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The vision that drove these accomplishments originated from the need to solidify our prominence in the context of a rapidly changing global, contextual and economic landscape, and to lead the quest for new paradigms in engineering education and research.

This vision is encapsulated by the statement that we should aim to make the Viterbi School:

- First of its kind
- A leader in the nation
- With constantly improving quality, and excellence in all of our endeavors

As the university is moving into a new era, with new leadership, and as I have been humbly entrusted with another term to lead this remarkable school, the vision for our school is as clear as before. I am adding a re-focusing dimension:

- Advancing and Fulfilling the Promise of Engineering to Empower Society as the Enabling Discipline of our Times—in What We Call Engineering.

Following this vision brings visions of breathtaking views. We see an underestimated educational experience enriched with collaboration, entrepreneurship and communication skills, and enhanced with community and global outreach.

We continue to pursue the fundamental discovery of new materials, processes and devices in collaboration with the sciences. We are forging new paths in interdisciplinary research and scholarship in close partnerships with medicine and health sciences, policy, communications, social sciences and the arts.

We are hammering out solutions to vexing problems, such as the NSF Grand Challenges, the promotion of which has been an unrelenting task of the Viterbi School along with its partners. We are also initiating a generation of new professionals with the skills and tools to implement these transformations and be the catalysts of change.

In the fall of 2010, this vision is as clear as 2020.
PARTICLES

Targeting Dirty Diesel Emissions
NEW USC VITERBI SCHOOL INSTITUTE FORMED TO IMPROVE COMBUSTION EFFICIENCY

A Hong Kong shipping executive has pledged up to $41 million to fund a research program at the University of Southern California to reduce emissions and improve combustion efficiency in marine diesel engines.

Kenneth Koo of TCI Hong Kong Shipping Co. Ltd. (HKSC) has collaborated with industry and academia in order to substantially reduce the greenhouse gas emissions and fuel consumption emitted by conventional large-bore two-stroke, single-acting marine diesel engines used by the world’s merchant shipping fleets.

“The best way to initiate change is to partner with an institution of higher learning,” says Koo, TCCH’s group chairman and CEO. “Let’s come up with designs that work and bang on the marine walls of industry.”

The problem Koo wants to solve is significant. Most of the world’s merchant ships, including tankers, container ships and bulk carriers, use large diesel engines that emit significant amounts of carbon dioxide, toxic pollutants and particulate matter. These emissions contribute to greenhouse gas buildup in the atmosphere as well as serious public health problems.

Complicating the problem are the lower-priced, lower-quality fuels typically used by merchant ships and modern emissions standards for the ships’ engines, whose design has been virtually unchanged for 100 years.

Koo has worked with the USC Viterbi School of Engineering to establish the new TCCH Institute for Emissions Reduction from Marine Diesel Engines. The plan provides a five-year research framework to assist TCGC Group with its efforts to reverse, recover or reduce greenhouse gas and other emissions.

The Viterbi School’s research plan will proceed along two paths:

• A combination study that will compare and measure differences in emissions and efficiency between diesel engine combustion by conventional means with that assisted by transient plasma ignition (TPI).

• A nano-second pulsed power study that will develop diesel-prototype transient plasma ignition equipment to achieve more complete combustion in diesel engine cylinders.

The first phase of research will be conducted at USC, with the goal of producing diesel-prototype technology that can be scaled up for eventual testing in actual full-size engines.

Koo intends for his company to lead the way by funding research from his own charitable foundation, and engage engine manufacturers and shipping owners around the world to commercialize and fully implement the technology.

Viterbi Dean Yannis Yortsos says the school is thrilled to be working with TCCHC and its visionary leader. “We applaud Kenneth Koo for his interest in conducting truly path-breaking research that could improve combustion efficiencies, while saving fuel and substantially reducing pollution,” says Yortsos.

Viterbi School professor Fotakis Kip taxopoulos, of Aerospace and Mechanical Engineering, and Martin Guntelum, of the Ming Hsieh Department of Electrical Engineering, will be the principal investigators.

Exploring Deep Space? The Mariana Trench
NANOSCALE ENGINEERING PAVES THE WAY FOR EXTREME TEMPERATURE APPLICATIONS

Andrea Hodge operating the Magnetron sputtering chamber inside Ronald Tuten Hall.

Andrea Hodge has a vision for getting to Pluto.

That mission can’t be accomplished with current technologies. But if Hodge has her way, the limitation won’t be because the shuttle engine decomposed due to extreme temperatures on the way to the edge of the solar system.

The Viterbi School assistant professor of aerospace and mechanical engineering (AME) is working on a new direction in materials development by studying nanoscale twin boundaries, or the interface between clusters of atoms of a particular material.

The desired result? Improving multi-layered thin film coatings using interrupted deposition to improve a material’s thermal stability and ductility.

Materials engineered at the nanoscale—defined as smaller than a tenth of a micrometer—typically have very high strengths. Yet when heated, they often lose all the benefits of a nanoscale microstructure due to an increase in grain size.

Hodge aims to customize materials so that they last longer, weigh less, and withstand the most extreme heat and cold temperatures.

All this begins with a little bit of thinning with grains and grain boundaries. Hodge aims to change the size and shape of each grain to increase the numbers of interfaces that allow engineering to certain, desired properties.

The machine that makes her work possible is a $1.5 million behemoth called a Magnetron sputtering chamber, which sits in a laboratory at Ronald Tuten Hall.

“It’s a very sophisticated machine,” says AME Department Chair Geoff Specding. “Not many universities have something like this at the industrial-scale size.”

The chamber allows Hodge to create thin layers (coatings) through physical vapor deposition of almost any element in the periodic table. The layers can vary in thickness from one nanometer to hundreds of nanometers. “Atom by atom,” says Hodge. “That’s how good our control is.”

The resulting material is tested for functional properties such as yield strength and hardness. And the results have been very promising.

Tike copper. After running regular copper through Hodge’s process, the resulting material—still pure Cu—yields a strength of 1,000 Mega Pascals. That’s five times stronger than typical copper.

“We can actually change what Mother Nature made,” says Hodge. “Instead of being face-centered cubic copper, we can make it body-centered cubic.” Hodge’s team is also working with Tantalum (Ta) and Niobium (Nb).

The applications for her work are vast. Using high-temperature unstructured coatings its engine means that they’ll last longer, use less fuel and withstand extreme temperatures.

“You could also use these coatings for turbine blades, aerospace applications, or anything else that must withstand severe heat or severe cooling,” Hodge says.

Tackling Blowouts in L.A.’s Water Supply
IMPACTING POLICY WITH ENGINEERING EXPERTISE

A rash of well-publicized breaks in Southern California water mains disrupted communities and destroyed streets during the summer of 2009.

Jean-Pierre Bardet, chair of the Sunny Astani Department of Civil and Environmental Engineering (CEE), led the blue-ribbon panel tapped by the city of Los Angeles to discover the causes.

As director of the USC Center on Megacities, Bardet brought to the investigation a history of bringing together experts from all disciplines—including engineering, architecture, economics, policy and public health—to innovate for a better future for megacities with more than 10 million people.

The water main breaks raised concerns from the media and the public about the safety of the city’s water distribution system. Why did they occur? Did the city’s new water retuning system play a role? Were old water pipelines being replaced in a timely manner?

To find answers, the committee met with Los Angeles Department of Water and Power personnel, studied system characteristics such as pipe diameter, thickness and age, and drew comparisons with other systems in large urban areas, including San Diego, Washington, D.C., and New York.

The team analyzed years of historical information about the immense L.A. water system, which involves 3,200 miles of pipe delivering 200 billion gallons of water at cost of $1 billion per year. They examined the chemistry of the soil and subsurface movements of the surrounding geologic area. They worked with Jet Propulsion Laboratory researchers to measure real-time stresses using satellite and ground sensors.

A conclusion began to emerge: The team found that the rationing policy—specifically, limiting lawn watering to two days a week—meant water pressure in the system dropped on certain days. This created stressful cycles of pressurization and depressurization for pipes.

The result for the pipes? Metal fatigue—the same phenomenon seen when someone breaks a coat hanger or paper clip by repeatedly bending it back and forth.

"The bottom line is, you want to create a more even usage... so you don’t have a sudden drop of water pressure at a given time of the day," he told the L.A. Times and various TV news crews following the release of the report in February 2010.

Bardet and his committee recommended an alternate, more gradual water conservation plan to help avoid future blowouts. And such a plan is now in effect. The committee’s work resulted in a computer model that portrays the LADWP’s distribution system in unprecedented detail, with the biography and composition of virtually every section of pipe documented.

Tat Fu, a CEE postdoctoral researcher, and Richard G. Little, director of USC Kester Institute for Public Finance and Infrastructure Policy, also sat on the investigative committee.

Mr. Meshkati Goes To Washington
REFLECTIONS FROM A YEAR AS A JEFFERSON SCIENCE FELLOW

This summer, industrial and nuclear safety expert Najmieh “Naj” Meshkati completed a year as a Jefferson Science Fellow. Run by the U.S. Department of State, that program called for Meshkati to serve as a Senior Science and Engineering Advisor for the Office of the Science and Technology Advisor to the Secretary of State. Established in partnership with the National Academies and the science, technology and engineering community in 2003, the Fellowship’s purpose is to create a platform by which science and engineering can inform foreign policy decisions. Meshkati, a professor of the Sunny Astani Department of Civil and Environmental Engineering and the Daniel J. Epstein Department of Industrial and Systems Engineering, offered this reflection on his experience.

Mr. Meshkati’s efforts in Washington, D.C., revolved around the development of science and engineering diplomacy initiatives for partnership creation, capacity building and conflict resolution, especially as such initiatives are needed for interacting with countries in the Middle East.

My work encompassed integrated technical and policy-based, systems-oriented frameworks to improve the safety and reliability of large-scale technological systems in the civil aviation, nuclear power, and upstream and downstream oil industries. It was not only a journey to Capitol Hill but also a global adventure: I met with scholars, diplomats and policymakers in Athens, Paris, Bahrain, Cairo, Alexandria, Timb and Stockholm over the last seven months.

One of the most interesting experiences of my assignment? The opportunity to closely observe the making of a major threat of the Obama administration’s foreign policy. Following President Obama’s historic address to the Muslims of the world in Cairo on June 4, 2009 which he dubbed “the New Beginning,” the administration embarked on a series of initiatives geared toward the realization of meaningful collaborations in science and technology for developing new sources of energy: green jobs, digitized recombinant clean water and new crops.

Now called the “Global Engagement,” they comprise a major U.S. foreign policy initiative that could eventually rival the Marshall Plan. As that 1948 program helped rebuild the broken countries of Europe following World War II, the Global Engagement initiative could also substantially rebuild badly damaged relations between the U.S. and Muslim majority countries, if it is formulated correctly and executed prudently.

Something else that impressed me was the direct, key role that young, enthusiastic staffers play in the administration’s policy formulation. Although they may not “make” final policy, they are surely the brains behind its framing and institutionalization. Many of my talented former USC students, especially engineering students who choose interdisciplinary paths, are certainly at least as remarkable as these staffers, if not more so. I came back to campus with renewed interest in encouraging my future students to try seek such influential positions within departments of the executive branch in Washington, D.C.

They can make a difference.

Throughout the year, I felt doubly proud of my Trojan connections—USC affiliations as both an engineering alumnus (BS EMT ’78 and PhD IE/ SE ’83) and a faculty member. During an important meeting last April at the headquarters of the League of Arab States in Cairo, the high-ranking host thanked me for my technical and diplomatic contributions, and also noted that “he is coming from one of the best universities in the world, the University of Southern California.”

On the April of his fellowship, Meshkati was selected to serve on a National Academy of Engineering/National Research Council panel investigating the BP Deepwater Horizon explosion and Gulf oil spill.

WILLOW GARAGE ROBOT COMES TO CAMPUS
The Viterbi School is one of 11 universities worldwide whose research proposals survived a rigorous screening by the robotic company Willow Garage. As a result, a Willow Garage PR2 (Personal Robot 2) has arrived at the Robotics Lab in Tutor Hall. The arrival kicks off a three-year program in which the Viterbi School will pursue research and development goals critical to developing sophisticated mobile robots.
Smile, and soon the Webcam Will Know You’re Smiling
DEVELOPING FACIAL EXPRESSION RECOGNITION TECHNOLOGY

Can a webcam system figure out whether you’re happy or angry, and adapt its reactions depending on your state of mind? Gérard Medioni of the Department of Computer Science is well on his way to determining the answers. The HP Labs Innovation Research program has selected Medioni to develop new and inexpensive interfaces for human-computer interaction.

