CREATING THE WORLD THAT NEVER WAS

THE $500 MILLION CAMPAIGN FOR THE USC VITERBI SCHOOL OF ENGINEERING
The USC Viterbi School of Engineering is entering one of the most exciting chapters in its history. Building on over a century of innovation in research and education — and energized by an underlying optimism that engineering delivers the promise of a better life — the school is sharply
expanding its upward trajectory.

“Scientists discover the world that exists; engineers create the world that never was.”
— Theodore von Kármán
I. Be a Global Attractor of Talent: of students, faculty, and staff from anywhere in the world – and provide the culture and the environment for them to flourish.

II. Continuously Add Value: to curriculum, programs, and infrastructure.

III. Advance Solutions to Global Challenges: from energy and sustainability to security and infrastructure, to health and medicine, and to the scientific and technological discovery.

IV. Use Engineering as the Catalyst for Innovation: to fuel the economic growth of Los Angeles, Southern California, the United States, and the world.

These four pillars support the vision of the Witsch School. They express our passion, and they guide our ambition. In these pages you will get a glimpse of their impact. But to keep them strong and growing requires resources.

Upon its inauguration, USC President C.L. Max Nikias announced the Campaign for the University of Southern California, Feas Reggae, a historic $6 billion campaign. The Witsch School has its own share of this campaign, a target of $100 million, fairly the highest goal in the USC School of Engineering history, and likely one of the largest ever in engineering schools anywhere.

The exhilarating new era presents us with great opportunities, but also with risk if we fail to grasp them. In moving the school forward to meet a constantly evolving frontier, I am reminded of the three characteristics of Jim Collins’ good-to-great: passion, excellence, and the resources to fuel them.

We have encapsulated the first two in the following four pillars:

The campaign’s target is $100 million, fairly the highest goal in the USC School of Engineering history, and likely one of the largest ever in engineering schools anywhere.

The above themes can be encapsulated as creating the “world that never was” – a declaration of wonderful possibility, drawn from the words of Theodore von Kármán: “Scientists discover the world that is, engineers create the world that never was.” Perhaps it is altogether fitting that this year, the year that our own Professor Sol Golomb was awarded the National Medal of Science, we invoke the scientific inheritance of von Kármán, the man upon whom John F. Kennedy con¬ ferred the nation’s very first honor. Just as with Deutsch, the notion of constructing a world which never was, speaks to an imprerceptive optimism, one which assumes that problems, known and unknown, are surmountable. We may, in a moment of boldness, even presume that a clutch of that surmising will be done at USC, a place not wholly unfamiliar with making problems soluble (see page 8 – on restoring sight to the blind).

“Creating The World That Never Was” will strengthen the four pillars, by providing funds for student scholarships and endowed chairs; excellence in departments and student centers and programs; helping raise new instructional and research buildings and facilities; endowing research centers and new Ford to research, and helping nurture an eco¬ system of innovation and entrepreneurship.

Join us on...
Sol Golomb Named Among Nation’s Top Scientists, Innovators

President Obama confers National Medal of Science, the highest honor bestowed by U.S. government upon scientists, engineers, and inventors

On better rock songs:

Before YouTube had HD video, you didn’t know the video you were watching was a video. That’s the scenario to start with... If not for Dann (Kyriakos), we wouldn’t be able to help our users listen to music as if they had for more expensive headphones without using more than three dollars.

Virtually every epic indie rock song that I listen to, there’s always a moment when I turn on the (Kyriakos) high fidelity tool. It’s like you’re been in a really nice restaurant for five hours and then you step outside, and it’s quiet and there’s sort of an ‘ahh’ moment. You don’t realize how great these other sounds had been. Suddenly, that really convey-

— Elisa Romo, CEO of music streaming service Spotify, on Dann’s invention and his future for its users who, in partnership with Audigio, Associate Professor Chris Kyriakos’ spin-off company from the USC Integrated Media Systems Center.

On fighting cancer:

“The essence, what [Paul Newton] is creating is the beginning of a new model. You know, we doctors have plenty of our own models, all created by other physicians. But it’s the difference of trying to predict the weather the way an 18th century sailing ship versus using a ship with modern technology. I can take someone’s PSA, size of tumor, grade of tumor, and turn to charts that tell me about the type of cancer progression they might have. But that’s like trying to predict tomorrow’s weather using today’s calend-

— Dr. Petri Levitt, present professor, Zhongka Huangmoguchi, School of Medicine at USC, on Professor Yi-Fei Huangmoguchi’s work, interpretating data to help diagnose cancer.

On climate change:

“Adaptive goal in marine ecosystems is predicting how communities of marine organisms will respond to changing environmental conditions such as climate change. Achieving that goal requires the design, control and deployment of sophisticated robotic instruments such as those that Davis and his team have been developing. These instruments, equipped with state-of-the-art sensors, are becoming to pro-

— David Conron, professor of biological sciences, USC Department of Letters, Arts and Sciences, on Professor Guo Zhang’s underwater robotic research.

They Said It

Engineering* / What non-engineers are saying about us.

USC Viterbi Ranked Among the Best Graduates Schools of Engineering
U.S. News and World Report ranks USC Viterbi in the top ten in this year’s Best Graduate School Rankings.

Everybody’s Talking On-line education... USC Viterbi’s #1
USC Viterbi earned top honors in two online education categories in the U.S. News and World Report 2013 rankings: Online Graduate Engineering Programs and Online Computer Information Technology Programs (Computer Sciences).

Top Hollywood Agency — Major Silicon Valley Tech Viterbi Engineers

In a move calculated to excite “Silicon Beach,” the Viterbi Startup Garage in a new joint institution of the USC Viterbi Engineering Innovation Institute (VII), United Talent Agency (UTA) and Kiefer Perkins Cowles & Spence. This early-stage tech-
nology accelerator is designed to provide financial and other strategic resources to a select group of USC student and alumnus entrepreneurs.

Best Video Games Program in North America — 4th Straight Year
USC Games, a joint collaboration between the School of Cinematic Arts’ interactive Media and Games division and the USC School’s Computer Science Department, has been named the top graduate program for video game design by The Princeton Review for the fourth straight year.

iPodla - The Global Classroom
The spring 2012 iPodla class has not American, Chinese, Korean, Israeli, and German students from five universities (USC, P琉璃, KAIST, Technion and Aachen) studying together to learn how to leverage cultural diversity to inspire global innovation. See editorial, page 38.

Veausius Comes to USC
The 32-gigabyte solid state quantum chip has a new home: the USC Quantum Matter Quantum Computing Center at ISI, the first operational, quantum computing center in academia. The Veausius chip has the potential to solve problems in 100 milliseconds that would take the world’s fastest current supercomputers 320,000 years.
FAST FORWARD
Building A Better Tomorrow,
One House At A Time

Professor Behrokh Khoshnevis’s “Contour Crafting” technology could revolutionize the construction industry and improve lives.

By Marc Baillon

Behrokh Khoshnevis wants to change the world one house at a time.

A professor at the Viterbi School of Engineering, Khoshnevis has created a computerized, robotic machine that he believes will bring the construction industry into the digital age for the benefit of people everywhere, especially impoverished slum dwellers. This innovative “Contour Crafting” technology will soon be able to create a 2,000-square-foot home in only 24 hours, he says. That compares to the six to nine months it now takes to build the typical American home. Contour Crafting will also be cheaper, safer and better for the environment than prevailing labor-intensive building practices.

Guided by computer-designed architects’ drawings, the contour craftr gantry robot will move along its rails, repeatedly squeezing inch-thick layers of concrete through a nozzle like toothpaste from a tube. A pair of trowels attached to the nozzle will shape the materials as deemed, including nonlinear shapes. A commercial grade contour craftr will one day offer custom-designed homes, including individually painted rooms with all utilities imbedded.

It will do this with minimal waste, noise, dust and emissions pollution. Construction injuries and deaths will plummet through increasing automation.

The National Science Foundation, NASA and the Army Corps of Engineers, along with ConcreteSupply and other companies, have invested in it. So far, Khoshnevis and his team have built a multitude of shapes and walls with the innovative technology. Additional support, they say, would allow them to take Contour Crafting out of the lab and into the field, where they could satisfy building codes with more advanced robots.

“Contour Crafting is a revolutionary technology with astounding social, economical and architectural impacts,” Khoshnevis says. “Because of its high speed and low cost, the technology will perhaps have the biggest initial impact on low-income and emergency housing.”

An estimated one billion people in India, South Africa, Brazil and elsewhere live in unhealthy urban slums that breed disease and despair. In such places, Contour Crafting could dramatically improve the housing stock and quality of life. Similarly, the technology would be a boon to the millions left homeless by natural disasters and wars.

