumman and the labs at the USC campus.

> "Robotics opened so many doors for me. I went into the class a shy and timid student and came out a confident leader."

Supporting the National STEM agenda

These outreach programs not only align with the Viterbi school's mission, but they also support the national agenda to increase the pipeline of students who go to college and graduate with STEM degrees. Over the past 10 years, growth in STEM jobs was three times greater than that of non-STEM jobs, according to a 2011 report from the Economics and Statistics Administration within the United States Department of Commerce, and STEM jobs are expected to continue to grow at a faster rate than other jobs in the coming decade.

Engineering, in particular, has been the subject of much attention from the Obama administration, with the president's recent initiative aimed at training an additional 10,000 engineers each year. "There's an increasing realization at the national level that there is a weakness in our educational system in regard to STEM," says Maja Matarić, vice dean of the Viterbi School of Engineering, who also leads the school's center for robotics. "There has been a real push to show the broader impact of a STEM education, and one of the ways we're doing that is by taking research out of the lab and translating it into the K-12 classroom."

Viterbi's commitment to building the pipeline of STEM students starts as early as elementary school. "We are targeting students at the middle school level or earlier because that's when students are still interested in science," Lim says. By high school, it's too late, he says. "We find that students lose interest in science, and not because of intimidation, but boredom. Science could be taught in a much more exciting way at the high-school level."

The stereotypes about science and those that enter the field also come into play. "It's so important to show kids that science doesn't have to involve sitting in a cubicle or a lab—but that it can be very creative and fun," Matarić says. USC has found many ways to break down these perceptions and make science more approachable. The field of robotics, which deals with the design, construction, operation, and application of robots, represents a great entry point to the sciences. "The notion of creating something real from scratch that actually moves and works is very compelling to students," Matarić says. Last April, Matarić led the second annual national robotics week at USC, which attracted more than 1,000 attendees and featured robot dogs, exercise coaches, humanoids that make eye contact and robots that help treat autism.

The Key to Student Engagement

But even with a sexy subject like robotics, students need great teachers to motivate and inspire them. USC has its fair share of those, such as Darin Gray, science coordinator for the MESA program who previously worked as an electrical engineer at Hughes Aircraft. "It's hard to lure engineers out of industry and into education—but for me, teaching has been very rewarding," Gray says. "I love

How to Make 7th Graders Love Viscosity

NSF GRANT USES HUMAN BODY AS PORTAL TO ENGINEERING


Dr. Krishna S. Nayak

The National Science Foundation has awarded more than $1.3 million to a team of four USC Viterbi School of Engineering professors who hope to increase interest in science and engineering at the middle school level.

With the federal funding, professor Maja J. Matarić, and associate professors Dr. Krishna S. Nayak, Dr. Andrea M. Hodge and Dr. Gisele Ragusa have started a five-year program called "Body Engineering, Los Angeles" that sends doctoral candidates into local middle schools to teach engineering. Instructors will show students how their bodies work and how that connects to engineering, emphasizing that the human body is a machine to be studied, analyzed and experimented upon.

The creators designed BE-LA to improve the lack of engagement between math and science education and K-12 schools, Nayak said, and simultaneously help the instructors grow as leaders and communicators.

"People who can convey passion about their field, who are enthusiastic about their subject matter—that's contagious," Nayak said. "To be in the classroom and have that will create change."

Starting in January, nine doctoral students will spend 10 hours a week partnered with a middle school science teacher, assisting with teaching and creating three units of their own: one related to their research, one that teaches measurement and data analysis, and a third that encourages students to create a science experiment at home using their own body. For example, testing how levers work by placing varying weights on an arm, then flexing.

"A body is something that everyone has, and everyone relates to," Nayak said. "We've seen in the past that when we talk about the body, students are engaged and interested."

The human body showcases a range of science topics, Nayak said, from basic ideas like fluid viscosity to more challenging concepts like muscle control, perception, reasoning and planning.

BE-LA has been developed in conjunction with Viterbi's Engineers as Teachers program and Iridescent, a non-profit that fosters children's curiosity in science, technology and engineering. It is the first USC GK-12 program to offer tuition stipends equivalent to those of fellowships or research assistant grants.

NSF funding, approved in mid-August, takes effect immediately. An estimated 35-40 students will apply for nine spots, which should be filled by the end of October, Nayak said. An external consultant will monitor the program's progress through a series of surveys, and the 13 Viterbi faculty members on BE-LA's governing board will also visit the classrooms to observe, Nayak said.

In May, Viterbi will host a public gala to showcase the BE-LA program. At the end of the five-year grant, Viterbi will continue to partially fund the program, Nayak said, in hopes that BE-LA can become permanent. //

getting kids excited about math and science and watching them realize that they can be the next Einstein or rocket scientist," he says, admitting that sometimes the roles do get reversed in the classroom. "They challenge me every time I walk in the room and make improvements to every project I give them," Gray says. Projects in Gray's classroom range from homemade microscopes to cotton candy machines and prosthetic arms.

These programs also give students the confidence to apply what they've learned in the classroom to other pursuits. Gray recounts the story of an eighth-grade Mission Science student, whose previous teacher had described her as disengaged. Her attitude changed when Gray offered her quite an alluring incentive. Several old computers had been donated to the school and Gray told his class, "if you can make them work, you can have them." This student made it her mission to figure out how to recycle the old computer parts and make them usable again. Gray says she became so proficient at it that she was able to create a side business of restoring computers. "By her senior year she was going to the penny saver store buying dead computers and bringing them back to life," Gray says.