“The technology we propose to develop is a real-time, efficient and general facial expression recognition prototype,” says Medioni’s research proposal. The new work will build on technology previously developed by Medioni’s lab and is composed of two modules. The first one estimates the 3D head pose and facial deformations, and the other classifies and describes expressions using a non-linear manifold learning process.

The existing technique is effective and can accurately recognize eight expressions—surprise, anger, joy, disgust, sadness, eyes blinking, left eye winking, and right eye winking. However, it requires prior 3D mapping of individual faces.

The new system aims higher: incorporating a temporal dimension in analyzing faces captured on video, and then using adaptive algorithms to fit them on the fly to a generic 3D model for real-time frame rate implementation, says Medioni.

“Such a system should allow a user to experience seamless immersive interaction, and will constitute a major step toward the development of new, reliable, fun and inexpensive interfaces for human-computer interaction,” he concludes.


The Viterbi School’s 2010 Commencement Webcast Goes Global!

On May 14, 2010, the USC Viterbi School of Engineering hosted nearly-2,000 Trojan graduates, alumni, family and friends via a live webcast. At its peak, the audience from Asia and North America drew the largest audience. In the United States, California and Texas had the highest viewership. We were proud to welcome our virtual audience to commencement ceremonies.


M.C. Gill Commemorates His 100th Birthday

Viterbi leadership gathered at the California Club in August to celebrate centennial M.C. Gill, a Pasadena industrialist and longtime supporter of the Viterbi School. Gill, who graduated from USC in 1937 with a bachelor’s degree in chemical engineering, launched the M.C. Gill Corporation out of a rented garage in 1945. He grew the company from a mom-and-pop maker of composite roof panels into the world’s largest manufacturer of advanced composite materials, particularly Nomex. In 1976, Gill endowed an academic chair at the engineering school for the study of advanced composite materials. In 2002, he endowed and named the M.C. Gill Center for Composite Research at USC. Both he and his wife Hester sit on the Viterbi School Board of Directors.

M.C. Gill (center), with (l. to r.) wife Hester Gill, M.C. Gill professor Steven Pruitt, Viterbi Dean Vinita Hertogs, and Viterbi CEO of External Relations Christopher A. Strow.
Guiding the CS Department
A DECORATED COMPUTER SCIENTIST BEGINS HIS 2ND YEAR AS CHAIR

Shang-Hua Teng, with the backyard blackboard where he does much of his brainstorming.

Last fall, Shang-Hua Teng, the 2008 Godel Prize winner, came to USC to chair the Department of Computer Science (CS). Shortly after, he won the Kershner Prize for the highest honors in applied mathematics given to more than 30 years jointly by the American Mathematical Society and Mathematical Programming Society. He was also elected a fellow of ACM.

“I came to USC because its faculty contains pioneers in modern cryptography, software engineering and computational neuroscience, as well as younger stars in computer graphics, natural language processing, network sciences and robotics,” says Teng. “The CS Department here is also unique in that it has more than 40 research faculty members from the world-renowned Information Sciences Institute (ISI)—a major player in the creation of the Internet—and from the Institute for Creative Technologies (ICT).”

It was a return to campus for Teng, who earned a master’s degree from USC in 1987 before going on to Carnegie Mellon University for his Ph.D. He brings back to his alma mater a passion to elevate the CS Department as one of the world’s premier computer science programs.

“We need to focus not only on the strategic growth but also on the insti- tutional culture. The CS Department has become that much more of an exciting place for our students and faculty to learn and create,” says Teng of his vision about the department.

Part of this quest means making sure neither side of computer science—a discipline at the crossroads of science and engineering—is overlooked. “The science side tends to place emphasis on fundamental training and research, while the engineering side has more need for an immediate connection with applications and industrial practice,”

addition to being a top scientist in the field of intersecting theoretical computer science, game and economic theory, and scientific computing. Teng, who has 19 patents, has also developed software for some of the most innovative companies in the business.

During his first year at USC, Teng guided the department in the successful recruit of Yan Liu, a prominent female faculty in the strategic area of data analysis and machine learning. With the assistance of his faculty leaders, Teng launched a monthly Ph.D. social and organized a research conference to build stronger connections among students and faculty with varied research interests and between USC computing and its industrial and interdisciplinary partners.

Teng also taught a required undergraduate class which launched a curriculum improvement effort. The course also paved the way for the first-ever successful nomination of a CS student for the Mellon Mays Undergraduate Fellowship, which aims to increase diversity.

One agenda going forward is work- ing to build an “absolutely dominating at the national level” CS program at USC, and fostering concrete mechanisms to fully leverage and expand ISI and ICT’s expertise in areas such as natural language processing and digital graphics.

“My goal is to build a premier CS program so that we can continue to attract first-class scholars to USC and better place our students after they graduate, going not just to good jobs, but also to premier schools and to elite labs like Microsoft Research and Google.”

Two actors strapped in motion sensors circle each other, as engineering researchers study at the periphery of a USC Viterbi School of Engineering laboratory, taking notes. It’s an unusual partnership between the artists and engineers, and a union of the National Science Foundation (NSF) experts will achieve two historic methods of modeling human behavior.

The NSF, under its Creative Information Technologies program, awarded a three-year grant to faculty from the Viterbi School and the USC School of Theater and Dance to research how human behavior through improvisation and motion capture technology can be modeled by two performers on stage. The “ultimate Holy Grail is to be able to build technologies to mimic aspects of human behavior,” says Shri Narayanan, the Andrew J. Viterbi Professor of Engineering and professor of electrical engineering and computer science.

Armed with such state-of-the-art technolo- gies, scientists could build devices to help autistic children, create advanced methods for studying human speech and visual behavior, and perhaps even quantify humor.

“The applications are limitless given the fundamental nature of the issue we’re addressing—understanding human behavior,” says Sharon Camnicke, a professor in the USC School of Theater and Dance.

In the lab, Narayanan and Camnicke seek to collect digital representations of human emotion and behavior, one bit at a time. Drawing upon acting students, Narayanan and Camnicke have engineered the collection of hundreds of sequences for analysis and created a database they call the USC CreativityIT Database.

“It’s human data,” Narayanan explains. “Can we predict from these measurements? Can we develop a mathematical way of explaining patterns in human behavior?”

On one particular spring day, Camnicke supervises an improvisation exercise with two actors. Each gets exactly one action verb and one phrase they’re allowed to utter to achieve opposing objectives.

Outsides of these verbal instruc- tions, the sky’s the limit on physical interaction and expression. By controll- ing certain elements, the researchers can record data for the variables that spring from manipulating expressive voice and body.

Will Thomas reach for Rose’s arm? Will Rose eventually get frustrated and raise her voice? The conflict is easy to see, but how their interaction will play out in the real question.

Meanwhile, Narayanan monitors a sophisticated motion capture (tracking) system, which collects data from tiny sensors embedded in the actors’ black sleeveless jumpsuit.

“The resulting motion capture images make possible an intensely close analysis of what happens from moment to moment in the rehearsal hall,” says Camnicke. “It exposes the bones of the actors’ interactions.”

The mocap technology is that same as that used on the sets of films such as Avatar and Star Trek. But the purpose is different.

“Perhaps virtual humans or robots can eventually be designed to improve upon themselves,” says Narayanan. “Not just deciding to do it—but how to do it, also.”

Other potential applications span a number of domains that relate to behavior. They include addiction treat- ment, cognitive and behavioral therapy, customer care in business settings and global security applications where socio-cultural behaviors come into play.

In the first year the professors used scenes from Shakespeare and Chekhov to draw out the actors’ improvisations. Next year, the researchers plan to use real life scenarios, such as how humans behave after working for 90 minutes in the DMV.

ENGINEERING + THEATER
IMPROV THEATER AS A BASIS FOR QUANTIFYING HUMAN BEHAVIOR

HOSTING GREEN: THE L.A. CONSTRUCTION INDUSTRY COMES TO CAMPUS

Loading innovations in green building and construction sustainability headlined the 2010 Sustainability Leadership Conference Symposium at the Galen Center in April. Above, the last of the panels, was hosted by the Viterbi School and its Sonny Astani Department of Civil and Environmental Engineering. L.A. Mayor Antonio Villaraigosa delivered an address, and Viterbi faculty Hau Kofman, John O'Brien and J.P. Bardet gave creative presentations or panels over the event.
Faculty Accolades

VITERBI PROFESSORIAL AWARDS AND ACHIEVEMENTS

Murali Annavaram
Andrea Armani
Raj Ershaghi
Himanshu Inamdar
Michael Kasner

Murali Annavaram of the Ming Hsieh Department of Electrical Engineering (EE) join’s the school's roster of distinguished National Science Foundation CAREER Award winners. This funding will allow his team to answer fundamental challenges to processor reliability.

Andrea Armani has won a Presidential Early Career Award, the U.S. government's highest honor for scientists and engineers beginning their independent careers. Armani, of the Mork Family Department of Chemical Engineering and Materials Science (CHE/MS) and the Fluor Early Career Chair in Engineering, also won a 2010 NIH Director's New Innovator Award for his work in developing "ultrasonic nano-fibers for optical communications, solar energy and materials."

Her work is integral to developing faster communications systems and improving technology to capture solar energy.

Poulini joined the Viterbi School in fall 2008. She received her Ph.D. in physics from MIT and completed her postdoctoral work at Stanford University. She currently holds the Women in Science and Engineering (WISE) Junior Gabilan Chair and has received many awards, including the Army Young Investigator Award and a Presidential Early Career Award. She is the third Viterbi professor to be named to the TR35 in the last two years; Andrea Armani and Eiji Iwamoto were named to the 2009 class. Other previous winners include world-changing innovators as Jerry Yang of Yahoo, Google co-founder Larry Page, and Linus Torvalds of Linux fame.

Michael Kasner, Shri Narayanan, and Prasanna were elected Fellows of the American Association for the Advancement of Science. Kasner, of the Department of Aerospace and Mechanical Engineering, was named for his contributions to "human communication science and technologies and their application to engineering systems development." Prasanna, the Charles Lee Powell Chair in Engineering (EE), was honored for his work in the field of parallel and distributed computing.

Shri Narayanan, of EE and the Department of Computer Science (CS) with appointments also in linguistics and psychology, received the 2010 Distinguished Faculty Service Award for his service to the Senate-PIsost University Research Committee over the last five years. Other recent awards include an IEEE Signal Processing Society Best Paper Award and an InterSpeech Emotion Challenge Award, presented at the 10th Annual Conference of the International Speech Communication Association.

Bhaskar Krishnamachari of EE and CS has been named this year's recipient of the Frederik Emmons Terman Award by the American Society of Engineering Education (ASEE) and the award's sponsor, the Hewlett-Packard Co., selected Krishnamachari for his early contributions, including his textbook Networking Wireless Sensors (Cambridge University Press, 2005).
Aiding People with Developmental Disabilities

VITERRI SCHOOL UNDERGRADS BUILD DEVICES TO FILL REAL NEEDS

With the needs they had observed in mind, the students went off to the drawing board.

One student group's weeks of intensive work resulted in a mobile device designed to help clients use public transportation to get to and from their jobs.

The device provides prompts at every juncture where a person's route might change—literally every turn—and suggests corrective actions should the user get lost. The device is also outfitted with a panic button and a smart speech synthesizer, which enables bystanders to be alerted for help by broadcasting, for example: "Excuse me, could you help me get to Orchard and Adams?"

A second group chose to focus their work on facilitating more independent shopping activity by people such as Sarah, a 25-year-old woman with Down's Syndrome who lives with her family.

The students created a navigation/tasking system that featured an automatic, annotated shopping list, as well as an application that downloads maps of a specific street (in this case, a Trader Joe’s).

The device identified the locations of the specific items sought by Sarah, sorted the list by zones, and presented it in a logical navigational pattern for Sarah to follow. The application kept a record of successes and "errors" for assistance and intervention when needed.