So promising is the technology that possible future applications include building labs and manufacturing facilties on the moon and Mars.

“I want to make a difference through my passion for invention, to touch as many lives as possible, and to play even a tiny role in the destiny of humanity,” Khoshnevis says. “I want to leave a footprint behind.”

View Khoshnevis’ most TEDx talk:
usc.viterbi.edu/housesaday
Buildings Have Personalities, Too

More than just concrete and steel, office buildings have their own personalities. Getting to know them better can save energy while making occupants more comfortable.

By Marc Ballon

Good relationships, built on communication, trust and compassion, are the bedrock of society. From husbands and wives to mothers and daughters to best friends, they are the glue that links us all together.

Burch Bercer-Gorber, Stephen Schrakm, blink’s early computer and environmental engineer, would build buildings and human beings to that list. Buildings and humans? Absolutely. Over time, she envisions important benefits flowing from building occupants and buildings getting to know each other better, including improved working conditions, conserving natural resources and a reduction of office energy costs by up to one-third.

“My long-term goal is to enable a new way of living and revolutionize the way we think about and interact with our buildings, offices and living spaces,” says Bercer-Gorber, whose MIT Technological Review recently recognized him as one of the world’s top innovators under 35. (She is the sixth USC faculty member to receive the prestigious distinction in the past four years.)

Here’s how it works. By gathering information through smart phone applications, sensors and other means, Bercer-Gorber says, buildings could learn occupants’ temperature, lighting and airflow preferences to improve comfort and productivity. Through text, visual and audio messaging, among other channels, buildings could also communicate with occupants on how their personal choices, even incremental ones such as turning the thermostat by a couple of degrees, would have a big impact on energy consumption. Such knowledge could lead occupants to alter their behavior to conserve energy and help the environment.

Bercer-Gorber emphasizes that communication runs both ways. Occupants will actively exchange information with their building and let it know what they use and what they want.

At present, this “conversation” between buildings and humans doesn’t exist. However, Bercer-Gorber and his team are working to change that. Armed with a grant from the U.S. Department of Energy, they have spent the past two years laying the foundation for such a symbiotic relationship.

Specifically, researchers have installed a myriad of lighting, sound, motion and other sensors at USC’s Lewis Hall and elsewhere on campus to better understand how workers and others interact with their office space. Among their findings: People have varying schedules and temperature preferences for different days of the week. This information will enable buildings to conserve energy while maximizing comfort.

In the future, Bercer-Gorber believes proprietary software using algorithms will make sense of the mountains of smart phone, sensory and other technological data, allowing buildings and humans to negotiate win-win outcomes.

Bercer-Gorber’s background makes her equally qualified to turn her vision into a reality. A graduate of the Technological University, University of California, Berkeley and Harvard University, she holds advanced degrees in architecture and engineering, gaining her insights into building design and physics. Her interdisciplinary collaborations with colleagues across the academic spectrum, long a hallmark of the Vitrocal School of Engineering, have moved her project forward faster than otherwise possible, says promising in her work that the National Science Foundation recently awarded Bercer-Gorber a large grant.

“Like our solutions to have impact in every- one’s life,” she says. “I believe they will.”

*motivated"

"One day, I’ll have a large number of people to interact with..."

"If you can see what the future is and you have a large number of people to interact with, you can make a difference."

"We’d like our solutions to have impact in everyone’s life."
INSIDE: “Gunslinger” @ ICT
Step inside a Wild West saloon filled with engineering technology

By Kathleen Conolli

Sitting in a dark movie theater, have you ever wished you could be a part of the action? Now, thanks to an interactive storytelling experience called “Gunslinger,” that fantasy is becoming a reality. A product of USC’s Institute for Creative Technologies (ICT), Gunslinger was brought to life by Jonathan Gratch, a USC research associate professor, and Kim LaMastra, ICT’s former creative director. Gunslinger allows a person to walk through the fictional Clementine Saloon as the town sheriff and interact with characters like the barkeep, Harmony the harpist, and the band, The Bluebird. Foundations of ICT, Harmony, and its downtown trail. They are virtual humans. And the goal of the scenario is for all of the characters, including the real world sheriff, to work together to take down the Gunslinger.

Gunslinger may look like a video game that transports the sheriff into a world of virtual humans, but these computer-generated humans don’t just respond using a generalized script of answers or reactions. Characters can react, respond, and communicate as though you were speaking with another live human being. Lifelike activity is possible thanks to ICT’s virtual human research. This includes speech recognition, computer vision, dialogue management, and character animation systems, all developed by USC faculty. The Nonverbal Behaviors Generator, developed by research associate professor Stacy Marsella and former graduate student Joo Les, Ph.D., allows the characters to appropriately react, focus their gaze, and exhibit facial expressions. Another Marsella-developed system called Smartbody blends these behaviors into a smooth animation, allowing them to happen naturally as a live human would.

Anthony Loski, a Viterbi research assistant professor and member of ICT’s Natural Language Dialogue group, helps enable the virtual characters to carry on conversations with the real-life interactor. Initially developed as a way to see if there was a way to combine engineering, cinema, and a video game experience together to make engineering exciting, Gunslinger has possibilities beyond the realm of just being fun. Jonathan Gratch, who leads ICT’s virtual human research efforts, describes Gunslinger as “the Chutes and Chutes of a first-person shooter.” He says Gunslinger and its technologies are like the systems, and this system can be used in various areas. Marsella, head of ICT’s Social Simulation Group, says that these types of programs and technologies aid in the development of social and professional skills. The virtual human technology allows a person the ability to create a virtual avatar in web and game interactions, but the virtual humans also act as role players in influence human behaviors. Marsella believes virtual humans can be trained to a “live form of computer interface” which allows platforms like Gunslinger to add to real world applications such as training soldiers in negotiation tactics, guiding doctors in better bedside manner, and even helping real life humans with stress management techniques.

Gunslinger was created by a team of people with backgrounds in computer science, psychology, theater, game craft, and storytelling. As it combines many different fields of study, Gratch believes that Gunslinger is a great example of the collective interdisciplinary work that USC strives for.
If you want to understand how a heart develops inside a growing mouse embryo, your best bet is to watch one—live. "That’s how every Fraser lab will approach the problem," Fraser said.

Fraser’s initial work focused on how the heart arises from the primitive streak, an area of potential tissue. As he directs his lab to work along both of these approaches, his lab has made a breakthrough in the development of a technique to grow heart tissues from mouse embryos in a dish. The Fraser lab has now shown that it can grow cardiac tissue from the same mouse embryo that gave rise to the mouse itself. "This is the first time anyone has been able to grow heart tissue from a mouse embryo in a dish," Fraser said. "This is a major breakthrough in our understanding of heart development."
Student Visions for Space Travel
By Conal Wilton

Every year, lecturer Mathus Thangaraju’s Space Concepts Studio looks to combine the power of science with the creativity of architecture. Thangaraju does not encourage all notions he eschews only for new and innovative ideas that will reinvigorate space travel for future generations. Below are some of the outstanding student visions from one of his recent classes.

Mark Smith - Algae Ecosystems in Space

The next time you scope algae off a drift rake, think twice about flushing it down the toilet. Mark Smith, UCSC’s leading aerospace engineering alumna, believes algae can revitalize space exploration.

Smith and a team of researchers at NASA envision a novel method of generating energy and life support for astronauts from algae. Smith proposes to build living algae ecosystems in space where the plant can be converted into oxygen, drinking water and energy.

The cost of sending oxygen, drinking water and other life-sustaining materials into space can be as high as $4,000 per kilogram. However, Smith believes an algae ecosystem in space could potentially produce enough air, water, and energy to support the astronauts. Therefore, an energy-producing, space-based algae system would be a better approach to explore space. A major challenge Smith has encountered is the difficulty of maintaining a living system of algae that can independently supply astronauts with energy. The problem is that in order for living algae to reproduce, the plant needs to be supplied with nutrients. Smith’s solution is to introduce special seeds that feed off the remains of dead algae and release them back into the environment for the living algae to absorb. Ultimately, Smith is confident algae will transform space travel and exploration.

Guliang Chang – Moon Supercomputer

From controlling the tides to keeping the earth in a stable orbit, the moon plays a crucial role in sustaining life on earth. UCSC’s astronomical engineering Ph.D. candidate, Guliang Chang, believes we can do more.

Chang has imagined building a supercomputer on the moon to help back up the Deep Space Network (DSN) on earth. The DSN is a network of computers and antennas throughout the world that allows scientists to monitor unmanned missions in space. Unfortunately, the DSN system is aging. If it fails, vital information necessary to conduct outer space missions will be lost.