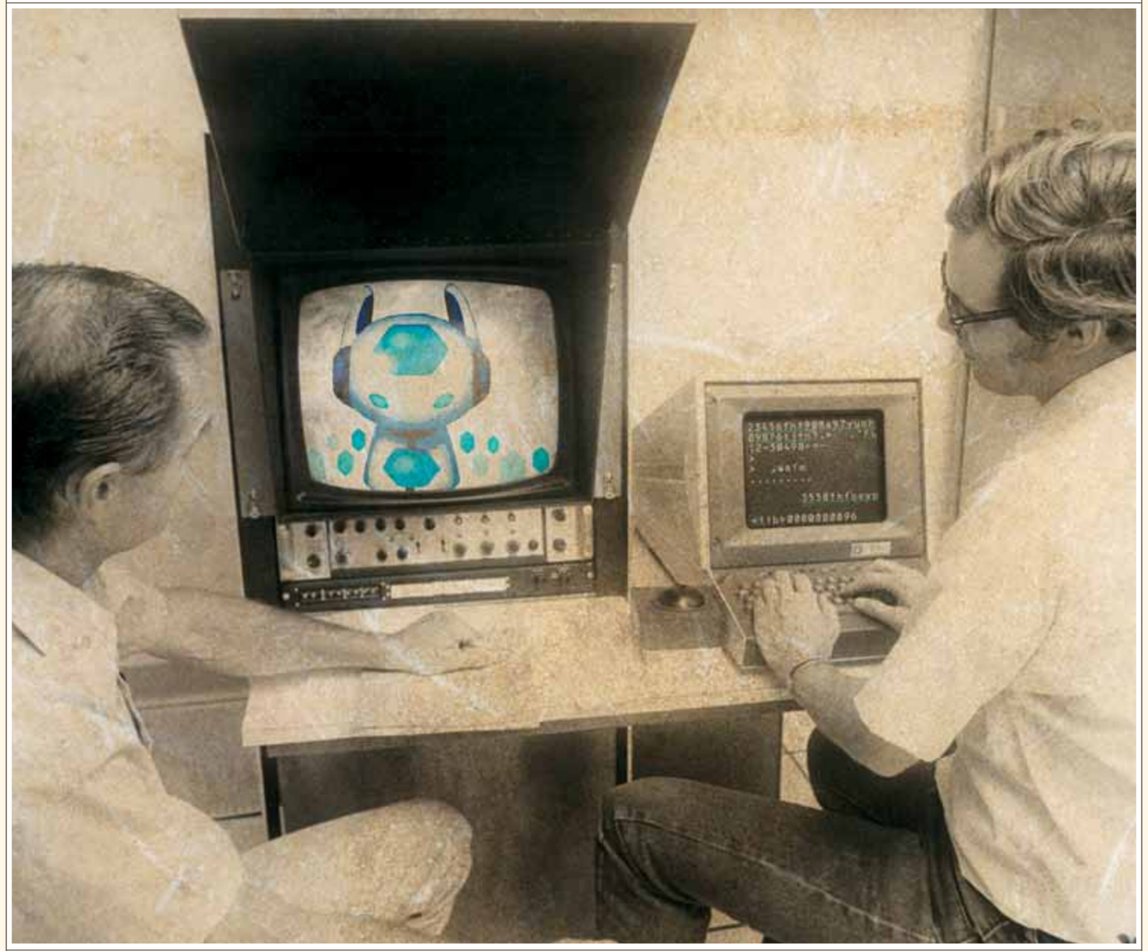
In addition to using incentives to motivate students, competition is also another effective tool for student engagement. "The only competition many of these students see is athletic competition. They often don't have the opportunity to compete in an academic event, let alone win trophies, medals and ribbons for their academic successes," Lim says. The USC MESA program offers students the opportunity to compete in several math and science competitions, including the JETS team competition, in which students apply math and science concepts to real-world problems, and the FIRST Robotics competition, in which Gavidia competed, where students and engineers work together to brainstorm, design and construct a robot.

While most universities see a need for this type of outreach to students, "USC is at the cutting edge of these programs," Lim says. The instructors involved in the MESA program teach much more than the fundamentals of math and science—they teach students to see their potential, which can be equally as powerful as the academic learning that takes place. "Thirty years ago there were not a lot of outreach programs to interest kids in becoming an engineer. Usually it was the children of engineers who went on to become engineers. But we're here to change that," Lim says. //

The Only Game in Town

X PRIZE LAB, MASEEH PRIZE AND GAMEPIPE—THE LATEST ITERATIONS OF USC VITERBI'S MISSION TO PRODUCE THE MOST INNOVATIVE, CROSS-DISCIPLINARY ENGINEERS

by Adam Smith



"AMOEBATTLE": THE LATEST OFFERING FROM HANDHELD GAME DEVELOPER INTRINSIC GAMES PITS AMOEBAS IN BATTLE FOR SINGLE-CELLED SUPREMACY. THE COMPANY, COMPRISED OF VETERANS OF VITERBI'S GAMEPIPE LABORATORY, IS JUST THE LATEST EXAMPLE OF STUDENTS TURNED ENTREPRENEURS.

"We don't really care what you think."

The conversation that day, 25 years ago, had been about dolls. Jon Lasch still winces at the memory.

The audience was the design team and chief operating officer of a major toy manufacturer. Lasch and his team of visiting PPG chemists were experts in photochromic materials—the same materials they'd previously used to great effect with transition lenses for eyeglasses. They hoped to use the same technology on toys.

"We'd like to make a doll that tans," the designers said. "When you take it outside, we want it to tan."

One of Lasch's chemists spoke up: "You know what you ought to do—you should make clothes that change colors for the dolls."

As Lasch recalled, at that point, the COO stirred, and said rather brusquely:

"We don't really care what you think. Either you can make a doll than tans or you can't. That's what we want. Now can you make it or not? "

It was a real eye opener for Lasch: "The chemist knew that his idea would work best with the technology we had. But that's not what the marketplace wanted."