Wizynski invited engineering leadership and disability experts to attend all student presentations in order to provide feedback in the development process. “Everyone in the disability community who saw the work was excited,” says Wizynski. “Our USC engineering students had produced a design that was in concert with needs in the field of disability.”

Several students hope to find a way to produce and market a variation of the devices they developed in the class.

One mobile creation helps people navigate public transportation. Another device downloads maps of local stores and creates ideal routes based on items on a shopping list.

Both are designed to bolster the independence of people with developmental disabilities. They are the result of efforts over two semesters by two Viterbi School computer science student teams who participated in this year’s Senior Design Capstone Projects.

The work grew out of collaboration between David Wizynski, a professor of computer science, and Barbara Wheeler, a professor of the Keck School of Medicine of USC and associate director of the USC University Center for Excellence in Developmental Disabilities at Children’s Hospital Los Angeles.

Wizynski’s students first learned from Wheeler that the developmentally disabled may experience problems with comprehension, memory, problem-solving and communication. They might also have trouble sequencing steps in a complex task or evaluating potentially dangerous people and situations.

Then, at AbilityFirst, which trains and employs people with developmental disabilities, the students observed and interacted with disabled individuals to better understand their needs.

“We talked about many communities needing easy-to-use devices to live more independently, to do routine tasks such as knowing how to use a taxi,” recalls Ian McDaid, director of Business and Employment Services at AbilityFirst.

X PRIZE Lab Starts Up at USC

VITERBI STUDENTS DEVELOP A CONTEST CHALLENGE AROUND SOLAR ENERGY

The X PRIZE Foundation—the not-for-profit organization that nurtures big prize-money contests to encourage talented researchers to tackle big problems—launched a laboratory in 2010 at the University of Southern California.

The Foundation aims to bring about radical breakthroughs for the benefit of humanity by incentivizing teams and individuals to tackle global challenges in the sciences, environment, education, global development and many other areas.

Developing technology around solar energy to make life better was the focus of the new USC lab, which launched a spring 2010 course, Engineering 420X, around the task.

The goal was to create specifications for new potential X PRIZEZ in the solar energy area to present to judges for consideration. The co-directors of the effort were Jonathan Lai, director of the Alfred E. Mann Institute, and Gene Miller, director of the Lloyd Greer Center for Entrepreneurial Studies in the USC Marshall School of Business.

The lab’s 16 students came from both the Viterbi and Marshall schools.

The students attended guest lectures about all aspects of solar, from technology to marketing. They then explored background technology and recommended ways to market and commercialize projects.

The result? Two team proposals on opposite ends of the scale, dealing with different parts of the world.

Microsystems in Africa. This second proposal involved a giant solar system with enough power to power the Orange Line of the Los Angeles mass transit system, day and night.

The next step involves seeking companies willing to put up cash to reward research success in solving solar energy challenges. In the past, X PRIZE sponsors have included Google for a lunar lander contest, and Progressive Insurance, for development of a next-generation car.

Eileen Bartholomew, senior director of prize development for the X PRIZE Foundation, said the organization was “impressed with the students’ enthusiasm and the caliber of their work this semester on solar energy.”

Viterbi Dean Yannis C. Yortsos says the X PRIZE effort “measures precisely the qualities we are trying to develop in our students, including the right blend between technology and entrepreneurship.”

The X PRIZE mission began in 1999 when Dr. Peter H. Diamandis, inspired by the story of the Ormig Prize that Charles Lindbergh won in 1927 by flying across the Atlantic, established the Foundation to encourage and promote contests similar to the one that spurred the Spirit of St. Louis flight.

Eileen Bartholomew with Viterbi Dean Yannis Yortsos.

X PRIZE Students Kyle Obergefell, Lorenzo Mangubat and Anna Harley-Treichlczynski.
Does the Sun Shine Brightly Enough in Hawaii?

VITERBI SCHOOL OF ENGINEERING

If you have a particular plot of land, do you choose to build a solar farm for photovoltaics, biomass or agriculture?” asks Vortos. “How do you make best use of the land and the surface area it provides?

“Ultimately, it becomes an issue of what decision society will make,” he concludes.

Vortos also addressed the important element of energy efficiencies, the role of nuclear power, and also the social and political issues that are critical factors in the implementation of renewable resources.

“I think the Tichonor II, a sophistication double major in aerospace engineering and economics, says he learned from Vortos environmental truths that “I wouldn’t easily find searching the Internet or reading the news.”

“The course has made me more well-versed in talking about energy at all levels,” says Tichonor, who partnered with mechanical engineering student and fellow sophomore Damian Peregino to research and present a project about Hawaii.

Vortos says the island state provides a unique case study for the implementation of renewable resources due to its geographic location and endless miles of coastline. Its population of 1.3 million has a daily energy consumption rate of about 1.9 million KWh.

Tichonor and Peregino examined Hawaii’s current mix of traditional and renewable energy production and looked at the potential for generating all its needs through alternative methods.

“We found that the potential for solar, in particular, would be huge,” Peregino says. “The potential for the sun’s energy in Hawaii is in a lot greater than other places.”

Yet, even with all that potential, less than 2 percent of Hawaii’s energy needs are currently being met through solar power. The students also looked at windpower, wave power and geothermal energy sources.

A version of the sustainability lectures was also presented as a mini-seminar to entering USC freshmen, namely “watts per square meter.”

VITERBI SCHOOL AIMS TO WIDEN PIPELINE FOR PH.D. RECRUITING

Realizing that it’s the students that help comprise a top-notch research and teaching institution, the Viterbi School launched its inaugural Engineering Achievers (REACH) event on campus this fall. REACH invites junior, senior and recently graduated national high achievers from groups historically underrepresented in engineering to visit campus for a three-day, all-expense-paid doctoral program preview.

They met with faculty and current students, explored research opportunities and learned more about Viterbi doctoral programs. They also toured campus, attended special workshops, and learned more about the graduate application and admissions process.

“Bringing talented students to campus to visit with faculty and current students is the most effective way for them to discover all that USC has to offer,” says Mangle Berti, Associate Dean for Doctoral Programs.

Forcing Global Engineering Education

USC and Peking University Collaborate for iPodium Class

The Chinese undergraduate students and their USC counterparts from the Viterbi and Marshall Schools sat in rows of four, facing each other with backs straight and faces attentive.

Nothing less than the Pacific Ocean, a 24-hour time difference and a video-conference connection separated them. Meanwhile, Viterbi School Professor Stephen Lu’s voice broadcast maximizes regarding the global economies and innovation opportunities of globalization.

“What’s really behind the subprime mortgage crisis?” asked Lu, who is the David Packard Chair in Manufacturing Engineering and a professor of Aerospace and Mechanical Engineering.

“Oversupply of credit. Traditional economic theory breaks down and doing business-as-usual will go terribly wrong,” 24-student faces registered engagement from two classrooms on the USC and Peking campuses, 6,000 miles apart.

In a groundbreaking exercise combining both the international and virtual, Lu this spring launched the inaugural course of the iPodium program, an experimental, cooperative global innovation education program between USC and the prestigious China University of Peking University (PKU).

“Podium is the next step in our vision for Technology-Enhanced Access to the Classroom,” says Viterbi Dean Yannis Vortos.

For the three-semester class, Lu and his counterparts at PKU, Dean Shihi Chen and Prof. Jianqi Tian, brought together a band of graduate students from both institutions. The Chinese students also do classroom work and join in class discussions, meaning presentations are 30 minutes long.

Lu said the deans, faculty and staff at USC and PKU, as well as support from the Distance Education Network made the course possible. He also thanked an anonymous donor, whose generous support enables students from two top universities in USA and China to learn with, and from, each other interactively and collaboratively without leaving home.

As the donor commented, this is indeed the true spirit of the learner-centered education paradigm and a new chapter of global education in the 21st century. /
Intelligence: The Eyes Have It
$16 MILLION PROJECT AIMED AT A CAMERA THAT CAN PROCESS AND RECORD

By Eric Mostvi

FIVE years ago, the Viterbi School’s Laurent Itti, working with a colleague at UC Irvine, building on years of previous work, published a groundbreaking paper on how humans see the world.

Today, Itti, an associate professor of the Department of Computer Science, is heading a $16 million project attempting to teach machines to see the world in the way humans do.

Itti is building a visual system from the ground up, creating a prototype intelligent eye. The insights that he will draw from his research may drive development of new tools to help diagnose human problems in thought and perception.

Itti’s new project, funded by the Defense Advanced Research Projects Agency, builds on his previous effort called Neovision, which aimed for similarly lofty goals. However, Neovision relied on existing software systems not completely compatible with the neural systems Itti has discovered are crucial to enabling cameras to pick out what is potentially important in images.

Itti aims to develop a system that will not require human operators or peer continually at screens to make sense of what they see. Because existing sensors lack the intelligence to parse and summarize the data they collect, information overload often results.

“Our goal is to create intelligent general-purpose cognitive vision sensors inspired by the primate brain, to alleviate the limitations of such human-based analysis,” says Itti. In other words, he’d like to create a system that needs no human intervention.

Itti plans to design the software and hardware needed create a “neuromorphic visual system for intelligent unmanned sensors” to make visual surveillance systems smarter. It will pick out novelty and important details in what their cameras record.

This is a formidable undertaking. A camera simply records patterns of light, dark, and color. By contrast, the human visual system has evolved to seek out the specific visual signals critical to a creature’s survival, or “possible threats and opportunities,” as Itti characterized them in his earlier paper.

This involves complex circuits in the retina, where the outputs from light detector cells are processed to give rise to twelve different types of visual “images” of the world. Complex neural circuits in visual cortex and deep-brain model, including the superior colliculus, further process the images, which also drives eye movements to focus on specific parts of the image.

The plan is to model a complex interactive system to be able to understand the exact messages transmitted from the retina to cortex and further to the colliculus, and how the brain cells understand them. It would then enable parallel interactions, using the same perception algorithms, into working silicon systems.

Working with researchers, a core team of engineers, Ph.D. students and postdocs, Itti plans to create a whole series of prototypes, complete with hardware based at a rate of one every six months. The work will comprise an ongoing backand-forth with researchers who will continue to refine understanding of how living eyes work.

Viterbi Dean Yannis Yortsos said the school was exceptionally well-equipped to support the research.

“We have state-of-the-art facilities for development of electronic and mechanical breadboards, boards and prototypes,” says Yortsos, “including a machine shop that provides precise machining capabilities from a highly trained staff.”

For this project, Itti is partnering with researchers at UC Berkeley, Caltech, MIT, Queens University, Brown University, Arizona State University and Penn State University, among others.

In addition to the work on artificial eyes, Itti is continuing to pursue basic research on natural ones. By studying slight variations in the reactions of eyes of different humans to the same stimulus, Itti believes, it may be possible to diagnose possible human attention or vision or information processing problems.

This comprises a medical version of the old idea that “the eyes are a window to the soul.”

Laurent Itti with a robotic-assisted scenery model used to train and test neuromorphic vision-inspired machine vision algorithms. One robot arm controls the position of the sun, while the other moves objects around the scene. This creates hundreds of thousands of new scenarios for observation and analysis by the vision algorithms.

Organic photovoltaic (OPV) cells have been proposed as a means to achieve low cost energy due to their ease of manufacture, light weight and compatibility with flexible substrates.

At the very least, graphene OPVs would be major advance in at least one crucial area over a rival OPV design based on Indium-Tin-Oxide (ITO). In the USC team’s tests, ITO cells failed at a very small angle of bending, while the graphene-based cells remained operational after repeated bending at much larger stress angles.

Zhao and the other researchers on the USC team—which included Y. Zhang, Cody W. Schlenker, Konstantin Ryu, and Mark E. Thompson in addition to Gomez De Arco—are excited by the potential for this technology.

Their paper concludes that their approach constitutes a significant advance toward the production of transparent conductive electrodes in solar cells in the criteria of “abundance, low cost, conduction, stability, electrodeorganic film compatibility and flexibility.”

Abigail Malek

University of Southern California team has produced flexible transparent carbon atom films that the researchers say have great potential for a new breed of solar cells.

“Organic photovoltaic (OPV) cells have been proposed as a means to achieve low cost energy due to their ease of manufacture, light weight and compatibility with flexible substrates,” writes Chongwu Zhou, a professor of electrical engineering in the USC Viterbi School of Engineering, in a paper recently published in the journal ACS Nano.