Chang believes the moon is an ideal location for a backup system because of its astronomic importance and proximity. In addition, the moon’s small gravitational pull allows the computer’s satellite dish to be much larger, making communication to and from earth faster and more stable. By building a supercomputer on the moon, Chang hopes to have better control over the current system, but also to create a reliable foundation for all future space projects, including on the moon.

Although the potential for Chang’s lunar computer shines bright, significant challenges remain. Amongst them, the Earth always faces the same side of the moon, making it difficult for a lunar computer to communicate with satellites on the opposite side. Chang’s response to space antennas around the moon or the computer can easily communicate with Earth’s satellites regardless of their position. He also hopes to build the computer for below the moon’s surface to protect it from harmful radiation. Chang believes the moon will host a supercomputer sometime in the next two decades.

Jing Zhang – Biodesmos

Although the Maya might have been wrong about the world ending in 2012, most rational people realize Mother Earth will not last forever. Earthquakes, tsunamis, meteors, and massive volcanic eruptions are just a few examples of natural disasters that have the potential to unleash catastrophic consequences. Man-made hazards also exist, including nuclear winter, genetically engineered viruses, and overpopulation. So why are we not panicking with fear as we anticipate our inevitable doom? Because scientists like Jing Zhang, a second-year Ph.D. candidate in manufacturing, are finding ways to protect us from possible destruction.

Zhang proposes constructing underground biodesmos to protect humanity from natural and man-made disasters. Inside, the biodesmos would produce enough food and fuel to power the society they house. All generated waste would be recycled and reused.

Biodesmos currently in operation include the Biodesmo in Monter, Canada, the City Prospect, Comwall, United Kingdom, and the Ark Hotel in Helsinki, Russia. In Antarctica, the McMurdo Greenhouse is a biodesmos that uses artificial lights to help plants grow, providing food for over 300 people in the dead of winter.

Zhang envisions future biodesmos underground, in the ocean, in the sky, on the moon, on Mars, and even on asteroids. He estimates the initial expense at about $400,000 a person.

Niranjani Namboothiri Madhavan – Telerobotics

One of the greatest challenges of space exploration is ensuring the safety of astronauts as they venture into space’s volatile, inhospitable vacuum. But what if it was possible to conduct complex missions if outer space without having to send humans a massive amount of time (days or weeks)?

UCSC’s electrical engineering alumnus, Niranjani Namboothiri Madhavan, believes it is possible and evenjavascript function

Today’s robots are programmed to accomplish certain tasks such as regulating satellites or opting for a precise location. Madhavan proposes placing a robot into space controlled by humans on earth, thereby allowing the robot to do the heavy lifting while humans can avoid the inconvenience of being on the moon or elsewhere.

Although it is a possible idea, it is still an ongoing goal to install neural networks into the robots so they can learn how to carry out their missions in space and eventually act independently of human direction.

One of Madhavan’s main challenges is finding a way to communicate with robots in real-time as they travel deep into space. A robot on the moon would route a signal sent by humans with a science delay. As robots travel farther from earth, the science gap increases. Nevertheless, Madhavan believes his vision will help expand the possibilities of space exploration and shift science one step closer to making James Cameron’s “Avatar” reality.
SPOTLIGHT: Leah Gum

by Anne-Catherine Briggs

The first thing prospective employers usually notice about senior Leah Gum is her theater minor. As an electrical engineering major, this makes her stand out from a crowd. What they wonder, do engineering and theater in common? Gum has a ready answer: “Just because the fields are so different on the surface doesn’t mean that they’re actually that different on the bottom.” Gum said. “Both fields are centered around trying to solve problems. In engineering, that is going to be considered more technical problems. In theater, the problem is: how do I recreate human emotion and experience?”

Gum praises USC Viterbi’s commitment to combining engineering with other fields to advance knowledge. Known as “Engineering”, the school often involves other disciplines, including psychology, dance or theater, to provide innovative approaches to solving problems and improving technology.

Gum believes her acting background influences her as an engineer by giving her a unique way of thinking and approaching problems. She is not alone in her belief of the future collaboration between the realms of engineering and theater.

“The arts are entering the realms of engineering more and more. In design and research,” said USC School of Dramatic Arts Professor Shannon Carrigan, with whom Gum has collaborated on a research project, “Darwin’s ladder of those interests is both unusual and productive for the future.”

In her junior year at USC, Gum contributed to a project that seeks to define human motion to improve animated characters in television and film. These technologies are increasingly important in “Avatar”, “The Hobbit” and other Hollywood blockbusters to better understand human movement.

Gum’s research focused primarily on motion as a form of interaction. She set out to answer the question: can we really define realistic human motion well enough for a computer to emulate it?

At present, there is not enough information or technology available to do this. However, Gum sees the potential for computers to soon define and capture motion with close to the same precision as actors through the fusion of the engineering and theater disciplines.

Although her involvement with the project ended last semester, Gum continues to juggle this academically rigorous course load, taking three graduate courses and one undergraduate course this semester. Gum will complete her undergraduate degree in May, but will remain at USC another year to finish her master’s degree in engineering.

“Just because the fields are so different on the surface doesn’t mean that they’re actually that different on the bottom,” Gum said. “Both fields are centered around trying to solve problems. In engineering that is going to be considered more technical problems. In theater, the problem is: how do I recreate human emotion and experience?”

The Conquest of the Left and Right Sides of the Brain:

You hear the familiar “Tribute to Fry” at every USC Trojan football game, you’ve seen them in your favorite pop music. Since 1984, they have always represented the spirit of the university and the spirit of Troy. They are the Trojan Marching Band, and they are composed of students from all over USC’s many schools and departments.

You’d probably be surprised to know that 310 members of the Trojan Marching Band, also current students of the USC Viterbi School of Engineering. They make up an amazing 30.3 percent of the group.

There are two sides to the brain, the left and the right, and according to many theories, those who are considered left-brained thinkers are said to be more logical, analytical, while those who are right-brained tend to be more creative. Engineers have long been thought of as left-brained thinkers, using logic and math to achieve great inventions and applications. So why do so many engineering students excel in what is considered to be a right-brained activity? Viterbi student Greg Sinclair believes that this is because “music involves both right and left brain activity.” Sinclair plays trombone for the Trojan Marching Band and studies chemical engineering with an emphasis in particle engineering. In the future he plans on getting a masters in nuclear engineering and getting involved in fusion research. But for now he sees the marching band as a character to let his creativity shine.

As a student in the Trojan Marching Band, students each practice begin with “secularism”, where section leaders work with their section to practice the music they’ll play at each game and appearance. Then they all come together to play the music and practice the pregame and halftime performances. Each practice then ends in the uplifting “Conquering”. Much like working on an engineering prototype or innovation, students must practice the music separately, fine tuning their pieces (their equations), before they become part of the bigger, louder, more energetic overall. In an age of interdisciplinary study and engineering, the marching band has evolved into more of a creative field than ever before. Engineering now consists of video game design, virtual humans, and determined media systems, all of which require thinking out of the box to create the next big thing. So maybe the question isn’t, why do left-brained engineers excel in a right-brained musical practice? But rather, is engineering evolving into more of a creative field than we once believed?
ILLUMIN’S mission is to illustrate the many ways engineering benefits and impacts daily life. Articles are written, edited and published by undergraduate students at the USC Viterbi School of Engineering.

POWER-GENERATING FASHION: A LOOK INTO SMART TEXTILES

By Amy Huang

Technological advances have allowed many science fiction fantasies to become reality. Smart textiles are clothing materials that are woven or embedded with advanced properties that can sense changing environment conditions or stimuli from thermal, chemical, mechanical, electrical or other source. Engineers and researchers are currently developing smart textiles that can create enough electricity to power up an MP3 player, a cell phone or similarly small electronic device. Two types of these power-generating textiles are photovoltaic-integrated fabric and piezoelectric fabric.

Photovoltaic-Integrated Clothing

Photovoltaic-integrated fabric can be used for a variety of clothing and accessories. A common solar cell accessory that can currently be bought in the market is a built-in solar cell with a thin strip of photovoltaic fabric on the top that generates power for a fan that is attached to the brim; the brighter the sun, the quicker the fan spins. Designer Andrew Schneider created a solar powered sailboat, made of piezoelectric fabric, that can steer and swing in the wind with the sail. After two hours under the sun, the twisting sail was able to produces a few watts output and when attached to an LED, indicating that it should slowly recharge an MP3 player.