For engineering students in Lasch's USC X Prize Lab—a joint program in entrepreneurship between the X Prize Foundation, USC Viterbi School of Engineering and the USC Marshall School of Business—ending that disconnect is at the core of his curriculum. The course, one of only three university X Prize laboratories in the country, forces Viterbi students to "go beyond drilling down on technical stuff" and immerse themselves in analyzing markets, learning from visiting entrepreneurs and making formal presentations "to defend their point of view."

Entrepreneurship, intellectual property, leadership—these are more than the slogans of the modern engineering education. As USC Viterbi Dean Yannis C. Yortsos observed in a recent speech:

"Today's engineering is not your father's engineering, nor is it like 'Dilbert' in the cartoons. It relies more than ever before on the creation of new intellectual property.

Increasingly... the United States will depend on our ability to continue innovating technologically. In fact, innovation will likely be the only game in town."

Professor Peter Beerel, director of Viterbi's Maseeh Entrepreneurship Prize Competition (MEPC), is certainly no stranger to innovation—his recent start-up, Timeless Automation, is now producing asynchronous chips under the banner of Intel. For him, the distinction between "your father's engineering" and the type that must now set Viterbi engineers apart is very real.

"The type of a person who just sits in a cubicle and does his stuff," Beerel said, "is gone. If you're going to just sit in your cubicle and do your thing, you might as well be in India. You need the type of people who stand up and look around. We need to teach people it is not good enough just to do your job. It is your responsibility to think about how you can make your whole company more effective."

Through a $1 million gift from entrepreneur Fariborz Maseeh, MEPC allows Viterbi students to "stand up and look around" with $50,000 worth of seed money for the best business plan. Last year's winning team, Abtum—a duo of research assistant, Behnam Analui and Hossein Hashemi, associate professor in the Ming Hsieh Department of Electrical Engineering—were particularly grateful for the mentorship component.

Said Hashemi, "The best part of the entire process was being assigned a mentor (Vacit Arat, chief executive officer of Microfabrica)—we met with him at least once a week. Our business plan changed dramatically; our first version was far less aggressive."

Michael Zyda, director of Viterbi's GamePipe laboratory, notes that Viterbi's cross-disciplinary bent is a critical shift from his own days as a graduate computer scientist. "Historically, when you learned computer science, the projects were single student based. In the games program now, we run in quite large teams because that's the way industry works. It's not atypical in our 491/521 joint games class that we'll have engineers in there, designers from cinema, artists, musicians all working together. The team might be 32 students large."

Zyda's program is on the vanguard of the Viterbi Department of Computer Science's evolution from writing theorems to building things that compete in a crowded IP marketplace.

"I believe," said Zyda, "in the modern engineering school, patents are of more value than journal papers. I think our dean recognizes that."

For his part, Lasch, now executive director of USC's Alfred Mann Institute for Biomedical Engineering, remembers his own evolution: "I was a guy at the bench who made compounds. I was in my own little world—I was just trying to push my technology into the marketplace. We can't return to that place." //

Changing Face of Leadership

Maseeh Entrepreneurship Prize Competition (MEPC)

WHAT IT IS: An annual business plan competition to help inspire Viterbi student innovators to be at the forefront of the NAE Grand Challenges. Through a generous gift from Fariborz Maseeh, MEPC provides a $50K award in seed funding. Each start-up must include at least one Viterbi student in a leadership role.

FACULTY: Peter Beerel, director of MEPC; associate professor, Ming Hsieh Department of Electrical Engineering

THE IDEAS (SAMPLING FROM 2011 COMPETITION):

- **Abtum, Inc. (2011 Winner):** Enable the development of low-power, low-cost, universal wireless devices by designing and selling break-through integrated programmable wireless transceiver chips.
- **Anomaly Robotics:** Bring robotics to the home of the Do-It-Yourself community by providing a range of services to cost-effectively create, rent, and buy robot kits and robots for the home.
- **Fitness-i:** Enable real-time quality health informatics for clinical and therapeutic use via an accurate, objective, personalized and ubiquitous fitness monitoring solution using on-body movement sensors with mobile phones to augment, process and share information via social networks.
- **LQ International Group, Inc.:** Deliver a commercialized blind-spot detection system that will detect any vehicle or object moving into the blind spot and warn the driver when there is imminent danger of a side-to-side collision.

WHAT'S NEXT: Build a network of alumni through this program and connect to all similar programs at USC: CRUNCH design competition (USC Annenberg Innovation Lab); New Venture Seed Competition (USC Marshall School of Business); Ideas Empowered Program (USC Stevens Institute for Innovation).

QUOTABLE: Beerel on MEPC benefactor Fariborz Maseeh: "Fariborz was someone who was an engineer, who became an entrepreneur and looked back on his experience and said, 'If I only knew these things...'

X PRIZE LAB: AFTER TACKLING ISSUES OF SOLAR ENERGY AND WATER IN PREVIOUS YEARS, THIS YEAR'S COURSE FOCUSES ON INNOVATIONS IN URBANISM.

Things like what a business plan looks like, how do you talk to a customer, how do you determine if your idea is going to sell, how hard is it going to be to build, who will be the suppliers, what's the adoption curve, who are your competitors, all these kind of questions. We need to teach the engineers the language. It's not a clear boundary: the engineer does the engineering and the business guy does the business."

X Prize Lab—USC Viterbi School Of Engineering

WHAT IT IS: X Prize partners with USC—Viterbi School of Engineering and Marshall School of Business—to examine the ways that incentive prizes can spur innovation around humanity's grand challenges.

USC is home to one of only three university X Prize laboratory programs in the country.

The students produce concepts for new X PRIZE competitions in one of four prize groups: Education & Global Development; Energy & Environment; Exploration; and Life Sciences. At the end of the semester, students present their ideas to senior Foundation leadership and members of the X PRIZE Foundation's Board of Trustees.