The technique described in the article describes progress toward a novel OPV cell design that has significant advantages, particularly in the area of physical flexibility.

A critical aspect of any OPV photo-electronic device is a transparent conductive electrode through which light can couple with active materials to create electricity. The new work indicates that graphene, a highly conductive and the transparent form of carbon made up of atoms-thick sheets of carbon atoms, has high potential to fill this role.

While graphene’s existence has been known for decades, it has only been studied extensively since 2004 because of the difficulty of manufacturing it in high quality and in quantity.

The Zhou lab reported the large-scale production of graphene films by chemical vapor deposition (CVD) three years ago. In this process, the USC engineering team creates ultra-thin graphene sheets by first depositing carbon atoms in the form of graphene films on a nickel plate from methane gas.

Then they lay down a protective layer of thermoplastic over the graphene layer, and dissolve the nickel underneath in an acid bath. In the final steps they attach the plastic-protected graphene to a very flexible polymer sheet, which can then be incorporated into a OPV cell.

The USC team has produced graphene/polymer sheets ranging in sizes up to 150 square centimeters that in turn can be used to create dense arrays of flexible OPV cells, which convert sunlight to electricity.

One drawback? They’re not as efficient as silicon cells, which generate 14 watts of electricity per square meter for every 1000 watts of sunlight, says Lewis Gomez De Arco, a doctoral student and a member of the team that built the graphene OPVs.

“Organic solar cells are less efficient than silicon-based photovoltaics for that same one thousand watts of sunlight would be only 1.3 watts.”

But what graphene OPVs lack in efficiency, they can potentially more than make up for in lower price and greater physical flexibility.

By covering excessive areas with inexpensive solar cells, says Gomez De Arco, it may be possible to generate enough power to run printing presses. Such cells could even be made into fabric and worn as power-generating clothing or hung as curtains.

Approval for public release by DVIDS, Distributed Vistualization.
A Doctor in Your Pocket
DELIVERING PERSONALIZED HEALTH CARE THROUGH YOUR CELL PHONE
by Lesara Cha

Imagine getting real-time feedback from a doctor about your eating and exercise habits. Getting prescriptions personalized to your weight, height and lifestyle habits. Now envision having all this information streamed into your pocket—into your cell phone.

Researchers from the Viterbi School, in collaboration with domain experts at the Keck School of Medicine of USC, have developed a mobile technology platform for collecting, analyzing and sharing biometric data about an individual’s physical, physiological and, potentially, emotional state.

“Cell phones used to be just voice communication devices, then they morphed into data communication devices, and now into entertainment devices,” says Mani Annavaram, a professor of the Ming Hsieh Department of Electrical Engineering.

“The next incarnation in this rapid progression is personalized avatars. As avatars these devices know who we are, who we are, and what we are and eventually deliver value based on user’s context.”

The Viterbi team’s ultimate goal? Enabling evidence-driven health care by developing systems and interventions that are completely personalized.

They imagine a world in which health care originates and evolves with the patient, providing real-time context and “just-in-time” intervention and care, notes Shri Narayanan, a professor of electrical engineering.

“There is overwhelming evidence that a “one-size fits all” approach to health care can be ineffective and even potentially dangerous. Subtle and not-so-subtle physiological differences—which can vary dramatically within a single person’s body at different times of day—can require substantially different doses of medications or even surgical procedures. For example, a diabetic’s blood sugar level before and after a meal can vary dramatically. The most effective treatment approach requires more than just a blood sugar check to determine whether insulin is needed.

“The technical foundation for the team’s work is the KNOWME Network, a suite of wearable, wireless sensors that send streaming data to mobile phones. The mobile devices collect, store and transmit data from the sensors to a secure web server. The data might include: when you last ate or how much you are physically exercising yourself. It can note your current blood pressure, blood sugar levels, electrocardiograph signals or galvanic skin responses. It can pinpoint your geographic location by GPS—should an emergency intervention be needed. Health professionals can monitor and analyze the information, and deliver real-time feedback through the phone display, text messaging, imaging and voice prompts.

Right now, KNOWME can text you reminders to give yourself a shot. In the future, KNOWME might direct an implanted insulin delivery system to automatically increase delivery levels.

“It’s not farfetched to think that the network might one day run complex algorithms that can identify irregular heartbeat, detect an elderly slip-and-fall, or even determine an emotional state,” says Gunav Shikhatane, a professor of computer science specializing in robotics and sensing.

One continuing challenge? Mobile phone batteries were not designed to support 24-hour biometric signal processing with significant Bluetooth communications.

“We’re using the phone in new ways, so we must design new algorithms and new ways of processing signals that use less energy,” says Urbashi Mitra, an electrical engineering professor specializing in wireless communications.

The team has the potential to consider patients with Parkinson’s disease, diabetes, movement disorders, cardiac abnormalities, autism, sleep apnea, geriatric health and post-traumatic stress disorders.

With Donna Spruit-Metcalfe of Keck, the Viterbi team has outfitted teenage test subjects with sensors and Nokia 95 mobile units in an ongoing pediatric obesity study.

“The teenagers are fascinated by their own data,” says Mitra.

“As one youth put it, the experience was like having a doctor in your pocket.” //

Spotlight: Ted Berger
A PIONEER IN NEUROENGINEERING

One of his biomedical engineering graduate students once said that since meeting Ted Berger, “Every following moment has been an aha moment for me.”

That student is not alone. Over a three-decade career as a biomedical engineering professor and decorated scientist, Berger has not only inspired many young students but also made groundbreaking contributions to the field of neuroengineering.

Consider just one heavily publicized project in his vast portfolio—one that might have implications for people affected by strokes, epilepsy or Alzheimer’s disease.

In this effort, the Viterbi professor of biomedical engineering is leading a team of USC scientists to design and build an implant computer chip that could restore mental function in damaged or diseased brains.

By extending principles of neural encoding learned from developing the “cognitive implant” computer chip, Berger also has developed pattern recognition systems that perform automated identification of garnisons, footsteps, fence climbing and other events linked to security. This software is now used by the military and police protecting vital assets and in fighting inner city crime.

Recently he began working with two Viterbi School students to investigate how the brain’s non-neuron parts, specifically astrocytes, contribute to brain function. (The students won a $100,000 Qualcomm project grant.)

The potential payoff is gigantic, says Berger, who is also Director of the USC-Center for Neuroengineering and the David Packard Professor of Engineering.

“If we begin to factor in astrocytes, it’s going to completely change our understanding of how synaptic transmission works and it will change our understanding of how drugs work in the brain.” //

Ted Berger in his laboratory with a “conformal multi-electrode array system” designed to function as an interface between a living slice of rat brain tissue (shown in the video monitor) and miniprobe electronics (not shown). Such “neuron-optimizer interfaces” are allowing biostmetic microelectrodes to connect directly with the brain, and enabling them to serve as neural prostheses for the damaged brain.

Viterbi Professor Murali Annavaram (in grey Mozer), flanked by KNOWME graduate students Li (to R Ming Li, Sangwoon Lee and Karthikeyan Vishwanath.)

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Understanding Cancer By Tackling Its Triggers

NIH TAPS VITERBI PROFESSOR TO DEVELOP TECHNIQUE TO STUDY DNA

By Lisa E. Ota

Imagine the day a machine can draw your blood, screen it for genetic mutations and chemical variations that can cause cancer, and pop out a drug tailor-made for your DNA. That hypothetical drug would target—and fix—the point irregularities which have occurred over time that can lead to the formation of tumors—and cancer.

The National Institutes of Health has tapped Andrea Armani to develop a key instrument that takes researchers a step closer to realizing this vision.

“Personalized cancer drug delivery? Depending on the approach, it could be as soon as 10 to 15 years away,” says Armani, an assistant professor of the Mark Family Department of Chemical Engineering and Materials Science.

Armani has received the NIH’s 2008 New Innovator Award, which recognizes a select group of researchers with “exceptional creativity” and bold approaches that “have the potential to produce a major impact on broad, important problems in biomedical and biological research.”

The award amounts to a $2.3 million research grant over five years to investigate epigenetics, the study of changes in DNA which are associated with cancer.

Analysis of these DNA changes has shown promise in the early detection and treatment of ovarian and other types of cancer, says Armani.

But current research methods are only able to capture snapshots of these DNA changes, instead of monitoring the process continuously. Therefore, they miss information that could be vital to understanding processes that have been linked to cancer and other diseases, like Huntington’s and diabetes.

The sensitivity or resolution of many of these techniques is also very poor. “It’s like trying to watch a TV show through static,” says Armani.

Her method will push the field into high-definition.

Armani proposes to develop an ultrasonic nanolaser that would allow her to detect changes in DNA as they happen in real-time. This device will also allow her to study a single DNA strand in isolation, rather than groups of hundreds to thousands of strands as researchers must do with current technology.

As DNA binds to the surface of the nanolaser, the “color” or lasers wavelength emitted by the laser will change. As the DNA changes, the color will change again. The improved resolution is a result of the precision with which the color can be monitored.

Armani—and her lab, for that matter—is uniquely equipped to build this instrument; her postdoctoral work spanned both the chemical engineering and biology departments at the California Institute of Technology.

Vinod Dean YannosYotonosays this background equips Armani with the knowledge to walk that gap between engineering and medicine.

“Andrea’s knowledge puts her in the company of the few people in the world who can tackle cancer in this way,” says Yotonos. “She has the vocabulary and the language to speak with the medical professions with which engineers must work in tandem to solve society’s most pressing problems.”

Armani explains it like this. Like in any other field, communication is crucially important. Most hinders in this field sprang from an inability for engineers and physicians to communicate. “Being able to excel in this field requires researchers to dive in,” says Armani, who received a bachelor’s degree in physics from the University of Chicago, and Ph.D. in applied physics with a minor in biology from the California Institute of Technology.

“The first biology course in graduate school was like learning a second language. But by the fourth course, it became apparent that many of the underlying concepts were the same, they just had different names.”

Her laboratory setup illustrates this duality perfectly. One wing focuses on developing new types of optical devices—where you might wear a tip-top shirt to keep dust away from microfabrication processes—while the other side focuses on chemistry and biology. A simple lab coat and goggles might suffice over there, she says.

“This NIH project represents the perfect merging of my expertise,” she says. The first part of the project focuses on building the nanolaser instrument, while the second half funds the DNA experiments.

The goal: What Armani calls “un-doing” these triggers that can cause cancer.

She will focus first on developing the instrument and performing initial proof-of-concept experiments using known triggers, such high concentrations of common solvents and cleaning agents. Part of this process involves taking a single strand of DNA, exposing it to a harsh chemical and seeing whether a specific change is initiated. Ultimately she’d like to be able to warn people who triggers to avoid. In the future, she plans to move the instrument to the Epigenome Center at the Keck School of Medicine and work with her collaborators there. “There are truly some of the world experts in this field at Keck, and I am looking forward to collaborating with them to explore the full potential of this instrument.”

Armani joined the Viterbi School in 2008 as an assistant professor, and rapidly began adding awards and distinctions to an already distinguished resume. In 2009, Armani was named to MIT’s coveted TR35 list, which recognizes the world’s top 35 innovators under the age of 35.
Data, Data, Data: NEW FORMS, BIG VISION

Society is inextricably interconnected, and the amounts of data that come out of its complex interactions exceed our capacity to store it.

Indeed, our cell phones and networked computers and research labs and sensors are creating bits of data—0s and 1s in computer language—on an increasingly mind-boggling scale. By one estimate, humankind created 150 exabytes (a billion gigabytes) of data in 2005. In 2010, just five years later, it will create nearly 10 times that amount.

USC played a significant role in the inauguration of this information explosion decades ago, when researchers at the Information Sciences Institute (ISI) played major role in the creation of the Internet and email. (See page 5 for more about ISI’s role)

This quest continues today. A group of leading Viterbi faculty and researchers have made it their mission to address data on this large scale and ask themselves on a daily basis: How do we make sense of what we’re collecting in every domain imaginable? And how can our findings be put to good use in developing applications that benefit society?