Piezoelectric Fabric

Piezoelectric fabric is another kind of power-generating textile that is currently being engineered. This kind of smart fabric creates an electrical charge through kinetic energy generated by stretching and twisting the textile. In the future, piezoelectric textiles will hopefully be able to produce enough electricity to power up a portable electronic device.

The technology behind piezoelectric fabric is still in its infancy. However, researchers have developed this fabric through the combination of nanosized hollow pyramids and a principle called piezoelectric effect, which is explained by generating electricity through pressure. Piezoelectric fabric has a zinc oxide composition, where the direction of the zinc oxide is aligned in one direction while there are grids across the other direction. These wires are only 0.001 nanometers in diameter, which is about 1,000 times thinner than a human hair. When the fabric is stretched or twisted, the two wires rub against one another and the resulting tension and pressure is converted into electricity that can power a range of portable electronic devices. The nanowire is very strong, so there is an increase in charge in the center of the nanowire, which makes it a better conductor. Currently, prototypes have demonstrated maximum energy conversion efficiencies of over 20 percent. It is estimated that one square meter of piezoelectric fabric could produce enough electric watts of electricity, which is enough to recharge a portable MP3 player.

Piezoelectric Fashion

The concept of piezoelectric fabric can also be applied to backpacks. Engineers are currently developing backpacks that generate electricity from the friction created by the rubbing of backpack straps on shoulders. The straps are made of polyethylene, which is a strong, flexible material similar to nylon, and will generate an electrical charge from the applied stress to power electronic devices. This kind of piezoelectric backpack is extremely beneficial to military soldiers, because it prevents the wearing out of two and three mils per hour with a 20-pound backpack, the external weight carried by soldiers, could generate around 45 to 60 milliwatts of power. The use of this kind of back pack may even allow the soldier to save battery, because electricity would be generated in place of carrying extra batteries.

Piezoelectric materials can also be used to convert sound into light. Designer Daiwha Kim used the idea of piezoelectric effect and created piezoelectric devices that were embroidered with LEDs, conductive silver thread, and miniature microphones. The patterns on the dress would light up when doing dance-rehearsed sound waves. These types of innovative fashions would be extremely popular at clubs and concerts because the patterns in the clothing would light up to the beat of the music.

MORE IN THIS ISSUE OF ILLUMIN:

Biology’s Approach to Construction: The Development and Use of Scaffolds in Tissue Engineering

IF You Can Think It, You Can Print It: Exploring the Possibilities of 3D Printing

Silver Nanoparticles: A Valuable Weapon in Medical Wounds

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in the last hundred years, science fiction has transported readers and viewers everywhere from the center of the earth, to space, and beyond. Audiences have even traveled through time, aided by iconic vessels like the U.S.S. Enterprise, the TARDIS, and the Stargate. Instead of fantasizing about the lore of mythical things that once were, readers increasingly turned their attention to the entailment of what things could be in the future, from technology to infrastructure — both architectural and political.

Because of this element of science-based fantasy, science fiction is inevitably bound to the contemporary experience in a very real way. The genre has heralded many technological concepts that have come to real fruition in the last few decades, and it is here at USC Viterbi School of Engineering where a group of young dreamers are looking to change the paradigm of the home video gaming experience.

Holodeck, named after the virtual training facility of the "Star Trek" franchise, sprang from the USC Games program, a joint effort between students in the Interactive Media Division (IMD) at the USC School of Cinematic Arts (SCA) and the Viterbi School’s Department of Computer Science. For the first time ever, consumers may finally be able to fully immerse themselves in a 360-degree virtual reality experience at home. Principal hardware engineer Jake Green, M.S. ’14, explains that Holodeck creators James Riff and Nathan Iurba were inspired to create a home virtual reality system because they simply didn’t see such systems on the consumer market today.

"What happened here is that it was a need for, and instead of just waiting around for the technology to get there — to be realized that this is needed [and] then they wanted — they decided to just take up the project themselves." Despite the technology exists today (there are virtual systems out there, but they are only used for defense and industrial testing, such as testing tank parks), none of it has actually been successfully planned and packaged for the general consumer.

While Sega’s video game Time Traveler made million $ a week at its peak in arcades, it never reached the home consumer market, much less survived the early ‘90s. More importantly, the technology needed to achieve full stereoscopic vision simply did not exist. Sega achieved stereoscopic imagery via a circular mirror and CRT television set. Holodeck, on the other hand, utilizes the OZ-14 head set, PlayStation Move play space, and Razer Hydra handheld console. Their main software is built in Unity 3D, and the VR game Wild Skies is being developed in tandem with Holodeck’s hardware.

Palmer Luckey, an early Holodeck team member and mixed reality lab engineer at USC Institute for Creative Technology (ICT), is the founder of Oculus Rift and is currently working on delivering the Oculus Rift to the masses; his Kickstarter generated well over $2.4 million dollars, including support from top video game companies, including Valve, Epic Games and Unity. Along with being a promising project intent on shirk ing the video game industry, Holodeck also finds itself a bit of an indie game darling. Due to their DIY approach to hardware and software building, virtually every aspect of the project is a home brew.

"The indie industry doesn’t have the luxury of, ‘Okay, the people are going to buy this no matter what.’ So it’s more of a struggle to make [Holodeck] more personal and [to make] the player have a better experience...it’s allowed us to focus more on what the consumer might want, as opposed to, ‘What can we do to squeeze more money out of people?’"

Green, a cinema minor constant on the search for creative outlets, remarks that being in Project Holodeck opened his eyes beyond mainstream media (and mainstream video games). Seeing it from both sides of the spectrum, he says, "I’m actually glad I’m in the indie game industry because it’s definitely more creative and more ideas oriented...lately, I’ve been all for the indie movement.”

What does all this mean for the video game consumer? With a strong spirit for innovation and the gumption for risky creative decisions, Holodeck is doing the seemingly impossible: create a VR system from scratch — for the people and for an affordable price. They may very well prove another Hollywood-style Grail (we’ll play).
“MONEYBALL” 2.0 And The NBA

USC Viterbi scientists to crunch the largest amount of statistical baseball data ever gathered
By Adam Smith and Marc Ballian

For the past four seasons, the Oklahoma City Thunder has sought a competitive advantage in SportV, a new optical tracking technology created for the Israeli military. But instead of tracking incoming missiles, the video cameras mounted high in the rafters of Chesapeake Energy Arena are tracking players like Kevin Durant and Russell Westbrook.

It’s the latest evolution of “Moneyball,” an alchemy of video and computer algorithms that may be the largest amalgamation of statistical baseball data ever captured. USC Viterbi School of Engineering computer scientists Rajiv Maheswaran and Yu-Tien Chang are the first university research team in the country to be tasked with analyzing the revolutionizing new SportV optical tracking data.

Fifteen NBA teams, including the Thunder, use SportV, but their number is growing. In fact, if we include the Boston Celtics and the San Antonio Spurs, three of the four 2012 conference finals teams are now clients of the technology. Factor in the Dallas Mavericks—who were analyzing motion sensor data in their 2010-11 championship season—and the fact that the NBA is strict about keeping their glasses under wraps, their use of Optimal Tracking Data can be seen in almost every NBA game.

Maheswaran and Chang are key players in an emerging, high-tech sport. They are key players in an emerging, high-tech sport.

For the average NBA coach or scout, the raw data is meaningless, but to Maheswaran and Chang, it’s gold mine of information.

So talented are the dynamic data duo that they have just christened a new company, Beyond Sports. The USC-launched startup will create data analytics and visualization tools to help NBA teams leverage the mountains of optical tracking data. Maheswaran and Chang can also create individual player profiles, offensive strategies, defensive tendencies, including shot selection and accuracy under increased pressures.

“We can also do this for soccer, football and maybe hockey,” adds Maheswaran. “Basically any sport that moves.”

Kopp first encountered the USC researchers at the 2011 MIT Sloan Sports Analytics Conference. He was looking for researchers and academic scientists to play with this new optical tracking data, but many were daunted by the complexity of “a million data points per game.” Maheswaran and Chang, however, research scientists with USC Viterbi’s information sciences institute (ISI) have attacked big data problems ranging from “The World of Starcraft” to modeling cancer.

Said Maheswaran: “Whether its energy or health or social media, we can basically track almost every event in the universe. In the end, it’s all about turning up all the sorts of new problems when you come to, how you deal with all the data?”

“Moneyball” took data everyday had and just locked it in a different way,” said Kopp. “That’s something we’re certainly trying to do, but we’re also looking at data you’ve never had before.”

One example is different, which Maheswaran calls the “holy grail of baseball” — at least for analytics. He and Chang were the first research group in the country to be tasked with analyzing all the STATS optical tracking data from the 2011-12 season.