FACULTY: Jon Lasch, executive director of USC Viterbi's Alfred Mann Institute for Biomedical Engineering; Gene Miller, director of the Lloyd Greif Center for Entrepreneurial Studies at USC Marshall School of Business.

CHALLENGE IDEAS (SAMPLING FROM 2011 COMPETITION):

- **Cleaning Up the World's Water:** Design a self-sustaining unit that can process unclean water and output potable water that meets EPA standards for microorganism and virus reduction and passively outputs 100 ml per minute per person or actively outputs 1 L per minute per person. The unit should cost $2 per person initially, cost $1 per person per year subsequently, and have a longevity of 4,400 L per person.
- **Under the Sea:** Build a self-contained submersible vehicle that can sustain 3 humans in the deep sea and roam for 3 months while continuously transmitting data to a surface station.
- **Halophytes:** Develop a genetically modified crop taking advantage of high-salinity water resources for the production of biofuel.

GAMEPIPE LAB: RECENT STUDENT VIDEO GAME "THE BRIDGE" ALLOWS PLAYERS TO USE VOICE COMMAND TO CAPTAIN THE BRIDGE OF A STARSHIP.

WHAT'S NEXT: Visioneering Day 2012—the first time X Prize Foundation has partnered with an academic institution in a 24 hour brainstorming session. With 40 invited student and alumni participants, The USC hosted event on January 27 will focus on the topic of "Engineering, Business and Communications Solutions for Global Healthcare Problems."

Viterbi GamePipe Laboratory

WHAT IT IS: Top ranked video game program in North America, per Game Pro Media and Princeton Review—a joint program between The School of Cinematic Arts' Department of Interactive Media and the Viterbi School's Department of Computer Science.

FACULTY: Mike Zyda, Viterbi computer science professor and director of USC GamePipe Laboratory.

SAMPLE GAMES FROM 2011 DEMO DAY:

- **The Bridge:** Reminiscent of Star Trek, allows the player to command a starship entirely with voice control.

MASEEH PRIZE: LAST YEAR'S WINNERS, BEHNAM ANALUI AND HOSSEIN HASHEMI, WITH THE $50,000 START-UP PRIZE.

- **Dance Pad:** Where the player performs, creates, and shares iconic dance moves using fingers on an iPad.
- **Unchained**: The player plays as a roguish trader piloting an airship in a exotic steam-punk world.
- **Mother Nature:** A game of artistic expression whose motto is "use your body to give birth to beauty." Mother Nature uses a Microsoft Kinect 3D camera to track the movements of a player's body, turning those movements into in-game events and action.
- **Fruits vs Veggies:** An iPad game developed by Jonathan Zhang and Mindy Goto that many people are calling "the most beautiful iPad game ever developed." Fruits vs Veggies will be coming out under the Happynin Games brand next summer.

RECENT PATENT: Zyda and three computer science students (Dhruv Thukral, '06; Wei-Chung Chang, '09; and Shu-Fen Lin, '08) collaborated on a MEMS body sensor that monitors the user's precise activity and measures its intensity. So, for example, in the Humana-funded game "PetPal", an animated dog's happiness is governed by the user's actions. The copycat dog avatar can run, jump and ride a bicycle only if the player is doing the same in real life.

LATEST PATENT FILED: Integrated news feed in video games, based on a $1.2 million grant from DARPA. Imagine a war game based in Iraq with real time news feeds from CNN.com. Suddenly, the news feed reports a real world bombing in the city your characters are in—the avatars on the screen react accordingly. //

ALUMNI NEWS

VITERBI ALUMNI RELATIONS

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

You are part of a distinguished group of more than 55,000 Viterbi School alumni. We hope you take advantage of the many opportunities to build connections with this group through volunteering, guest lecturing, career mentoring and supporting the school.

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

Stay Connected

We rely on your accurate mailing and email addresses to ensure you receive our many publications and invitations to special events. Please update your information online at viterbi.usc.edu/alumni or by contacting the VSoE Office of Alumni Relations at 213.821.2424.

Inside The Corridors of (SCE) Power

AS TOLD TO ADAM SMITH

The first time Alan Fohrer ever worked in an office was at Southern California Edison (SCE).

It was 1973. He was a civil engineer coming out of USC. His last day working in an office was also at SCE—37 years later, retiring as chief executive officer.

From working on the San Onofre nuclear power plant as a young engineer to helming SCE in the aftermath of the California energy crisis, Fohrer still maintains: "I am the typical introverted engineer. The former president of SCE once said the only thing you're comfortable talking to is your shoes."

Here's some snapshots from the evolution of an engineer.

FIVE LESSONS: AN ENGINEER TURNED CEO

1. There's a World Beyond Your Desk. Visit It.

Al Guerrero at SCE pushed me to a one year cross-training program in finance. I didn't want to do it. He didn't give me a choice—actually, he gave me three choices:

- I could quit.
- I could report to Farmington, New Mexico for a year (the Four Corners Power Plant).
- Or I could go to the treasury department.

Suddenly, finance looked pretty good for a year. (My new boss) Mike Noel became a good mentor and a friend. A number of times along the way, when there was a safe choice and an unsafe choice—Al pushed me to do what was more risky...this lead to meeting people like John Bryson, the future chairman of the company and current nominee for U.S. Secretary of Commerce.

2. Your Investment Portfolio: Consider Humans

I've had young people come up at SCE, and I've talked to them and later on, several years later, they'll come back and say, "Do you remember when you did this?" And I honestly don't. But clearly that five minutes had meant an awful lot to them. Taking time for people is probably the most important thing we do.