This feature will examine how our researchers are incorporating this data deluge in the school’s long-term strategic vision: by working on developing game-changing applications that range from language translation and intelligent video surveillance to terrorism prevention and environmental monitoring; by effectively dealing with infrastructure issues along the way, reaching out to experts in other disciplines such as computational biology and creative arts; and by addressing advancements in network and social interactions.

We invite you to read about our work not only collecting, processing and analyzing large-scale data, but also in creating new forms with which to address those 0s and 1s.

BY ROBERT BRADFORD, LENORA CHU AND ERIC MANKIN
"There is tremendous opportunity in society's influx of data. This is revolutionizing the way we look at science." — GAURAV SULKHATNE, PROFESSOR OF COMPUTER SCIENCE

This summer, the New York Times began a series called "Your Brain on Computers." The stories examined how the "deluge of data can affect how people think and behave." In major media sources throughout the world, from The Economist to CNN, one can read similar stories on a regular basis.

The stories echo a common theme: the number of bits of data that are being produced in the world is overwhelming. Why? Scientists have become increasingly proficient at translating the real world of sights and sounds into digital format. That accompanied by decades of rapid technological advances and humankind's near-complete dependence upon computers have caused an explosion in data that must be stored, mined and analyzed.

For a group of Viterbi faculty, however, this data deluge poses an entirely different set of challenges. They are not overwhelmed by data; in fact, they want to gather more and create new forms of it. They see limitless possibilities in how acquiring and analyzing new information can enhance our understanding of the environment, improve global health, bolster national security, transform the way we create films, and the list goes on.

**Deploying Robots to Explore the World**

"For me there is tremendous opportunity," says Gaurav Sulkhatne, a professor of computer science and co-director of the Robotics Research Lab. "I see the influx of data as a revolution in an entirely different way. This is revolutionizing the way we look at science."

Sulkhatne builds robots that will explore the natural world—from oceans to forests to mountains—and bring back data that people have been seeking for decades. He is currently working on developing a fleet of robots that can be deployed in the ocean to understand what is a largely unknown part of the planet. "I often tell people that we have a better map of the surface of Mars than the ocean," says Sulkhatne. "But the ocean has tremendous implications for global health and communities. I take my kids to the beach and my son can't wait to jump in the water. I can see the draw—it's very fundamental to us."

"We need to understand how pollution from the Los Angeles River affects coastal communities and we need to look at how pollution affects water quality across the globe."

Working with field biologists, Sulkhatne is programming two-meter robots that look like small torpedoes to intelligently gather data about contamination or water quality or the implications of oil spills. The big problem with the RP-system, Sulkhatne argues, is that scientists have not been able to precisely measure the true extent of the spill. "There’s a nice 3D representation of this oil spill," he says. "In a decade’s time, however, we could put robots in the ocean and we could get a clear representation of a major spill."

"My goal is to design robots that in the end can be an instrument for field biologists. What do I do in engineering research is to do research that is relevant, to think beyond the boundaries of my discipline."

**Data-Driven Robot Learning**

Stefan Schaal similarly sees the future in autonomous intelligent systems as an interdisciplinary, data-driven endeavor. And Schaal, a professor of computer science, neuroscience and biomedical engineering, factors into his work on humanoid motor control insights from neuroscience and the behavioral sciences. His goal: to contribute to both a better understanding of the human brain and to develop technological motor systems that have similar robust autonomous performance as humans.

In the last two decades, research on autonomous intelligent systems has increasingly turned towards inductive, data-driven, learning and reasoning approaches, says Schaal, who sees a future in which learning and performance in autonomous systems is achieved by machine learning from massive amounts of data generated by massive amounts of sensors.

"This is not unlike how we think that brains must be set up to perform intelligent information processing," says Schaal. He works on understanding autonomous systems in motor control, perception and learning. Among the most salient projects are his work on machine learning with humanoid robots and—most recently—one of the videos of his research with a robot dog has reached almost a million hits on YouTube. In this video, a small robot dog demonstrates unparalleled performance in walking and climbing over rough terrain.

"One key to our research is interdisciplinary work between engineering sciences and neuroscience," Schaal states, "and the glue for a greater understanding often comes from insights from statistical, data-driven learning."

**Peeling Onion Skins**

Sitting in an office two floors down, statistical machine learning expert Fei Sha is pondering how the robot brain could make sense of data collected from so many sensors.

"In particular, the robot brain ‘sees’ the environment in a data format represented by hundreds or thousands of numbers—each corresponding to a particular sensor’s output," says Sha, a professor of computer science.

Identifying patterns in those numbers is a daunting task and recurring theme in modern statistical analysis. Sha and his collaborators are working on inventing algorithms to reduce the amount of these numbers, in an effort technically known as ‘dimensionality reduction.’

The goal is to bring data from a difficult-to-imagine high-dimensional space down to a more manageable low-dimensional space—in some cases even two-dimensional plots so that humans can intuit it knowledge—without losing the essential structure and information in the data. As an example, Sha used one of his techniques to place 580 pictures of USPS zip codes on a two-dimensional plane. Each picture has 784 pixels (each could be the output of a photoreceptor sensor). Yet, two-dimensional coordinates are sufficient to capture the essence of the structure hidden in these 580X784 numbers. Nota Oh! A graph, pictures of similar zip code digits are clustered together.

"Once we accomplish this reduction of dimensionality, we can apply existing techniques for displaying and visualizing data," says Sha. "Our goal is to make sense of the data by turning it into more powerful techniques such as ours will play more important roles in helping both human and robot brains grasp knowledge and information."

**Sharing Information—Underwater**

John Heidemann, a research associate professor of computer science at the Viterbi School of Information Sciences Institute (ISI), wants to make sure these robot brains can share information after they are deployed.

"I am interested in the networking part of the piece," says Heidemann. "My team is developing the technology to allow these robotic brains to communicate with each other."

Heidemann says he’s also interested in a related question: How would you put 100 sensors in the Port of Los Angeles to monitor water quality? "My group has looked at the wireless acoustics networking protocols to make that feasible," he says.

For Heidemann, the goal of new methods to gather and analyze data in remote places is aligned with one of the mantras of the Center for Embedded Network Sensing, a research consortium that includes USC, UCLA, UC Merced, UC Riverside and Caltech: “We want to make the unobservable...observable.”

A robotic glider from Gaurav Sulkhatne’s laboratory develops and tests algorithms for underwater robotic sensor networks that intelligently gather ocean data.
Sensors for Many Situations

For Ramesh Govindan, the research possibilities using sensors are vast. Govindan, a professor of computer science and head of the Embedded Networks Laboratory at USC, works with a team to move seamlessly from developing sensors to assess the structural integrity of bridges to understanding the mating behavior of birds in remote forests.

“When we deploy sensors in bridges, we are getting a vibration signature. If you are trained, you can get a sense when things are out of whack,” says Govindan. “Now, we’re starting to use tiny sensors to gather the data wirelessly and download it. You can get all the data at your fingertips in real time.”

For Govindan, gathering large amounts of data quickly and analyzing that data has been enhanced exponentially by the proliferation of smart phones. The concept of huge numbers of people recording and sharing data is called crowd sourcing, and Govindan and his colleagues believe it has tremendous potential for researchers.

Crowd Sourcing and Air Quality

Sultahame, for example, is examining how crowd sourcing might be used to gather valuable information about air quality in the diverse communities throughout Los Angeles.

“Everyone in L.A. knows when it’s a smoggy day,” says Sultahame. “You look at the mountains and if you can’t see them it’s a problem. I’m interested in the air pollution in my backyard.”

So Sultahame and his team are experimenting with crowd sourcing through cell phones to see if they can get fine measurements of pollution in individual communities in the Los Angeles metropolitan area. The idea is pretty simple: Have people take a picture of the sky with their cell phones with the time of day and upload that picture to the Internet. Sultahame could then gauge, by looking at the opacity of the atmosphere, air quality levels in a specific area.

Complementing this work, Govindan and his team have been working for the past two years on a project to develop software that would make it easier for people to take videos on their smart phones and upload them to the Internet. “We are no longer in an era where researchers have to go out with specialized equipment to get information — there is now a democratization of information gathering,” says Govindan. “If you extrapolate to saying that within five to 10 years 3 billion people will have a smart phone, the reach of information gathering becomes limitless.”

While the idea of understanding air quality in a neighborhood is within reach, there are myriad other ways that the gathering and analyzing of information can contribute to public safety.

Data and Airport Security

In 2004, Millind Tambe and his team were looking at the relatively esoteric idea of multiple-robot coordination with the concept of randomization.

Around that time, CREATE (Center for Risk and Economic Analysis of Terrorism Events) was inaugurated at USC and several presentations emphasized that society works in a timely fashion.

“And orderly fashion gets exploited by the terrorists,” says Tambe. “This connected with our work on randomization.” Tambe’s team found that by using fast algorithms to solve large problems cast in a game-theoretic framework, they could develop the right type of randomization that would be beneficial for security and law enforcement agencies interested in detecting terrorists, who often conduct surveillance and exploit patterns in police activities.

Thus was born the concept for Assistant for Randomized Monitoring Of Routes (ARMOR).

Tambe’s game-theoretic approach requires large amounts of data concerning the area under protection. Police provide data of the area they wish to protect, such as volume of travelers and traffic, from which ARMOR infers the relative importance of different terrorism targets in that area and effectiveness of possible police strategies.

The data changes from one day to the next, possibly from hour to hour.

The ARMOR model runs and churns out a randomized plan for where security personnel should go, and when. The software spews out decisions based on calculated probabilities of breaches at certain locations, using mathematical algorithms.

Currently used by the Los Angeles World Airport’s Police Division since 2007, ARMOR provides law enforcement officers with an automated capability to randomize K-9 searches and vehicle checkpoints at Los Angeles International (LAX) Airport. The results have been impressive: It has been credited with the prevention of several loaded weapons being carried into LAX, and the seizure of large quantities of drugs and several arrests at the airport.

ARMOR has also been adopted by the Federal Air Marshal Service and the Transportation Security Administration.

Real-Time Data for Emergency Response

While the Tambe research group addresses questions related to safety in the air, Cyrus Shahabi, who directs the Integrated Media Systems Center at USC, and his colleagues are looking at the ubiquitous problem of ground traffic in Los Angeles. Shahabi wants to understand how to predict traffic patterns so he can help emergency response teams — firefighters, paramedics or police — get to locations as quickly and efficiently as possible.

“We collect data every minute to understand the behavior of traffic by generating a graph that shows the traffic pattern in a certain segment,” he says. “The cost of sensors and information technology is so cheap now. Our goal is to utilize this data to react to a crisis or perhaps prevent it altogether.”

Shahabi is also developing a unique navigation and information portal called icampus.USC. The portal includes a three-dimensional rendering of the USC campus and its neighborhood, providing geospatial information for students, faculty and staff. The development of icampus for USC has far-reaching implications. It could, for example, provide real-time data that would allow the university to analyze tweets or employ GIS information to track the spread of disease on campus, or analyze building video and GPS sensors to create an evacuation plan in the case of an emergency.

Beyond the emergency response use, Shahabi says icampus will serve as a social networking portal for day-to-day use, from learning about campus events to finding apartments to rent around campus.

Mining Blogs, Twitter

Using Twitter information with a distinctly different approach, Yan Liu specializes in mining vast amounts of data, ranging from biological data to climate data to social media. A new assistant professor of computer science at the Viterbi School, Liu spent the past few years at IBM Research in New York, where she developed machine learning and data mining algorithms to improve the efficiency of business transactions and generate insights on climate modeling for green energy.

She says her work in large-scale data mining from sources such as blogs can have far-reaching implications. “Our work is trying to identify the main topics from social perspectives — what communities of people are talking about,” says Liu. “We are trying to apply this to...”
This is the coming of age of a new era in technology... for the first time, we get to actually apply some of the ideas that we’ve been thinking about for decades. And we can produce something that is qualitatively different.

— Paul Debbe, Scientific and Engineering Academy Award winner and Research Associate Professor of Computer Science
Data-centric computing design and application are part of the Viterbi School’s future. It’s not just a simple reflection of the fact that nowadays it’s trendy to study data—we should continue to expand our capabilities in this field, building on our diverse strengths.