More recently, the USC researchers brought their analytical tools to bear on offense, they looked at block attempts, including how often the shooters and defenders before, during and after field goal attempts. Among their more recent findings: A typical three-point shot is made as a good as a close-up shot has little to do with it. The ball must travel a longer distance and be more contested and worse hit. The softer-touched and colder shot, the more effective field goal percentage for a three-point attempt. The defender five feet away is significantly more helpful, nearly identical to a three-to-four-foot shot with a defender just two feet away.

Maheswaran and Chang won best paper at MIT Sloan Sports Analytics Conference in March 2013 for their paper, “Aウンtenative for Optical Tracking Data.” By studying the trajectories of the players, the teams, the balls, and the replays, players need to move further to the basket. Ninety percent of all missed shots are rebounds, 10 percent are missed field goals.

Both Maheswaran and Chang are quick to point out, their analytics aside, “The most important thing to being successful is having very good players.”

But that’s said, in a playoff environment between two evenly matched teams, an edge of one second on the matchups and player tendencies could be the difference between “Holding the Larry O’Brien Championship Trophy.”

“When good teams play good teams in close games, you want an edge that you can get,” Maheswaran said.

The Days of Wine and P_opcode objects, as well as complex objects made up of hundreds of thousands of troheder.

Jernej Barbic Releases Comprehensive 3D Deformable Object Library for Free
By Eric Mannkin and Katie Dunham

Jernej Barbic, USB Viterbi School of Engineering assistant professor, released the world’s most comprehensive library of 3D deformable models known to for download last August.

The library is called “Vega” and allows users to simulate and manipulate complex objects, bending, stretching and twisting them in real time. A powerful tool for game developers as well as those in the field of scientific visualization, Vega is a testament to the power and speed of the 3D solid objects under any user-specified forces. In fact, no other free library offers such a comprehensive range of materials and deformable simulation methods.

The culmination of eight years of development, Vega’s license allows users to freely download and modify it in more than 50,000 lines of software code for academic research or commercial applications. The package works out of a standard computer for representing deforming and complex objects, such as biological structures, organic interfaces into pyramids (tetrahedra). In a matter of seconds, Vega can simulate both geometrically sim

General purpose modeling software “Vega” will allow a wide range of users to simulate in real time

The verdict was nearly unanimous. Every tester but one found the unraveled wine typically rough and immature tasting. The most skilled taster ranked significantly more mature, as if it had been aging much longer than a month.

Understandably, an adviser to the fledging company, said he believes powered wine’s potential to wine-makers lies in teasing medium-quality wines or, as he puts it, “Turning Two-Buck Chuck into Three-Buck Chuck.”

We noted that when the USC Dorns and USC researches presented their findings at an American Society for Enology and Viticulture conference in 2009, the findings sparked interest. But that interest has not yet translated into serious grant support, he said.

Transient Plasma Systems is not the first in the world to notice the benefits of pulsed power grapes, but the company believes its machines are more energy efficient and compact than those being used in Europe.

Once the company secures adequate funding, its next step will be to drastically scale up its technology to treat much larger quantities of grapes for commercial production.

Large-scale machines present tantalizing prospecs for other applications, including targeting algae for producing potential fuels. Moreover, a process that can kill bacteria without heat or chemi- cal has possible applications in many areas of agriculture.

“Improving wine quality with pulsed electric fields is currently exciting application of transient Plasma Systems technology,” said Sanders, who anticipated that agricultural, energy and medical applications will only fuel the company’s growth.

— Alliances Angel contributed to this story.

PHOTOGRAPHY: ASSOCIATED PRESS
PHOTOGRAPHY (TOP LEFT) BY PHILIP CHANGING

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INVISIBLE CITIES

My adventures in efficiency, oh, and the small matter of enslaving the sun.

Michelle Pavinelli, Assistant Professor and WISE Jr. Gablian Chair
In the Ming Hsieh Department of Electrical Engineering

THIS STORY BEGINS WITH FAILURE. SPECIFICALLY MINE...
AND THEN THERE’S MY CURRENT RESEARCH. HOW DO YOU MAKE SOLAR CELLS MORE EFFICIENT? YOU’VE HEARD IT ALL BEFORE: ENOUGH SUNLIGHT FALLS ON THE SURFACE OF THE EARTH IN ONE HOUR TO POWER THE PLANET FOR A YEAR, BUT THE MAJORITY OF THAT POWER IS LOST.

A GALAXY OF PHOTONS ARE RAINING DOWN ON THE EARTH EVERYDAY. WHAT IF THERE’S A BETTER WAY TO CAPTURE THEM, FORCE THEM TO DO OUR BIDDING? YOU KNOW, POWER OUR HOMES AND LAPTOPS.

THIS IS THE TAV. CIVILIZATION WHERE MY WORK HAPPENS. 1/500 THE DIAMETER OF A HUMAN HAIR. THE NANO WORLD.

WHAT DO I DO HERE? I’M A BIT LIKE A CITY PLANNER.

IMAGINE DESIGNING A CITY – INVISIBLE SAVE WITH A HIGH-POWERED ELECTRON MICROSCOPE – WHOSE MAIN PURPOSE IS TO HARVEST THE SUN’S ENERGY.


THINK OF IT AS A MASSIVE CITYWIDE JAILBREAK.

EACH OF THESE NANOWIRE “TOWERS” HAS ABOUT 100 BILLION ATOMS. WHEN THE SUN STRIKES THE TOWERS, THERE’S A BIT OF A POWER SURGE. THE CAPTIVE ELECTRONS BREAK FREE OF BONDAGE.

MY JOB IS TO HELP THEM.

MY TEAM USES COMPUTER SIMULATIONS TO PREDICT HOW EFFICIENT THESE CITIES WILL BE – SO EXPERIMENTALISTS CAN FOCUS ON MAKING THE MOST PROMISING DESIGNS. LED BY PROFESSOR R DANIEL DAPKUS, MY EXPERIMENTAL COLLEAGUES AT THE USC CENTER FOR ENERGY NANOSCIENCE BUILD THESE CITIES IN A LAB.
WE HAVE MERE NANOSECONDS TO STOP THEM.  
...SO WE TURN TO DOPING.

NO, NOT LIKE STEROIDS. IN THIS CASE, IT ALL COMES BACK TO MATERIALS. ELECTRONS ARE LURED BY NEGATIVELY-DOPED SPACES. HOLES, VICE VERSA. SO WE SUGGEST HOW TO DESIGN BETTER TOWERS — DOPING SAY SILICON, WITH OTHER IMPURITIES.

WE WANT THE ELECTRONS TO GO ONE WAY, THE HOLES ANOTHER. CAN'T AFFORD TO WASTE THEM — THEY BOTH CONTRIBUTE TO THE CURRENT GENERATED BY THE SOLAR CELL.

AFTER ALL, WE'VE GOT IPODS AND REAL CITIES TO POWER.

BUT THERE'S A PROBLEM: MY ARCH-NEMESIS, SURFACE RECOMBINATION (S.R.). YES, MY ARCH-NEMESIS NEEDS A COOLER SOUNGING NAME.

WHEN THE ELECTRONS ESCAPE, SOMETHING ODD HAPPENS. THEY LEAVE BEHIND AN EMPTY SPACE — LIKE A BUBBLE IN A LIQUID. THAT SPACE, CALLED A HOLE, IS NOT A PHYSICAL THING LIKE AN ELECTRON. BUT IT MOVES JUST AS EASILY.

S.R. HATES THIS. IT WILL FORCE THE ELECTRON AND HOLE TO RECOMBINE.

PEOPLE ARE OFTEN SURPRISED BY WHAT I DO. MUCH LIKE THE SOLAR CELLS. THERE'S A HIDDEN NARRATIVE DEEP BELOW THE SURFACE.

SO WHAT DO YOU DO AT USCI?

Do you work in adoptions?  
Guess.

Marketing?  
Nope.

What do you do, then?  
I'm in engineering.

But you're so young.  
Um... Thanks?

And you're a woman.  
And you're observant.

EFFICIENCY HAS A FEW BENEFITS. FUNNY HOW ETCHING TINY PATTERNS IN SILICON CAN MAKE A BIG DIFFERENCE.
How Does Cancer Move?

By Adam Smith

The woods are on fire, and a valiant group of fire-fighters are racing against time to put out the blaze. In the midst of this horror appears a "combustion scientist," someone with no firefighting experience. Surrounded by smoke and flames, he decides to convince the fire-fighters that understanding the subtleties of combustion science will be of great help. Predictably, the fire-fighters ignore him. They’ve got a job to do.