3. The Higher Up You Go, the Less You Do Yourself

You get everything done by other people. And how you treat people—that loyalty and commitment you want, it doesn't come from money. It comes from the fact they feel valued. It isn't just saying, oh, you're valuable. Anybody can do that.

What I'd like to do during our management meetings, I wanted to make sure everyone felt like they could challenge me. If someone came into my office to see me, they treated it as if I was doing them a big favor—I tried to let them know what a big favor they were doing by coming in and talking.

If they're afraid to tell you something, they'll watch you walk off the plank.

4. Your Enemy Today is Your Friend Tomorrow

Being a regulated utility, legislators and regulators have a big impact on us.

You'd have people who'd advocate strongly against your position. And if you take it personally, then you really do make enemies. What you find is that same person, later on, is very much the person you're in line with. What helped was getting to know them as people. Not just 'you're the enemy and I'm over here', but actually sitting down with them and getting to know them. That type of civility made a big difference.

5. You Are Not Atlas.

I had a young guy, even in recent years, come up and say, "You look like you're carrying the whole weight of the world on your shoulders." You'd realize, I'm internalizing things too much. You want to remind yourself to have fun.

Alan Fohrer, seen here during his tenure as CEO with SCE, credits his training as an engineer "with providing the analytical framework for solving big problems," particularly coming out of the 2000 energy crisis.

Edison went through a near death experience during the 2000 energy crisis. I think the people at the company at the time, they never lost sight of seeing the good things in people.

I love teasing and bantering with people. It's almost like you set the tone for 'that type of thing's all right.' When everything becomes so serious and people feel on edge all the time, they lose that sense of fun. I had a number of our younger officers that just loved this. They felt free to take a cheap shot that would get everyone laughing. When you set the tone that you can laugh at yourself, then people feel when there's a real serious issue, they feel they can challenge you. //

THREE VITERBI MEMORIES: PORTRAIT OF AN ENGINEER AS A YOUNG MAN

1. The Conversation

Like all freshmen entering into Viterbi, you're pretty much intimidated by the course load. One of the toughest courses that first year is Physics 151. We had a professor named Dr. (Gerhard L.) Weissler. The first test just about wiped out the entire class. The average score was like 17. I had something like a 50—I'd never had a score like that. I went into see him because I was thinking about dropping the class and changing to business. I was just lost. Now, I've never seen anyone that could intimidate 200 people at one time. And when you're in his office, I remember walking in and I remember walking out, and I don't think I remember anything else. Except for him saying, "And you will do fine, jah?" He had this thick German accent.

On the second test, I got a 90, which was the highest or second highest grade of 200 people. The only thing I could think later was that he terrified you so much that you had to do well. That was such a turning point because I was literally going to drop out of engineering.

2. The Mentor

Toward end of senior year, there was an associate dean (at Viterbi) who had a profound impact on a lot of us. His name was Clark Howatt.

It was the first time somebody said to me, "I want you to be more of a leader; I want you to step up." That really shaped how I started to see myself after school. Clark, once he got a hold of you, you never really got away.

We'd come to Clark about problems with undergraduate education, and he said, "Well, what are you doing about it?" We're looking at each other, going, "What do you mean, 'What are we doing about it?'"

He encouraged us to get involved. One of the things we put on the first year we were out of school was career day. It was an offshoot of my senior year when I didn't think we did enough. As a young engineer just out of school, we organized companies—Disney, Edison, Hughes Aircraft—to come in and spend time addressing freshmen and sophomores. In our view, the school was losing an awful lot of people during their freshman and sophomore years because they had no idea what an engineer did. So we got the companies to come in and set up booths and focus on younger people, as opposed to just graduating people.

3. The Showdown

There were a couple of us that went to see Dr. Kaprielian, the legendary dean of the school, later provost. I went to meet with him and caused all kinds of problems...I later learned undergraduates don't see Dr. Kaprielian. I told him there are problems with undergraduate education, and I'd like to have a meeting. He set up a meeting with me and all the department heads. Later, (the week before graduation) they had a meeting of all the professors in Olin Hall—my roommate and I came and addressed all the professors on problems in undergraduate education. Clark Howatt encouraged us to get involved, don't complain—do something.

It was my introduction to something other than just being an engineer, sitting down and doing calculations. That was the capstone of my career as an undergraduate, sitting down and addressing the faculty. //

Nano-Scale Architect

LYNDEN ARCHER (B.S. '89) REFLECTS ON ALL MANNER OF BONDS, BOTH COVALENT AND TROJAN *by Adam Smith*

When African-American students in Lynden Archer's sophomore fluid mechanics course see him at the head of the class, they often feel "he's one of us"—an African-American like them who has risen to the head of Cornell's School of Chemical and Biomolecular Engineering.

However, it took the intervention of USC for Archer to feel like "one of them."

"The beauty of what USC did," said Archer, "was give me the chance to come to the U.S. and be taken out of context—someone from Guyana (South America) of African descent—and find myself in a whole new context, as an African-American."

In 1986, Archer received one of the very first international merit scholarships from USC. He said goodbye to his warm, breezy city on the Atlantic, the bauxite mines of northeastern Guyana, chasing his older brother, Glendon, who had already stoked the flames of sibling rivalry among his many brothers, earning a degree in metallurgical engineering from Columbia University.

Archer matched him: he earned a B.S., Chemical Engineering (Polymer Science) from USC in 1989. He did it in three years.

Archer has two children now, a son and daughter, ages 11 and 14, respectively—the exact ages he was when his father and mother died, prompting the defining "emotional and spiritual struggle of my childhood." He has the directorship of a prestigious Ivy League engineering program, a $25 million grant from King Abdullah of Saudi Arabia to study the big carbon issues of the region and the world, a start-up company, NOHMs Technology, based on his Cornell research, and a garden where he grows "boring things like Japanese eggplants."