— SHANGHUA TANG, CHAIR OF THE VITERBI DEPARTMENT OF COMPUTER SCIENCE

“Researchers are already building machines that can talk, listen, understand, respond, perhaps even laugh and sing,” Nancy Yang says. “The great challenge is how we bring these together in meaningful and societally relevant ways.”

Lerman and a colleague analyzed postings in the site’s “upcoming” list of stories, which either disappear into the ether or get “promoted” to the main pages of the site depending on the number of comments and interactions for behavior all the time.

He also has applied a novel model of altruism to see how diverse as traffic in a congested city and vaccination decisions in social networks.

The starting point was a concept long established by game theory: the Nash equilibrium. That’s a situation in which no player has anything to gain by chang- ing his strategy unilaterally.

It turns out that Nash equilibria in traffic routing can be extremely wasteful. If everyone is completely selfish in how they want to get to work, everyone is lost. The result is traffic jams.

However, Kempe found that if all the travelers were just a little altruistic, the performance of the network drastically improves. Kempe’s work was unusual in that he quantified the value of altruism, showing that the price of anarchy with altruism is significantly smaller than without.

The understanding opens possibilities to policy makers to build incentives to altruism into the system, finding ways to identify and reward drivers who behave to optimise the road network, with predictable results.

Another – and Kempe studied look improve the problem of epidemics and vaccinations. Before an epidemic, people can pay a price (in money, time, even risk to their families) for hope for the best. But not vaccinating has social consequences. You risk passing on the disease to others.

“In contrast to the traffic routing scenario,” says Kempe, “it’s not enough if everyone is a little altruistic. They need to be a lot altruistic and also coordinate their actions to protect the network well. On the positive side, altruism and coordination together always do lead to a socially-acceptable outcome.”

The issue of Provenance

Speaking of patterns, Yolanda Gil of ISI has become embedded in studying a broad range of knowledge technologies, receiving more recently a National Science Foundation grant aimed at facilitating the sharing of scientific workflows.

The key problem Gil notices is one she calls “provenance,” which addresses where things come from and whether they can be trusted.

Internet pioneer Vint Cerf characterizes the issue with provenance: “The problem is—and this is true of books and every other medium—we don’t know whether the information we find is from the web is accurate or not.”

Information should be accompanied by details of who produced it, how it was produced, and whether it was derived from other sources. These provenance records are not difficult to capture in principle, but are complicated by issues of intellectual property rights and privacy, tarnishing and misrepresentation by third parties, and even pure lack of motivation of information providers—which results on incomplete and inaccurate records.

These challenges are being tackled by the Provenance Incubator Group, a new international effort Gil is organizing within the umbrella of the World Wide Web Consortium (W3C). What’s needed, Gil says, is a deeply rooted effort to create rigorous but generally accepted rules.

“We need to develop an open understanding about how to represent, manage, and use provenance in an open system such as the web,” says Gil.

The provenance of information may be questionable at times. But here’s what’s certain: The Viterbi School is at the forefront of creation and innovation regarding all things data. We invite you to continue to follow our breakthroughs in tackling the world’s complex challenges.

Data, Data, Data: New Formas, Big Vision

Engineering + Communications = New Frontiers in Media and Technology

With the idea that engineers and communications can explore new frontiers by working side-by-side, faculty from the USC Viterbi School of Engineering and the USC Annenberg School for Communication & Journalism met in the spring to discuss a plan for fostering research collaborations and joint course offerings.

“We have expertise on both sides: on technology, and on communications,” said USC Viterbi Dean Eowan Wilson. “Combining and leveraging the two will provide new insights, new methodologies and will help create new products.”

Taking an open approach, Viterbi researchers can develop algorithms for getting text messages through congested areas or the Annenberg faculty can apply this research and expertise to craft policy.

“Today is an area we can fruitfully explore together,” Vorbis says.

Already several interdisciplinary research projects are underway to develop:

• Message tailoring programs for food bank clients, which can receive relevant messages in real-time via text message.

• Interactive videos to help reduce risk of sexually-transmitted diseases.

• Multilingual speech translation technologies to assist medical patients with limited English proficiency.

• Behavioral patterns for the Smart Grid, a project with the Los Angeles Department of Water and Power to apply information technology to energy production and distribution (also involves USC College of Engineering).

Faculty also discussed offering joint classes designed around:

• New models of human machine communication

• Automatic categorization of Internet video content

• Use of teleconferencing to promote science and engineering workshops
President C. L. Max Nikias
USC’S 11TH PRESIDENT IS WIDELY HAILED FOR HIS ENERGY, INNOVATIVE IDEAS AND SKILL IN BUILDING PARTNERSHIPS.

Announcing the selection of C. L. Max Nikias as USC’s 11th president, Board of Trustees chairman Edward P. Roski, Jr., called him “a remarkable and inspiring leader, a brilliant scholar, and the best possible person to lead our university forward,” an opinion that is widely shared among faculty, students and alumni.

Over the course of his career as a researcher, educator and university administrator, Nikias has earned accolades for his leadership, innovation and fundraising, as well as his ability to build partnerships among varied constituencies.

As the university’s chief academic officer since 2005, he is credited with accelerating the university’s recent academic momentum, recruiting new leadership, strengthening the academic medical enterprise, helping attract a series of multidisciplinary and translational initiatives, creating innovative cross-disciplinary programs, enhancing the university’s globalization efforts, and increasing support for students at the undergraduate, graduate and doctoral levels.

While serving as dean of the USC Viterbi School of Engineering from 2001 to 2005, Nikias helped solidify the school’s position as a top-tier engineering school, oversaw expansion of the school’s biomedical engineering enterprise, and doubled its endowment. Viterbi School now ranks among the top five in the country.

He also established key partnerships with corporations and led a record-breaking fundraising campaign that, among many major gifts, brought in the $52 million school naming gift from Andrew and Ena Viterbi. He also recruited 30 world-class faculty members to the Viterbi School and tripled the number of women on the faculty.

Vittorio Forzani, who succeeded Nikias as Viterbi dean in 2005, credited the only sure way to predict the future is to invent it. And because USC’s faculty, students, alumni and staff comprise a global intellectual community of unsurpassed breadth, energy and dedication, “I have exceeding confidence in USC’s own future.”

“My wife, Nikki, and I and our daughters love being a Trojan family,” and we love being a part of the greater Trojan Family. To be able, then, to lead the Trojan Family forward now is a global opportunity of a lifetime, as we write together the next chapter in USC’s extraordinary history.

AFTER BEING NAMED provost in 2005, Nikias worked with faculty and deans to develop a number of new programs that would help create a distinct academic environment at USC.

To enhance the undergraduate experience for USC students, he established new scholarship programs that reward innovative scholarship and global academic immersion. He also sponsored a USC Arts venture that encourages cross-arts interdisciplinary programs, including minors, progressive degrees, joint degrees and joint classes.

He drove the creation of USC’s groundbreaking Visions and Voices initiative in the arts and humanities, now in its fourth year, which has drawn tens of thousands of undergraduates from all disciplines to a range of artistic and cultural programs.

Nikias launched other initiatives as well, including a quintupling of funding for Ph.D. fellowships to $20 million per year, a grant program for advancing scholarship in the humanities and social sciences, and a program to recruit leading interdisciplinary scholars as Provost’s Professors.

He recruited new leadership to the USC Institute of Medicine of USC, spearheaded the integration of the school’s 19 faculty practice plans, and oversaw the transfer of USC University Hospital and USC Norris Cancer Hospital to Tenet Healthcare Corporation to the university.

Nikias also was instrumental in negotiating on behalf of the university the relocation of the South Foundation—originally established by filmmaker and USC trustee Steven Spielberg—and the establishment of the USC Shoah Foundation Institute for Visual History and Education.

Nikias established an Office of Research Advancement in Washington, D.C., that has been directly responsible for helping faculty win more than $140 million in federal research funding in the past 30 months.

NIKIAS WAS RECRUITED to USC in 1999 to develop a national center for research on multimedia, and become the founding director and principal investigator for the Integrated Media Systems Center (IMSC). In a fierce competition in 1996, USC’s IMSC proposal to NSF was ranked first out of 117, a pool that included proposals from America’s top-ranked research universities.

In April 2008, he was named inaugural holder of the Malcolm R. Currie Chair in Technology and the Humanities. As president, he also holds the Robert C. Packard and President’s Chair.

Each fall, Nikias teaches a micro-seminar to incoming freshmen on the development of democracy and the dramatic arts within ancient Athens.

Left to right: Maria, Nikki, Max and Georgiana Nikias outside Mudd Hall.

C. L. Max Nikias

EDUCATION Graduated with honors from Farnam Bridge Gymnasium, a school in Cyprus that emphasizes science, history and Greek-Roman classics. Received diploma from National Technical University of Athens, also known as National Metsovon Polytechnic, Greece’s oldest and most prestigious institution of higher education. Earned M.S. and Ph.D. degrees from State University of New York at Buffalo.

PROFESSIONAL Internationally recognized for pioneering research on digital signal processing and communications, digital media systems and biomedicine. Senior consultant to a range of corporations and a high-level advisor to the U.S. government, having held security clearance for 15 years. Founding director of two national research centers at USC: NSF Engineering Research Center on Integrated Media Systems and Department of Defense Center for Research on Applied Signal Processing. Innovations and patents in sonar and communications systems adopted by Department of Defense. Author of more than 275 journal articles and papers, three textbooks and eight patents. Mentor of more than 30 Ph.D. and postdoctoral students. Before coming to USC, he held faculty appointments at the University of Connecticut and Northeastern University.

HONORS Member of the National Academy of Engineering and fellow of the Institute of Electrical and Electronics Engineers (IEEE), California Council on Science and Technology, and American Association for the Advancement of Science. Recipient of 2008 IEEE Simon Ramo Medal.

PERSONAL Wife Nikki has an accounting degree from Athens University of Economics and Business in Greece, and an MBA in finance from SUNY Buffalo; daughter Georgiana is a third-year student at USC Gould School of Law; and daughter Maria is a senior at the USC Annenberg School for Communication & Journalism.

To learn more about President Nikias, visit www.usc.edu/president.
The USC Viterbi School of Engineering was in the national spotlight October 6-8, 2010, and demonstrated, in the words of Viterbi Dean Yannis C. Yortsos, “that important issues addressed expertly can change the game.”

The electricity of intellectual innovation filled the University of Southern California’s Bovard Auditorium as leaders from a variety of disciplines met to explore the National Academy of Engineering’s 14 Grand Challenges.

More than 1,000 innovators, engineers, policy makers, educators, executives and students from around the world gathered to discuss the 14 Grand Challenges.

The audience was riveted by keynote speaker Charles Vest, president ofMIT, who noted: “Grand challenges, taken together, address the most pressing needs of our society and the world.”

NAS President Bruce Alberts, renowned geneticist and former president of the National Academy of Sciences, moderated the first day’s plenary session, highlighting the breadth of the challenge.

Grand Challenges Meet Great Minds as Summit Explores the Promise of Engineering Empowering Society

The USC Viterbi School of Engineering Hosts 2010 NAE Grand Challenges Summit

NAP President and keynote speaker Charles Vest focused on the underlying master challenge: the supply of engineering talent. Vest hoped for more engineering students in the new generation, noting that 25 percent of students in Asia receive degrees in engineering, 14 percent in Europe, and only 4.5 percent in the United States. “As a nation we are moving in the wrong direction,” Vest said. “Where we used to be number one, we are falling down the scale.”

The issue of both improving engineering education and attracting more bright people to technical careers was a continuing theme. The Grand Challenge Scholars Program is part of that effort, as is the Maseeh Entrepreneurship Prize Competition, newly-established at the Viterbi School (see sidebar on next page).

Additionally, a remarkable student program organized by Viterbi associate dean Louise Yates highlighted the next generation of engineers. The October 6 student day included a K-12 student competition, three demonstration sessions, an address by Dean Yortsos, a special meeting with NAE President Vest, and networking activities that attracted a capacity crowd.

The NAE Grand Challenges Summit proved to motivate and capture the attention of brilliant minds in whose hands the future is now placed. The Summit organizers were the USC Viterbi School of Engineering, along with Duke University’s Pratt School of Engineering, the Ohio College of Engineering, and the California Institute of Technology. Critical to the Summit’s success was the support of 25 major corporations, with Lockheed Martin serving as the presenting sponsor.