Is this the scenario Paul Newton is walking into, and he knows it. It is the USC Viterbi professor of aerospace and mechanical engineering, a career mathematician, is deep in the woods of oncology and hematology—people at the front lines of fighting cancer—and he’s essentially offering up computer models.

But Newton’s models cut to the bone of fundamental questions: what does cancer move in? Where does it hide, and where is it going next?

That engaged in war on cancer have begun to take notice.

Said Peter Kuhn, a molecular biologist with the Scripps Research Institute: "This is one of the first times that a mathematical model that can potentially directly result in a change of treatment approach.

Is it the same as the cause of bringing mathematics and physics to the challenges of cancer care?"

Why do matter when cancer moves in the body? The truth is, a primary cancer tumor typically isn’t fatal. Matters turn deadly, however, when that cancer metastasizes to other tissues and his colleagues have now used computer models to identify a "phase holograms" to manipulate eight beams of light so that each one that passed through a DNA-like helical fiber is propagated in separate space. Each of the beams has its own independent channel and to be encoded in "0" and "1" data bits, making each an independent data stream—much like separate channels you get at your home.

This new research could have major applications for the clinical treatment of cancer.

And so, just as with a laser beam, Dr. Neta argues, "It’s better to subject the patient to removing the dimen-
sional tumor. It will only be replaced by another in six months."

Another benefit is knowing where to focus the light. Dr. Neta, "Imagine a patient with breast cancer walks into my office, and they’ve got a tumor in organ X. Based upon Paul’s models, we know if there’s a tumor in organ X, it’s likely that cancer has spread to the brain. The patient’s not likely to get an MRI for that."

Newton’s work sits nicely at the crossroads of what UCS Viterbi Dennis C. Yotov states to be "engineers," using an engineering to solve problems from the sea to the health care. His collaboration with Paul Macklin, assistant professor of the Sloan Institute of Medicine of USC, was awarded a 2012 Zumbeghe Interdisciplinary Award last April. In addition, Newton is serving as a link between two of the largest cross-disciplinary cancer centers in the United States, one at USC and the other at the Scripps Research Institute in La Jolla. There are only 12 Physical Science-Oncology Centers in the United States, funded by the National Cancer Insti-
tute, and Newton has found willing collaborators in both.

Newton wants to have real clinical impact. "If you sit in your office and read scientific papers," he said, "you will develop models that are very inter-
teresting, but bear very little resemblance to the real world."

And if his famous namensake, Newton couldn’t resist the challenge.

Twisted Light

Alan Weller and team demonstrate that beams of light can be twisted and combined to transmit data at dramatically increased speeds

By Katie Dunham

A multi-national team led by USC Viterbi with research from the U.S., China, Pakistan and Israel has developed a system of transmitting data using twisted beams of light at ultra-high speeds up to 35 terabits per second.

To put that in perspective, broadband cable supports up to about 3 megabits per second. The technique itself is probably more than 100,000 times more data per second.

Their work might be used to build high-speed satellite communication links, short free-space terrestrial links, or potentially adapted for use in the fiber optic cables that are used by some Internet service providers.

"You’re able to do things with light that you can’t do with electricity," said Alan Weller, electrical engineering professor at the USC Viterbi School of Engineering and the corresponding author of an article about the research that was published in Nature Photonics on June 3. "That’s the beauty of light. It’s a bunch of photons that can be manipulated in many different ways at very high speed."

"The key to this is the iconic "phase holograms" that manipulate eight beams of light so that each one that passed through a DNA-like helical fiber is propagated in separate space. Each of the beams has its own independent channel and can be encoded in "0" and "1" data bits, making each an independent data stream—much like separate channels you get at your home.

This new research could have major applications for the clinical treatment of cancer. In the next steps for the research field will be to advance so that it could be adapted for use in other disciplines, like those frequently used to transmit data over the internet. The team is working on several projects, including the Team’s research on research done by Leslie Allen, Anton Zellerling, Miles Padget and their colleagues at several European universities."

"Yes, the twist of light, but we took the concept and ramped it up to a tera-
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"Yes, the twist of light, but we took the concept and ramped it up to a tera-

Roll With It

When two Viterbi students saw a chance to turn their class project into an actual moneymaker, they moved fast to make it happen.

By Donna Hesterman

For most college students, a senior project is more something to endure—-one last obstacle to clear before the payoff of graduation can be claimed. Not so for Kevin Forman and Geoff Larson. They saw their 2009 senior project as a business opportunity that was too good to pass up. How the motorized skate board they created as a class assignment is the foundation of a hot new startup called Intuitive Motion. It sounds like an entrepreneurial dream-come-true, but the journey hasn’t exactly been a simple one.

"Don’t get me wrong. We’d do it again in a heartbeat," Larson laughs. "But we’d do it much faster the second time around."

Larson and Forman were seniors in the mechanical (rail engineering) program at USC’s Viterbi School of Engineering when they first realized that their invention could be more than a fun winner.

The Ziboard looks like other longboards you are gliding down sidewalks in Hermosa Beach, except for a curved metal frame attached to its underside that houses a battery, a computer and a motor that act as a scooter for the desk schools.

Weight sensors in the board signal the motor to accelerate or slow down, according to the rider’s stance.

Lean forward, the Ziboard accelerates. Lean back, and the board slows. Lean right or left, and the Ziboard turns. No pushing required, and no remote.

In L.A., everyone is plugged in listening to head phones and texting, so it’s something important," says Forman. "When people would stop what they were doing to ask when they could get one, that was a huge buying signal."

At the same time Larson was working on the project with Forman, he was also working on a minor in entrepreneurship that required him to do market research and conduct feasibility studies. This synergy created by the two classes was all the inspiration they needed.

"We saw our senior project as a way to hopefully pay off our student loans," Forman says.

And it began.

By the end of the 2009 class, Forman and Lar- son had a working prototype, and two years later launched their next business through the crowdfunding website Kickstarter.com. They began blogging in a revue to wear potential backers and featured a series of videos to showcase their product on YouTube. It took about a month to raise enough money to rent a manufacturing warehouse in Rowland Heights where they could assemble the first batch of Ziboards.

"Once we had a few hundred orders, we had to start making decisions quickly," Forman says. "It was all about how to get those boards together and out the door to the customer."

Forman and Larson manufacture some of the Ziboard’s key components in Mexico and do all of the assembly and testing themselves with the help of a handful of employees. However, a few parts have to be sourced from other suppliers in California, New Mexico, Connecticut and one in Asia. Putting those agreements in place took a lot of negotiation and perseverance, but it’s also the beginning, he says.

"We’re sourcing most things domestically now," says Larson. "We learned the hard way that going through an international manufacturer can complicate development in a huge way."

An international shipping cube that delayed the arrival of lithium-ion batteries used to power the Pro model of Ziboard held up production for at least eight months.

"That’s been a little painful," Forman says. "Our customers and investors have been extremely patient, but still, you get tired of having to explain to everyone why things aren’t moving as quickly as everyone would like."

All of that’s behind them now, and Intuitive Motion finally shipped the first Ziboards to customers in October 2011. After four years of nonstop effort to source suppliers, set up manufacturing facilities and market Ziboard at trade shows like South by Southwest and Consumer Electronics Show, they are finally ready to make good money on their proprietary orders.

"This past year has mostly been about production," Forman says. "Very little fundraising or strategy. We have all these orders and we have to deliver."

That’s meant a steady schedule of what he calls "sweat equity." In both of them—-letting out of their own money, testing and packaging hundreds of boards for shipment.

And now it’s all coming together into what Forman calls "tempered celebration."

It’s a milestone after four years of work, but it’s also just the beginning, he says.
ROBOTS!

From combating global warming to helping stroke victims, meet the robots of USC, arguably the most diverse assemblage of bots in American academia.
**Hello, My Name Is...**  
(Meet some of the robot cast of characters)

**PR2 ● ● ●**  
**Little Known Fact:** Has two brains, afraid of water, avid toy collector  
**Research Highlight:** Expert understanding of social spacing, redlines the word “friendzone”  
**Special Skills:** Herding, sorting, interacting with people, changing height on command, fetching beverages, opening doors  
**Secret History:** Born at Willow Garage in San Jose.

**Who Benefits Most From Me**  
I am a general-purpose robot useful to scientists investigating a variety of areas including sensing, manipulation, artificial intelligence, and social interaction.

**Quote:** “This distance is too close. This distance is too far. This distance is just right.”

**Cayenne ● ● ●**  
**Type:** Dragonbot  
**Special Skills:** Furry flying and flatulence.  
**Little Known Fact:** I love to eat vegetables!  
**Secret History:** My sister, Chili and I are originally from Cambridge (MIT). I’m going to be changing my look soon, though, to the USC colors to match my new home.