And yet through all of it, he still can't shake the words of his mother, Joyce Maria Archer, words he heard over and over again as a child:

"Anything worth doing is worth doing well."

Archer once despised hearing those words. Now, he finds himself repeating them to his own children: "If you aspire to be a janitor, aspire to be the very best that ever was."

Archer does his own aspiring these days in the world of Nanoparticle Ionic Materials (NIMs)—a new material discovered at Cornell. NIMs, a hybrid of organic polymers and inorganic particles, can be shaped and molded in all sorts of remarkable ways. For carbon dioxide molecules, belched out of power plants in the form of super-hot flue gases, NIMs have the knack of capturing them, bonding with them in a sort of molecular Stockholm Syndrome and re-making them as something useful and benign, say, a polymer that can be re-purposed for the windshield of your car.

In addition to kidnapping greenhouse gases, NIMs have shown promise as materials for solar energy conversion, water desalinization, and even greater promise as electrode and electrolyte materials for the creation of high-performance, long life, rechargeable batteries. Needless to say, it wasn't long before King Abdullah University of Science and Technology (KAUST) came knocking on Archer's door in the form of a new KAUST-Cornell Center for Energy and Sustainability. As co-director of the KAUST-Cornell Center, Archer coordinates the resources of seven partner universities, focusing on the basic science and applications-oriented research critical to Saudi Arabia and the world.

Archer has never forgotten the merit scholarship from USC that paid his full tuition—to him, it remains one of the important ways of ensuring diversity both in the classroom and in the realm of ideas.

"Every generation we've replenished our stock of engineers and scientist by recruiting from the world," Archer said. "This cycle gets repeated again and again."

For Archer, that cycle began with one of his early mentors, Viterbi Professor Theodore Tsotsis, past chair of the Mork Family Department of Chemical Engineering and Materials Science—himself an expatriate of Athens, Greece. "He had a great impact on me," Archer said. "There was a big focus on acid rain at the time. As an undergraduate, I worked with Theo on a research project aimed at converting a hydrogen chloride waste gas streams into chlorine, a very useful commodity."

Archer's excitement these days increasingly turns to rechargeable/secondary batteries—namely, using NIMs as electrolytes and electrode materials to create new lithium batteries for cell phones, laptops and electric vehicles. His company, NOHMs Technology, has ambitious plans: smaller, safer lithium batteries with 10 times the cycling life and storage capacity.

Frankly, Joyce Maria Archer would insist. //

Alumnus Lynden Archer, now co-director of the KAUST-Cornell Center for Energy and Sustainability, leads a seven-university research consortium with Saudi Arabia.

ENGINEERING ME

Lynden A. Archer

William C. Hooey Director of Cornell's School of Chemical and Biomolecular Engineering

Engineering/Science heroes: Albert Einstein. A brilliant man—who understood the value of communicating ones ideas to the public and who loved life.

Toughest USC class: Finite element methods.

Favorite USC professor: Theo Tsotsis (departing chair, Mork Family Department of Chemical Engineering and Materials Science) and Kathy Shing (associate professor, Mork Family Department of Chemical Engineering and Materials Science).

Bragging rights: A sense of pride when I look back on where I came from.

Kids (what do they want to be?): My wife is also a chemical engineer. You put two engineers in a household, and you can be pretty sure their kids are not going to want to be engineers! Our kids are very bright and enjoy math and science. When the time comes for decisions about their career, I am certain engineering will feature highly among their choices. My daughter named our company, NOHMs Technology (focused on nano-material solutions for higher-energy, long life batteries). Batteries are something they know about and can understand the need for improvement. They play video games and know better batteries are needed to increase play time-before recharge. So, in this instance science finds expression in a product that is familiar.

On the nightstand: *World Without End* by Ken Follett (sequel to *The Pillars of the Earth*)—I am a big fan of history and of historical fiction.

How do you spend your free hours: I cycle for fun. Ithaca (New York, where Cornell is based) is an excellent locale for cycling. The terrain is wonderful and the scenery idyllic—lots of hills and valleys. I also garden. Very boring stuff, really—Japanese eggplants, spinach, Chinese long beans. I like to grow these vegetables because they are easy to cook, but difficult to grow in the up-state New York climate.

Favorite movie: "The Matrix," "The Lord of the Rings" and "Legends of the Fall"

In the next 10 years: I'm a one step at a time person. I usually don't think in terms of grand plans by decade. I will say the challenge of this decade has been and will be leadership. The next decade will likely be focused on commercializing technologies from my research—growing our company—our kids will be in college by that point!

Things I'd save from the fire: Laptop. It contains an unbroken record of everything I have ever worked on.

I wish I'd invented: A NIMs gasoline additive that boosts efficiency of the internal combustion engine.

Indispensable web-sites: BBC, Google, MSNBC, Yahoo! Finance.

Music to engineer by: Top 10 artists in playlist:
1. Bob Marley & the Wailers; 2. U2; 3. Pet Shop Boys; 4. Seal; 5. Creed; 6. Tupac Shakur; 7. Cranberries; 8. Sizzla; 9. Alanis Morisette; 10. Dixie Chicks

Me...Engineered

Where Art Meets Science

INVENTOR AND MUSICIAN NEIL SIEGEL '74 REFLECTS ON A CAREER OF CREATIVE ACCOMPLISHMENTS *by Alana Klein-Prisco*

Robyn and Neil Siegel

When Neil Siegel '74, vice president and chief engineer at Northrup Grumman Information Systems, isn't inventing groundbreaking military systems, he's likely reading one of his 10,000 books or playing his favorite Persian instruments, the ney and tár. The Brooklyn-born, but L.A.-raised award-winning scientist and engineer, who added a Ph.D. from USC to his long list of accomplishments last May, has bridged the proverbial arts & sciences divide, proving that creativity is an integral part of discovery.