For an archived webcast of the NAE Grand Challenges Summit please visit www.gcs2010.org/webcast.
Seizing upon the need to encourage entrepreneurship in the next generation of engineers, the Massian Foundation and the Viterbi School announced during the Summit the creation of a $1 million endowment to fund the Maseeh Entrepreneurship Prize Competition. Entrepreneur-engineer Fariborz Maseeh is donating the money through his charitable organization to create an annual $50,000 prize, which will enable a business plan competition for Viterbi students.

"Usually, engineers are taught to solve problems, but not to implement those solutions into businesses," Maseeh said. "The idea of this prize is to train engineering students more about business and competition in a professional way...and encourage engineers to think like entrepreneurs."

Viterbi Dean Yannis C. Yortsos lauded Maseeh’s vision and said the award will challenge students to "learn additional skills that assure their groundbreaking ideas build businesses that will grow the economy and improve society overall."

Maseeh, who is a member of the Viterbi School Board of Trustees, is committed to helping engineers reach their full potential to shape the world, and said the NAE Grand Challenges represent an ideal roadmap for engineers to create real change. Maseeh is a pioneer in the field of micro-electro-mechanical systems (MEMS) as well as a philanthropist. He said he selected the USC Viterbi School for the award because of the school’s traditions of engineering success, top leadership, and commitment to a vision for a better world.

Panel Highlights: Approaching the Grand Challenges from Six Perspectives

TECHNOLOGY
Panel keynote speaker Jean-Lou Chameau, President of the California Institute of Technology, framed the discussion by describing a fundamental difference between the 20th and 21st Centuries. "The 20th Century, Chameau explained, "focused on progress; the 21st Century must focus on sustainable progress, and this new approach should define the way we approach technological innovation. The United States needs to spark an innovation arms race." For Franklin Orr, director of the Precourt Institute for Energy at Stanford University, one of the keys to such sustainable progress is developing powerful new energy solutions.

COMMUNICATION
Communicating science and engineering to a broader audience is itself a challenge and an opportunity. "We have to explain complicated things in a way that an audience can understand," said panelist All Walsh, CNN’s Chief Business Correspondent. New York Times’ energy reporter Matthew Winkelman remarked that the public often doesn’t understand fundamental issues behind sustainability. "The trick in a general interest forum is writing something that will appeal to all constituencies."

EDUCATION
The Education panel focused on the challenge of educating future leaders in Science-Technology-Education-Math (STEM), and emphasized that innovation and education go hand in hand. Susan Hackwood, Executive Director of the California Council on Science and Technology, stressed that educators must also employ digital education to reach students with STEM education and that the digital classroom of the future could augment traditional schools. John Brooks Slaughter, a former director of the National Science Foundation and now a USC professor of engineering and education, said STEM is critical to meeting the Grand Challenges and tied to American competitiveness.

BUSINESS
The Business Panel emphasized the role of corporate investment in bringing the Grand Challenges to life. Peter Williams, CTO for the IBM-Rig Green Initiative, said that “we need to think of each of these Grand Challenges as a business rather than a grand idea.” One example come from Alexis Livanos, Corporate Vice President and CTO of Northrop Grumman, whose team is focused on the grand challenge of securing cyberspace. Livanos described his team’s “Observe, Orient, Decide and Attack” process to develop flexible systems and flexible architectures that address cybersecurity security issues.
A Trojan at the Helm
PLANNING SPACE MISSIONS AT NASA’S JPL

Bringing a piece of Mars back to earth. Peeking below the icy surface of Jupiter’s moon Europa, looking for an ocean below. These are some of Fiorut Naderi’s and the Jet Propulsion Laboratory’s latest challenges.

As an associate director at JPL in Pasadena, Naderi, O.M.S.E. 72, Ph.D. E.E. 79, oversees planning for future JPL missions.

One of the space exploration’s most challenging undertakings, the “Mars Sample Return” project, involves three spacecraft. Number One lands and sends out a rover to collect samples. Number Two takes the samples from the first rover and launches it into Mars orbit. Number Three collects the material from the Mars orbit and brings it back to Earth.

But the time horizon is long; 2018 is the expected launch date for the first mission.

Naderi’s role at JPL began after a series of costly failures at the Lab, which culminated in the loss of a pair of NASA Mars missions in 1999. The era was known for the slogan “Faster, Better, Cheaper,” a formula to which cranks excitedly added the words “Pick. Any. Two.”

Following the problems, in the summer of 2000, Naderi helped design a differently conceived, intricately woven program of missions, in which new space technologies would be spread out evenly across multiple missions to limit the downside consequences of a failure.

It worked. He led the program that resulted in three successful missions to Mars, including the spectacular landings of the Spirit and Opportunity rovers that continue to make discoveries well past their planned life spans. These were missions that captured the nation’s imagination.

Naderi, who was born in Shiraz, Iran, and moved to America 45 years ago, did not start out with a space bug like many of his JPL colleagues. He was hoping to become a veterinarian, but “found out that drawing—which you then had to do by hand—was not one of my strong suits, so I went into electrical engineering,” he says.

First he earned a bachelor’s degree from Iowa State University at Ames in 1969, and then went on for a master’s degree and a Ph.D. in electrical engineering at USC.

“The foundation that I built my career on is what USC gave me,” says Naderi, who says he likes to challenge himself by taking on new projects every five years. Before his work on Mars exploration, he worked on a series of efforts including the Origins Program, which was designed to observe the birth of the earliest galaxies, the formation of stars and the search for other Earths.

Naderi says he likes being a systems engineer, which he likens to being an orchestra conductor.

“You can’t be a genius of a virtuoso who is playing very well,” says Naderi. “You need to appreciate the orchestra’s individual talents, and make music together better than any of them can by themselves.”

Even though he’s fully assimilated, Naderi says never forgets that he came to this country as an immigrant and tries to keep the mindset of an intense need to try harder at tasks to show you can compete with anyone—and excel more than most.

When he speaks to USC students, he reminds them of what USC gave him. “When people say they want to do what I’ve done,” he says, “what I tell them is that USC gives you a firm foundation for this house of knowledge.”

“Beyond that, I tell them, remain hungry and remain curious. Don’t get comfortable. Constantly challenge yourself. If you do well, people will notice.”

— Fiorut Naderi standing before the nuclear-powered lander Mars Science Laboratory. It will be launched in the fall of 2011, and land in the summer of 2012.
STUDYING OPTICS AND C++ PROGRAMMING FROM AFGHANISTAN
“BATTLING ROCKET FIRE AND CONNECTIVITY ISSUES” TO EARN AN M.S.

Captain Matt Smith spent parts of the last five semesters bunkered down in forward operating bases in Kuwait and Afghanistan.

But the Army intelligence officer didn’t let that geographical challenge stop him from graduating this spring from the Viterbi School with a master’s degree in electrical engineering.

Smith, 25, attended EE classes, chatted with professors and took exams 100 percent online through the Viterbi School’s Distance Education Network (DEN).

“Going to graduation was the first time I’d stepped on campus,” says Smith of the May 14 commencement ceremony.

Smith earned a B.S. in physics while enrolled in the Army ROTC program at M.I.T. Two years into his Army service, he decided to pursue graduate studies while deployed and discovered DEN.

“It changed my perspective of online degrees to see an engineering student of USC’s caliber offer a distance education program,” says Smith.

But the journey was not always easy. During his first semester, he was sent to Kuwait during final exams. And during parts of his last two semesters, Smith was deployed to Bagram Airfield in Afghanistan.

There, he would spend 12-hour days, seven days a week, providing military intelligence support for strategic decision-makers and combat units on the ground.

Then held down dinner and head back the living quarters he called his “hut” and attend courses online, participate in class discussions, and study well past midnight most evenings.

“Sometimes the base would take rocket fire and my first thought would be ‘Man, this will make it harder to get back to my room and finish my assignment,’” says Smith.

Logistics were sometimes a challenge.

Once, while deployed, Smith had to arrange for the re-routing of a government line through Fort Bragg to call into USC for a live chat with Professor Armand Tanguay, who taught EES29 Optics.

Smith will finish his Army commitment in early 2011, after which he plans to pursue a career in medical physics, defense research or quantitative finance.

“My focus was signed and image processing, and all those fields are different applications of the concepts I learned while at the Viterbi School,” Smith says.

The Prasad Studies

The Prasad: Sulekha, mother Sreethi, father Surya, Ajay and Ajay’s father Archy at the USC vs. Oregon State basketball game in February.

As for Sulekha, she has worked her entire career for Hughes Aircraft, and thus Raymond when it purchased Hughes Aircraft’s defense business.

Sulekha held a grand total of eight jobs at the company before finally landing as a Product Support Division Program Manager that served as her original route into the company.

Rounding out the third generation of USC engineers is Surya’s grandson, Ajay Prasad, 23. As a child, he attended football games at USC with his family, and was often a visitor at Sulekha’s Hughes Aircraft office “to take a child to work” days.

One of the Prasad family’s favorite memories in their 2004 trip to the Rose Bowl, where USC beat the University of Michigan.

“I taught Ajay and his sisters how to make the Trojan ‘V’ victory symbol as soon as they were old enough,” says Sulekha. “You can never start too young.”

BOY WONDER WAS A TEENAGE BOEING CONSULTANT
Ryan Kramer was done with high school at 17 and college at 18. Soon after, he was helping Boeing develop missile concepts for planetary exploration on a part-time basis.

Last May, at 19, Kramer graduated from the Viterbi School with an M.S. in engineering management (Department of Industrial and Systems Engineering) and accepted a job offer to work at NASA’s Jet Propulsion Laboratory.

Kramer says the clout of USC’s engineering management program helped him land the top-flight position. He holds a bachelor’s in aerospace engineering from the University of Colorado at Boulder, but opted to pursue his master’s so the wouldn’t be “just an engineer.”

“The M.S. takes it one step further,” Kramer says. “Knowing how to design a spacecraft isn’t enough if you want to get it into space.”

Kramer never intended to skip grades during childhood; that decision was borne simply of a series of difficulties in finishing high school. He attended a school for a child who demonstrated a 181 IQ at an age most kids were pondering clothing options for the junior high school prom.

“I wasn’t feeling academically challenged and was high energy,” says Kramer. “I’d be singing opera in class and causing a distraction.”

Now that he’s entered the working world, Kramer says he’s happy to know where he got his engineering genes. Not recently united with his biological donor father only to find that he, too, received a master’s degree in engineering management.

“That’s not all: a donor half-sibling also finished high school three years early and went on to get a degree in nuclear engineering.”

“We do get a lot more than I would have guessed from our genes,” says Kramer, adding that his donor father’s family also includes a Trojans fan. “I’m the ultimate experiment in nature versus nurture.”

Grading Three Generations of Trojan Engineers
THE PRASAD FAMILY HAS USC “IN THE BLOOD”

Three full generations of Prasads have made USC their home, calling engineering their profession and football their passion.

“I grew up with USC in my blood,” says Sulekha Prasad, who hails from Generation 2.

Sulekha’s father Surya Prasad launched the family’s long affiliation with USC. Surya was born in the ancient city of Patna, India, a city located on the banks of the Ganges River. He watched a neighbor go off to USC, and Suryu followed shortly thereafter to study electrical engineering.

While at USC, the senior Prasad found a part-time job working as a technician in a painter company’s lab to support himself. He finished his bachelor’s degree in three years, and after his wife and young son joined him in the United States, they made the decision to remain and raise their family here. Within a few years, the young family of three grew to five.

Surya eventually earned not only two USC degrees, but also the distinction of being the first in the family to graduate from college.

“Surya provided a lot of our family that could not have been imagined over 50 years ago when my parents came to the U.S. from India,” says Sulekha.

“My dad was drawn to engineering, as I understand it, because engineers were said to make a good living in India.”

Surya recently retired after 32 years of helping to design and build L.A.’s excessive flood control system as a civil engineer for Los Angeles County.

Surya says he never would have guessed that he and his wife would blaze the trail for two successive generations of Trojan engineers. “They were all very studious,” he says. “Top of their class in math, so I’m not surprised that they ended as engineers from USC.”