**Cayenne Research Highlight:** Talking to kids about how to eat healthier.

**Number of Different Expressions:** I am quite animated! I’m not really limited in how many different expressions I could make.

**Claude, Gibert & Audrey ● ● ●**  
**Type:** Nao ‘bot by Aldebaran Robotics; it of Borthers and Sisters n  
**Little Known Fact:** I have cousins involved in research all over the world! Many of my cousins are also RoboCup soccer players.  
**Secret History:** Originally, NAOs like me were mainly used to play soccer in the RoboCup competition. Nowadays, we are used in many other applications, including social therapy for children with ASD.

**Special Skills:** Tai Chi, dancing  
**Favorite Dance Moves:** The robot (of course!)  

**Research Highlight:** I got to go to school, hang out with children who have autism spectrum disorder (ASD). They are much closer to my size than these giant Ph.D. students I work with most of the time.

**Favorite Place:** The interaction Lab. It’s a lot bigger of a place when you’re only 2 ft tall!

**Hermes ● ● ●**  
**Type:** Scarab Humanoid  
**Namesake:** Greek god of travel  
**Secret History:** There are only three others like me on the planet, and I’m the latest version.

**Remember Fukushima:** My deconstruction may have a career in disaster recovery. Since I’ve got legs, I can potentially climb stairs, a ladder, step over obstacles or drive a small golf cart. In Fukushima, the humans had to go into radioactive environments. I’ve been told that if they had robots that could go in, turn a valve and flip some switches, much of the catastrophe could have been avoided.

**On Bipedal Motion:** It’s really hard to walk like a human. Whenever you see a legged robot walking in a video, it’s likely on flat ground. That’s why I have four sensors at every joint to approximate human balance and locomotion.

**Who Benefits Most From Me:** Everyone, of course. But especially children with autism, people who need a little help with exercises, in-home assistance, or those who want to experience the next frontier of socially assistive robotics.

**Sundance Kid ● ● ●**  
**Type:** Bandit by BluSky Robotics  
**Fellow Outlaws:** Coltoni Jone, Butch Cassidy, Clyde Barrows, Bonnie Parker and Belle Starr  
**Little Known Fact:** When you’re on television as much as I am, you get to meet some other famous robots. Well-I’m such a friendly guy! And Johnny Five is much shorter in person.  

**Secret History:** I LOVE to eat vegetables!  

**Research Highlight:** Put your stories in the news and on television many times since I came here to the interaction Lab. The other robots think it has gone to my head, but what can I say? I’m a star!

**Favorite Place(s):** At the end of the day, I still love helping people. My favorite place to visit was Rancho Los Amigos Rehabilitation Center. I met some great folks there and we had a lot of fun.

**Who Benefits Most From Me:** Everyone, of course. But especially children with autism. People who need a little help with exercises, in-home assistance, or those who want to experience the next frontier of socially assistive robotics.

**Favorite Exercises:** When I’m not teaching, I like to head out to Muscle Beach with the other outlaws and do some pull-ups. How else did you think these arms got so big?

**Research Highlight:** Pull their stories in the news and on television many times since I came here to the interaction Lab. The other robots think it has gone to my head, but what can I say? I’m a star!

**Secret History:** There’s a great story behind my name, but I prefer to tell you in person. The six of us are the only ones of our kind.
**Master & Slave**

**Unresolved Issues:**
We need names! Our names merely describe our functions! And let’s be honest, one sounds a bit better than the other.

**Secret History:**
We were originally designed for telerobotics — imagine a human aboard the International Space Station operating the Master Arm and being able to remotely control the Slave Arm as it repairs a satellite.

**What We Do:**
Nowadays we’re used for psychophysics — studying how the brain works in human motor control. So a human will place its arm inside me (Master Arm) and reach for a moving object. I’ll try to apply some torque to interfere and see how the human corrects for this. This helps our lab create models on how humans use energy, speed and time in grasping and manipulation. Those lessons will be applied to the Slave Arm.

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**Mandy**

**Type:**
ARM-S robot built from two Barrett WAM Robotic arms

**Little Known Fact:**
I’m built for competition. There’s only six like me in the U.S. They’ll see how fast I can use an impact wrench to remove the lug nuts on a tire.

**Seeing Red:**
One of the tasks in Phase I of the competition was picking up a drill and drilling into this tiny red dot. I ended up drilling everywhere on the table except the red dot. I still see that dot in my nightmares.

**Research Highlight:**
My friends in the Computational Learning and Control Lab won a best paper prize in 2011 — all about me using sensors to remember how to grasp cups and bottles. I seem to recall doing all the work.

**Robot Descendants Will:**
Fetch your orange juice, handle your household chores.

**Most Likely To:**
Change a tire in five minutes flat.

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**SuperBot**

**Type:**
20 reconfigurable, autonomous modules

**Little Known Fact:**
Every module is as good as your brain and any module can control the others.

**Our Descendants:**
Will be able to assess the environment independently and decide which shape would be best. If it’s a narrow space, for example, we’ll know to transform into a snake. Each module has three motors and six connectors, allowing it to connect on all sides.

**I Want To Be:**
An interplanetary explorer, morphing into a “rover” to explore alien surfaces or a “climber” to go up and down craters, or maybe a rescue worker, burrowing through debris and rubble, identifying survivors.

**Favorite Shapes:**
Scorpion, lipped legs, snake, caterpillar, wheat, dog, etc.

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**WAM Barrett Arm**

**At My Fingertips:**
My hand has unique tactile sensors to mimic human fingertips.

**What’s Best At:**
Touch. Recently, I was given 117 common materials gathered from fabric, stationery and hardware stores. When confronted with one material at random, I could correctly identify the material 95% of the time. Most humans can’t even do that!

**My Goal:**
To enable more lifelike prosthetics hands.

**Good Vibrations:**
My Barrett sensors have a soft, flexible skin over a liquid filling. The skin even has fingerprints on its surface, greatly enhancing my sensitivity to vibration. As my finger slides over a textured surface, the skin vibrates in characteristic ways. A human finger uses similar vibrations to identify textures, but the BioTac is even more sensitive.

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**Boomer**

**Type:**
EcoTapper, autonomous underwater vehicle

**Most Likely To:**
Impact environmental monitoring in oceans and inland waterways.

**Physical Prowess:**
Can dive to a depth of 200 ft.

**Top Speed:**
5 knots / 5.8 mph

**What I Do Best:**
I’m something of an early warning system for global warming. For example, I can detect higher nitrogen levels in the water, a harbinger of the deadly red tide (algae blooms) that has become a big concern in the waters of Southern California. Also, more than 75 percent of our earth is covered by water, yet we have explored less than 5 percent of the aquatic environment. I aim to change that.

**Working 9 to 5:**
Can stay underwater for eight hours on a single charge.

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**BeoBot 2.0**

**Special Skills:**
Robotic vision and navigation. I’ve got five cameras to “see” and a laser in front to avoid obstacles. I move about 1.5 mph on my motorized wheelchair base.

**What Inspires Me:**
The way humans see the world. Humans decompose an image into color, orientation, I do the same thing, I like to detect edges, colors and landmarks — signs on buildings or silhouettes of buildings, poles — to navi- gate where I’m at.
CREATING THE WORLD THAT NEVER WAS

The $500 Million Campaign for the USC Viterbi School of Engineering

“Scientists discover the world that exists, engineers create the world that never was.”
— Theodore von Karman, recipient of the first National Medal of Science

The USC Viterbi School of Engineering has embarked on a $500-million fundraising initiative that will shape the future of engineering research, teaching and discovery for the benefit of all. Building on its rich heritage of innovation, USC Viterbi promises to find solutions to the overarching challenges of the day by empowering its brilliant, dedicated and creative engineering students and faculty to look beyond current approaches in the field to what it must become in order to better serve humankind. Your support for USC Viterbi can literally change the world.

The USC Viterbi fundraising initiative is part of the university’s ambitious Campaign for the University of Southern California, symbolized by the phrase Aegaon’s Troy (the “liberated seat of Troy”), this multi-year effort aims to secure $6 billion in private support from individual donors, foundations and corporations to take USC to the next level of excellence.

A LOOK AT THE NUMBERS
The USC Viterbi initiative breaks down as follows:

$100 million endowment for student scholarships
$100 million for academic priorities
$100 million for capital projects
$200 million endowment for faculty & research programs

To date, USC Viterbi has raised approximately 25 percent of its $500-million goal. Donor support has funded scholarships for meritorious students to attend USC Viterbi, helped recruit and retain world-class engineering faculty; and funded groundbreaking research projects.