Simply put, "I like to create stuff," Siegel says. "I find the creative process very satisfying because it combines technical skills and art, which explains why I have been a musician my whole life and why I chose the field of systems engineering."

As the son of an electrical engineer (his mother, USC '57 and '62) and a chemical engineer (his father), Siegel was destined to follow suit. He majored in mathematics as an undergraduate at USC, and then earned a master's degree in the field two years later. "Math was not very popular in those days. It was very rigorous, but I liked it," he says.

He then took a job at TRW, which was later bought by Northrop Grumman, as a computer programmer. He continued a career in computer programming for another few years, but increasingly felt a pull toward systems engineering. "I fell in love with it. I found it so interesting and foundational," he says.

From then on, systems engineering became his focus and passion. As a systems engineer, he invented several successful military and intelligence systems, including the Blue-Force Tracking system, a GPS-enabled system that has also found its way into consumer products, the Forward-Area Air Defense systems, and the Army's first unmanned aerial vehicle, among many others.

One work assignment took Siegel and his wife, who is also an accomplished singer and dancer, to the Bristol region of England, where he worked for the British Ministry of Defense. "I had always dreamed of living overseas," he says. Opting for an adventure, he and his wife chose to live in the village of Castle Combe, with a population of 100, in North Wilshire, England.

For such a prolific inventor of military programs, Siegel says he got involved in military projects by happenstance. "I didn't know much about the military or anyone who had been in it. But that's what I was assigned to and it turned out to be a lot of fun," Siegel says.

Even with more than 20 patents and the Simon Ramo Medal, Siegel still hungered for new challenges and enrolled in a Ph.D. program in Systems Engineering at USC in 2008, finishing in 2011. "I probably had some disadvantages as an older student, but also some advantages having seen so much of the world," Siegel says. //

SIEGEL'S FAVORITE INVENTIONS

PHOTO 1: This is the U.S. Army's Forward-Area Air Defense Command-Control-and-Intelligence system, known as "FAAD C2I." It's responsible for protecting U.S. military land forces (and civilian personnel and structures in the areas near U.S. military land forces) against threats that travel through the air, engaging these threats at ranges up to about 6 km. **PHOTO 2:** The RQ-5 Hunter is the U.S. Army's first unmanned air vehicle in flight. It was originally intended to serve as the United States Army's Short Range UAV system for division and corps commanders. **PHOTOS 3, 4 & 5:** This is the Force-XXI Battle Command, Brigade-and-Below System, known as "FBCB2." As the U.S. Army's principal combat battle command system, it provides command-and-control, situational awareness, logistics management, and other functionality to front-line combat forces in all Army branches.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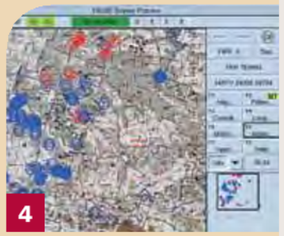
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In Memoriam

Elaine Masako Iba (MSEE, '88), 50, of Mission Viejo/Trabuco Canyon passed away on August 20 after a brief battle with lung cancer. An electrical engineer employed by Raytheon, her passion was athletics—she competed in USA Bobsled Team Trials and America's Cup races, and played Women's Professional Tackle Football, concluding her career as a captain and quarterback for the Southern California Breakers. Elaine is survived by her husband of 19 years, Randy Messenger, mother June, step-mother Margaret, sisters Nadine, Diane, Lynn, brother Wayne, step-sister Mylene, and many adoring nieces and nephews.

John H. Marburger, III, 70, former USC professor of physics and electrical engineering, and later chairman of the physics department and dean of the university's College of Letters, Arts and Sciences, died July 30 at his home in Port Jefferson, Long Island. A former president of Stony Brook University, he was a Democrat who served as science adviser to President George W. Bush. His survivors include his wife, Carol; their two sons, John and Alexander; and a grandson. His younger sister, Mary Hoffman-Habig, also survives.

Charles Luck (BSEE, '57), 77, and his wife Liping "Rose" Tang-Luck, died July 24 when their small plane struck a mountain near Juneau. Luck had been flying since age 20 and was a commercial instrument rated pilot. He owned his Cessna 182 for 30 years. Luck flew while he was obtaining an engineering degree from USC and when starting his own company Sound COM Engineering. He is survived by his children.

Brig. Gen. Wayne E. Schramm (MAOM, '67), 75, died Saturday, July 23. He served in the U.S. Air Force from 1958 to 1989, many of those years at the Pentagon. During his career, he received the Bronze Star, the Distinguished Service Medal and many others. He is survived by his wife Jean; brother, Dr. Vern Schramm; two daughters, Susan (Scott) Wilson and Judy (Wayne) Anderson; and eight grandchildren.

Tsen-Chung "T.C." Cheng, 66, an internationally known authority on power systems who was part of the Viterbi School's "Smart Grid" research initiative, passed away in his sleep July 12 at his San Marino home. Born in Shanghai, China, the 36-year Viterbi faculty member was named the Ming Hsieh Department's Lloyd F. Hunt Professor in 1984. The author of over 130 peer-reviewed publications, he co-founded three companies and held numerous patents in power engineering. He is survived by his wife Doris and son Jason.

Lt. Col. Stephen J. Demora Jr. (MSSM) 68, of Alabama, passed away July 7. He retired from the U.S. Army Aviation and Missile Command as an operations research analyst with 37 years of service, including assignments in Vietnam, Bosnia, and Germany. Survivors include his wife of 41 years, Janice; daughters, Judith Kliesner and husband Matthew and Jennifer Demora; grandchildren, Elliott, Noah and Lauren Kliesner; and sister, Helen Domis and brother-in-law, Gene Domis of Columbia, S.C.