His son, Ajay graduated one year behind his older sister, Sulekha. Ajay is now an engineering program manager at Qualcomm specializing in managing software releases for the company’s app store, and has worked for Hughes Aircraft Company, DIRECTV, Boeing, and Symantec in the past.
The Viterbi School as Startup Incubator
TWO YOUNG ENTREPRENEURS INVENT IBART, GLASS

What started as a summer lark for David Hedge (BSECS, ’11) became a best-seller in Apple’s App Store, and quickly led to a government contract and airline tickets to Italy and Atlanta from those clamping to work with the co-founder of the public transit startup.

In June 2008, the summer after his freshman year, Hedge, a computer science and business administration major, and his friend Ian Leighenson, who was majoring in mechanical engineering design at USC, Berkeley, won scholarships to attend a developer’s conference on how to create applications for the iPhone. Between sessions, they sat on beanbag chairs and sketched out ideas on a whiteboard before deciding to develop a trip-planning application for BART: a light rail transportation system in the Bay Area. Public transit was a long-time passion of Leighenson’s.

They thought the project, an exercise of sorts, would take two weeks. But as they started testing the application, they realized it might become a useful, meaningful product with real market appeal. Hedge, now 21, developed algorithms to connect with BART’s data, and Leighenson, also 21, worked on the interface.

The duo submitted their free app to Apple in mid-August, and within hours of its release, they had scored 10,000 downloads and dozens of glowing reviews, including an article from San Francisco magazine and mentions in the New York Times, Washington Post, and Atlantic Monthly.

Hedge today is working on developing applications for Los Angeles metro area, as well as Boston and Chicago. He has a version ready for beta testing in Los Angeles, but the market may be limited, he says, as few Angelinos use iPhones on public transit.

Speaking from Paris, where he was taking history and engineering writing classes through USC’s overseas study program, Hedge says the business took him by surprise. “For all I knew, it wouldn’t amount to anything.”

What wasn’t a surprise was his entrepreneurial path. Hedge had chosen to attend USC because the school gave him the flexibility to take computer science and business classes. “Normally, there’s almost no overlap at engineering schools. But in the real world, there’s a lot of overlap. It was great to learn things in software classes and then apply them in finance.”

USC provided the resources of a larger university, but had the feel of a small institution, he added. He gravitated to campus culture, in which smart students worked hard but still enjoyed themselves, to help restore balance in his busy life. Hedge trained with the school’s triathlon club.

After their breakout success, Hedge and Leighenson spent the fall of 2008 working on what to do next, and while they decided to keep IBART free and accessible, they would offer a paid upgrade ($4.99) that would offer users access to real-time arrival information on trains. Two nights a week, Hedge helped himself up in conference rooms on campus and by his pool, after an all-nighter, finished the upgrade, booked an airline ticket, and presented the app at a small meeting at Apple headquarters to fellow developers.

They named their startup Pandan, which has since incorporated with the help of USC’s Stevens Institute and its Small Business Clinic. The co-founders hired three USC students and landed a contract to develop a version for Alhambra’s transportation system. They also released a version for Chicago and Alhambra D.C. The original application has been downloaded more than 200,000 times and is used on average between six and 10 thousand times each day.

Pandan has turned a profit from sales of five upgrades, its most used version, the 30-day version, in a matter of weeks.

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The duo submitted their free app to Apple in mid-August, and within hours of its release, they had scored 10,000 downloads and dozens of glowing reviews, including an article from San Francisco magazine and mentions in the New York Times, Washington Post, and Atlantic Monthly.

Hedge today is working on developing applications for Los Angeles metro area, as well as Boston and Chicago. He has a version ready for beta testing in Los Angeles, but the market may be limited, he says, as few Angelinos use iPhones on public transit.

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Born in Chiapas and raised primarily in Tijuana, Prats has long loved the dynamism and multiculturalism of the borderlands from Los Angeles to Ensenada. He found that spirit at USC, where he studied the application of math, logic, and computer science to business processes in industrial and systems engineering. “It was a growing department, and I wanted to be part of a growing story,” said Prats, adding that he appreciated USC’s latin community.

“You meet people from all backgrounds and academic fields,” said Prats. “You’ll be at lunch, talking to someone working on an MRI machine, and on your right, you can talk to someone about the new Mark Twain autobiography.”

For six months, the co-founders worked on market analysis, looking for angel funding and putting together a prototype to show investors—while working multiple part-time jobs. Prats was also balancing work with studies as a doctoral candidate in systems and industrial engineering. They used empty classrooms at USC to practice giving presentations, meet to discuss strategies, and interview potential employers.

From the summer of 2008, after raising enough funding to support themselves, the founders devoted themselves full time to their startup, and Prats left the doctoral programs. Border Stylo, now housed in an office in Hollywood, has about 30 employees and interns. Their goal is to improve the beta version with a user feedback test and testing, creating the add-on for other Web browsers, and expand into international markets.

“We want to make products that keep in mind social and human interaction,” Prats said.

USC vs. Arizona Weekender TUCSON, AZ November 13, 2010
USC vs. Oregon State Weekender CORVALLIS, OR November 20, 2010
Half Century Trojans Going Back To College Day LOS ANGELES, CA February 17, 2011
USC Women’s Conference LOCATION TBD Spring 2011
USCAA Alumni Awards LOS ANGELES, CA Spring 2011
Remembering Arminta Harness
FORMER SWE PRESIDENT BLAZED A TRAIL FOR WOMEN ENGINEERS

During a 30-year engineering career, Arminta Harness (BSAME ’55) blazed a trail for all technically-minded women by becoming the first woman engineer in the U.S. Air Force. Harness, who passed away last February in Millville, Calif., at the age of 81, helped pave her Air Force career initially because she couldn’t get an engineering job after graduation. “Time and time again I was told, ‘as long as you are a returning GI needs a job, I’m not going to hire a woman,’” she said in an oral history documented by the Society of Women Engineers (SWE). This Air Force initially assigned her to recruiting duty. Later, she was transferred to Wright Patterson Air Force Base as an engineering job, but there was a snag. “The male processing officer at the base didn’t think women should be engineers and slated her for administrative duties. Undeterred, Harness trained another officer for the admin job and then assigned herself the engineering position, saying she’d learned how to transfer her own skills. From that point on in the Air Force, I was always an engineer.”

During her career, Harness designed intelligence-gathering equipment for the U-2 aircraft, provided management direction for the $2 billion Space and Missile Systems Organization budget, and was the first woman on orders as a test engineer during flight testing of the experimental equipment that she designed.

In Memoriam
Edward Louis Armstrong (BSME ’43, ’46) died in Lepusada Beach in May 2010. He was a retired U.S. Navy captain and World War II submarine officer. He held three years of experience at Rockwell and Automation, among other companies. He is survived by his wife of 47 years, Marilyn; daughter Victoria; son John; and three grandchildren.

Mag. Floyd Barrows Jr. (MSME ’63, ’68), passed away on May 25 in Chattanooga, Tenn. He served the Army, Air Force and completed three tours of duty in Vietnam. He is survived by his wife Betty of 53 years; children Bill, Teresa, Phil and Preston; three grandchildren; and five great-grandsons.

Howard Dean Rungard (BSME ’74, ’86; died December 20, 2009) in Sun Lakes, Ariz. He was an engineering appraiser at the August Sound Naval Shipyard in Bremerton, WA for over 30 years, retiring in 1974. He is survived by his wife Bernece of 63 years; daughters Juanita, Barbara, Patricia and Cynthia; six grandchildren; and five great-grandchildren.

Mark James Effinger (BSMS ’97, ’45; died on January 17). He worked in the telecommunications and software industry for more than 25 years and was the vice president of vertical services and support for Information in Edison, N.J. He is survived by his parents Frank and Anita; siblings Kelly, Miki and Tracey; and five nieces and nephews.

Robert C. Gardner (MSPE ’77, ’78; died on January 30 in Alaska. He was born in Hollywood, Calif., but went to Alaska first as a surveyor for the U.S. Army Corps of Engineers. Later he became principal or founding engineer of several consulting engineering firms. He is survived by his wife, Tracey, children Christopher, Geoff and Julie; and six grandchildren.

John A. Harbolt (BSME ’44) died May 22 in Peoria, Ill. He served in Vietnam and later worked for General Dynamics based out of Ft. Worth, Texas, as a technical representative for the F-16. He is survived by his daughter Tawn and five grandchildren.

Victor H. Smith (BSME ’44, ’46) died on January 29, in Gloswell, NY. He was an engineer for General Electric until 1979, and embarked on a second career as an engineering inspector and expeditor. He is survived by three children, Andee, Steve and Norma; six grandchildren; and eight great-grandchildren.

Perry Philip Tiet (BNSE ’73, ’46) of Portland, Ore. died on July 2 after a battle with pancreatic cancer. He was a structural engineer and owned KPT Engineering and Development. He is survived by his wife, Regina; daughter Britanny; and mother Phillips Tiet.

Frederic Clifft McCall (BSMM ’40, ’89; died in Gibraltar, N.C., on February 5. He served in World War II and spent the 25 years before his retirement with Olkinkraft Forest Products Company, retiring as vice president. He is survived by two daughters, Randy and Frances; his son Frederic; and three grandchildren.

Denny J. Purkey (BNSE ’76, ’70; died January 22 in Portland, Ore. He enlisted in the Air Force and later spent 13 years at McDonnell Douglas as a senior engineering specialist. He eventually went into business and tax consulting. He is survived by his wife Diane; sons David, Michael and Paul; daughters Christyan and Amy; 23 grandchildren; and 14 great-grandchildren.

Lois F. Ramsey (BSME ’50, ’86; died on July 25. Ramsey was an insurance agent for 17 years and later served on insurance commission for the state of Oregon until his retirement in 1985. He is survived by his wife, Suzanne; daughters and spouses, Karen and John French, Dina and Tom Gentry, Janis and Andy Andrews; and six grandchildren.
Q&A: Captain Chesley B. Sullenberger Comes to USC

Captain Chesley B. Sullenberger served as the USC Viterbi School of Engineering’s undergraduate commencement speaker in May 2010. This fall he will lead a Viterbi School symposium for aviation executives that will combine key concepts of organizational leadership with core ideas of aviation safety.

The pilot and aviation consultant was hailed internationally as a hero after he safely guided U.S. Airways Flight 1549 to an emergency water landing in New York’s Hudson River in January 2009. He saved all 155 passengers and crew disembarked before exiting the Airbus A320 himself. Since then he has become a global ambassador for aviation safety. He has published a memoir entitled Highest Duty and is working on a second book.

Sullenberger is a graduate of the United States Air Force Academy and served as a fighter pilot in the Air Force. He later became a commercial airline pilot and retired in March 2010 from a 30-year career. He earned his bachelor’s in psychology from the Air Force Academy, a master’s in industrial psychology from Purdue University, and a master’s in public administration from the University of Northern Colorado.

He spoke to the Viterbi School this summer about heroism, aviation safety, and what engineers can do to serve society.

The word “hero” and your name have almost become synonymous. What does this word “hero” mean to you?

In the last year, I’ve thought a lot about what “hero” means. I think that we are heroes when we do something to make life easier for others when we do something that makes us human. Many people may think of these as great deeds or great acts of kindness, but for some they have real meaning in real life with real consequences. These include doing good work, helping others, and sacrificing. The absence of sacrifice is normal; it’s heroism is being a hero.

We are an engineering school and we strive to prepare the next generation of engineering leaders. What do you see as the engineer’s main contribution to aviation safety? To society?

It’s important for engineers to understand and be well-educated in the science of safety. Your engineering work can be top-notch and it’s still possible to fail if you don’t have the knowledge and the training to do the job. You must have a system safety mindset that addresses not only human failures, but human limitations. By doing this, you provide benefits to society.

You have become a global ambassador for aviation safety. What particular areas need special focus or improvement?

Pilot experience is an issue, not only in the United States, but around the world. We transition from one generation of pilots to the next, and we need to make sure that those who follow have the same fundamental skills, in-depth knowledge, and the kind of judgment that comes only from long experience.

Additionally, fatigue is an issue that needs to be addressed. In this country, our decades-old rest rules need to be updated to reflect how we fly now, both on short- and long-haul flights.

And as we transition to the Safety Management System (SMS) concept, safety will become embedded in our processes as a core business function, and management at every level of the organization will be held accountable for safety. SMS has the potential—if properly implemented in an effective organizational safety culture—to take aviation safety to the next level.