Walter "Jim" Portenier, (BSAE, '69), 83, passed away on June 29 in Naples, FL where he has resided since 2004. An Army veteran of World War II, he joined the Aerospace Corp. at El Segundo in 1961, retiring from there in 1985. He was a Fellow of the American Institute of Aeronautics and Astronautics for over 50 years. He is survived by his loving wife of 18 years, Patty Caldwell, his daughters, Andrea and Renee, five grandchildren and a niece and nephew.

Eugene Barker Hoggatt, Jr., (BSCE, '58), 78, passed away after a long illness with Parkinson's Disease on June 21 in Tustin, CA. He enlisted in the Army during the Korean war and was assigned to the CIC (Counter Intelligence Corps) and was stationed in Iceland. After graduating from USC he attended Harvard University graduating in 1961 with and MBA. Gene's professional life was spent as a project manager in real estate. He is survived by his wife of 40 years, Shirley; son, Eugene B. Hoggart III; daughter-in-law, Lisa; granddaughters, Jessica and Leah.

Raymond "Ray" John Adams, Jr. (BS, '51), 82, passed away on June 19 in Carmel. He served as Lieutenant in the Army Corp of Engineers during the Korean War and co-owned and operated Ray Adams Construction Co. of Salinas for some 35 years. In his later years, he was the assistant tennis professional at the Ken Roswell Tennis Center on the Gold Coast of Queensland, Australia. Ray was preceded in death by his wife, Arva.

James "Jim" Lafayette Nash, 66, a 1972 USC graduate, died of a heart condition on June 18, while vacationing with his wife in his favorite place in the world—Kauai. A licensed minister in Ventura, he was a devoted Trojan all his life. He is survived by his wife, BJ; children, Ryan, Jonathan and wife Chelsea, Kelly and husband Santiago; and four grandchildren.

Louis John Gavin (MSAE, '66), 70, died on June 10 as a result of complications following surgery in Seattle. A member of the Green Berets during Vietnam, he received numerous commendations including the Bronze Star. Following service in the military, he worked for Boise Cascade and Bayliner, operating a plumbing supply business and Central Steel and Tank in Yakima. He is survived by his mother, Veda Gavin, his children, Kerry Stout, Kelley Hatfield, Peter Gavin and Carly Buwalda, his sister, Sally Nash and his brothers, Jim Gavin and Pat Gavin, numerous grandchildren, nephews and nieces and their children.

Q&A

Q&A: Kristina Lerman on Social Networks, Flash Mobs and the Former Soviet Union

Project Leader, Information Sciences Institute and Research Assistant Professor, Department of Computer Science

Tell me about how you came to the U.S.

I was born in the Ukraine—raised by a single mom—and being Jewish, the natural choice was to emigrate from the Soviet Union. Jews couldn't get an education in the Soviet Union; there were strict quotas on admission of Jews to institutions of higher learning. We came to this country when I was 12, settled in New York City, where the best and the brightest studied math and science at Stuyvesant High School.

What do you remember from the former Soviet Union?

It's all gone now. Gone from the mists of history. I remember being a Young Pioneer. They did a good job brainwashing kids—it was a special honor to be a Young Pioneer. There's a ceremony at the naval academy, the young naval guys tie the red scarves around you—this is a sign you're contributing to society, helping others. It's girl scouts with mandatory membership.

Does any of this inform your current work?

In the United States, everyone is obsessed with personal responsibility. That's the big theme. Everyone's responsible for himself/herself. In the Soviet Union, when I was growing up, you were responsible to others; you were responsible to your community. The theme of responsibility to others, the United States could benefit greatly from that.

No man is an island. In the complex systems, complex networks I study, everything is intricately linked. Your behavior affects the behavior of others, who, in turn, affect your behavior. There's no such thing as you by yourself make your own life.

How did you get into social networks?

I studied physics (complex systems). I knew I was going to get a Ph.D. in physics at 14. To me, that's just what smart people did. They figured out the secrets of the universe.

Then in 1994-95, the web happened. I remember just getting lost in it—following one hyperlink to another—there weren't even search engines yet. I made the decision right there I wanted to go into the web field.

In 2005, I was an amateur photographer—I was very passionate about it, participating in on-line forums, especially child photography—and somebody sent me a link to a Flickr stream. Once again, I was just lost in Flickr—but I wasn't just following hyperlinks between pages, I was following links between people. I was exploring one photographer's stream, seeing who commented, what they said, going from one stream to the next.

What are you working on now?

Right now, we are working with Twitter, using their follower graph. For every person who tweets something, we have that data set. The tweets contain URLs that we use as markers to track how information spreads through the network. Who are people following? Who are *those people* following? Who are the influential people in the network? It's like a huge bowl of spaghetti. You can't visualize it. So we use algorithms like Bonacich Centrality.

Social media has played a big role in the social unrest from London to Cairo. What lessons can be learned here?

(British prime minister) David Cameron followed the example of Middle East leaders in calling for a black out of social media sites. Such a response is inappropriately heavy handed and may ultimately prove counter productive by driving social media users deeper underground to even more unscrutinizable networks than the BlackBerry Messenger.

A lesson about such a move can be learned from the Bay Area Rapid Transit system, BART, which shut down phone and data service on its trains and stations to thwart flash mob protests over police actions. The protests still materialized, and the ensuing chaos, which closed down several BART stations at peak commute time, gave people even more things to be unhappy about. It will take BART years to repair its image. BART officials could get a few pointers from the Los Angeles Police Department... After a recent Hollywood "near riot," they assigned social media-savvy police officers to monitor Twitter streams.

In terms of your research, if there was an emergency and the government wanted to tweet specific instructions, could your models predict how quickly that message might spread?

Or hopefully my models could help them see who they should be sending those messages to in the first place—who should be asked to retweet the message so that it reaches the largest number of people.

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