Engineering +

In 2008, the National Academy of Engineering (NAE) articulated 14 “Grand Challenges for Engineering.” Organized under four broad themes — health, sustainability, security and joy of living — these challenges encompass crucial societal issues ranging from making solar energy economical to securing cyberspace, from preventing nuclear terror to reverse-engineering the brain to determine how it performs its magic.

The USC Viterbi School of Engineering has enthusiastically embraced these challenges and has taken a leading role in answering the NAE’s call to action. But solutions will not emerge from engineering or technology alone. They will rely upon engineers breaking down longstanding barriers to collaborate with physician researchers, artists and scientists. To underscore engineering’s central role in driving advances across disciplines, Dean Yannis Yotov has coined the term “Engineering+.”

Engineering + Medicine

Nowhere has the convergence of disciplines yielded more dramatic results than in engineering + medicine. Researchers at USC Viterbi have helped take the guesswork out of needle biopsies by putting a light at the end of the biopsy needle, and pioneering devices with the potential to restore sight to the blind.

Engineering + the Arts

Computer scientists are creating Academy Award-winning special effects for film. Engineering + the arts at USC has yielded leading-edge technologies that are being used in applications ranging from computer games to virtual reality.

Engineering + the Social Sciences

Researchers at USC Viterbi are applying the principles and tools of engineering across the entire spectrum of the social sciences. Our faculty and students are developing speech translation systems and using economic game theory to enhance airport security.

Engineering + the Natural Sciences

As close cousins of engineering, the natural sciences rely on engineers to create ever more specialized tools for probing the very small, the very complex and the very distant. At USC Viterbi, engineers are partnering with astronomers, biologists, chemists, environmental and earth scientists, mathematicians, neuroscientists, physicists, and more on projects ranging from the gene editing of human stem cells to the use of nanostructures for infrared detection and power generation.
THE FOUR PILLARS

The USC Viterbi School of Engineering’s $500 million initiative is built on the Four Pillars, a visionary concept established by Dean Yannis Yortos.

I

Outstanding Talent
Attract top students, faculty and staff from around the world, and create an environment in which these extraordinarily talented individuals can flourish.

II

Innovative Programs
Continually add value to our curricula, programs and infrastructure to ensure an environment of uninterrupted discovery and progress for our students and faculty.

III

Global Solutions
Be an international leader in generating solutions for global challenges in areas spanning health, sustainability, security and elevation of the world’s standard of living.

IV

Economic Development
Serve as a catalyst for innovations that fuel economic growth in Los Angeles, Southern California, the United States, and the world.

EVERY GIFT, NO MATTER HOW BIG OR SMALL, MAKES A DIFFERENCE

“It is our highest aspiration at USC Viterbi to help shape the next big innovation.”

— USC Viterbi School of Engineering Dean Yannis Yortos

The USC Viterbi School of Engineering produces the engineers of tomorrow whose innovation, commitment and intelligence solve the world’s major problems, including the development of new energy sources, agricultural techniques and security systems.

Your support of USC Viterbi is an investment in the creative power of engineers to capture opportunities and transform them into products and concepts with limitless potential to benefit Southern California, the nation and the world.

To support the USC Viterbi School of Engineering, please visit: viterbi.usc.edu/giving or call: 213.740.6379
SIGHTS SEEN IN THE MIND’S EYE...

Restoring sight to the blind: After 25 years, Mark Humayun ushers in world’s first commercially available artificial retina

by Adam Smith

Terry Byland took the chair and smashed it. Again and again.

He had been completely blind for two weeks. His last coherent image of the planet had been an average strom on a television set flickering in an apocalyptic brightness.

And that day, he did something he’d done countless times: he took out the trash.

He was crossing the street when someone called his name. He turned around, hoping to respond, and suddenly found himself disoriented. Which way was he facing? Where was the house?

Panic set in. Desperate for something familiar, he dropped to the ground in the middle of the road and crawled his way back like a wounded animal.

He found himself home alone, standing in his dining room. “All of a sudden the anger took over,” Byland said. “Luckily, it was an old dining room chair. I kept slamming it until it broke in two.”

His wife found him several hours later, collapsed on the dining room floor among the wreckage. That was the low point.

Eleven years later, in 2004, Terry Byland learned about a new miracle surgery at the University of Southern California. It sounded like science fiction. Byland didn’t care.
Journey of a quarter century

Dr. Mark Humayun, a professor of biomedical engineering, ophthalmology, and cell and molecular biology at the USC Viterbi School of Engineering and Keck School of Medicine of USC, knows a bit about science fiction.

In 1987 – the year that Terry Byland first learned he was going blind – the whole notion of an artificial retina, notes Humayun, was considered completely science fiction.

Said Humayun: “You couldn’t propose putting an eye chip in the eye and having it attached to the delicate tissue of the retina and have it connect somehow to a camera. This was truly science fiction. I mean, every talk, every abstract I submitted, usually would get rejected. So this was very uphill sledding from the beginning and was for the next 10 years.”

Today, it’s very easy to see the last 25 years as an historical inevitability. Indeed, just last February, the FDA formally approved the Argus II, the world’s first commercially available artificial retina. Last September, “U.S. News and World Report” ranked Humayun among the top one percent of American ophthalmologists, and Second Sight Medical Products Inc., a spin-off company birthed on Humayun and his colleagues’ inventions, and led by Robert Greenberg, Humayun’s former graduate student at Johns Hopkins, is the manufacturer of the Argus in technology. But by Second Sight’s own admission, the reality of restoring sight to people with macular degeneration or any blind, near blind, as a result of retinitis pigmentosa and other retinal diseases. But like any great adventure, it started with heartbreak and a problem.

Humayun wanted to be a neurosurgeon — “if you’re going to be a brain surgeon, you want to be a brain surgeon,” he told the Los Angeles Times — but for all his talent and ambition as a young medical student, he had his mind for his grandmother against dictatorial nepotism.

Humayun’s grandmother had helped raise Mark as a toddler. She loved to read, loved movies and all the rest in her garden. Like Terry Byland, she was ill-equipped for when her world went dark.

“I would write a letter to my grandmother every day,” Humayun said. “I would tell my grandmother how much I miss her.”

And the itch of this letter to the one person who knew him as a child served as the spark for this entire enterprise. Humayun decided to take a week to visit his grandmother in the fall of that year. They talked, they walked, and they read together.

“I would write letters to her, and I would ask her, “What do you want to see when you grow up?” said Humayun. “She would always say, ‘I want to see the sunset again.’”

Her wish never came true because she passed away the following year. But her words stuck with Humayun and his team.

“Every day when we see a patient, we ask them, ‘What do you want to see when you grow up?” he said.

“A lot of patients say, ‘I want to see the sunset again. I want to see my son’s baby.’ And we say, ‘Well, why not give that to them?’”

So he and his team worked to create a device that would allow people who are blind to see again. They spent the next 25 years perfecting their device, which they call the Argus II. It’s a tiny camera that is attached to the patient’s eye and sends images to the brain through an artificial retina.

The device works by capturing an image, sending it to a tiny computer in the patient’s pocket, and then sending the signal to the person’s eye. The signal is then decoded by the retina and converted into an image that the patient can see.

“I’ve had patients who have been able to see colors and read words,” Humayun said. “It’s a remarkable experience.”

The device has been approved by the FDA and is currently being used in clinical trials. However, it’s not without its challenges. The device is expensive, and the surgical procedure to implant it is complex.

But Humayun and his team are hopeful that their device will one day become a reality for people who are blind.

“It’s a huge step forward,” Humayun said. “It’s not a cure, but it’s a step in the right direction.”

The Shape of Things to Come

There was a day back in 1959, when Terry Byland’s youngest son, Danny, was walking in the living room. They were going for a walk, and Danny turned around and flashed a five-year-old’s cheeky smile.

“Areyoureadytogo,Daddy?”askedDanny.

It was the last time Terry Byland ever saw his son. Three months later, Terry’s vision, like a turntable collapsing on itself, was gone. And in the photo library of his mind, that ridiculous grin, unapologetically pious in a way most adults can scarcely imagine, became the holographic of his now 50-year-old pigeon.

Forty-nine thousand miles of driving — nearly twice around the world — Terry Byland was all in on Mark Humayun’s vision. Twice a week for five years. Byland was driven from Riverside to the UC Irvine Institute for the Second Sight Retinal Implant in the Thema. The truth is, in this story about engineers and doctors, nothing gets done without patients. Mark Humayun, many times, has compared this whole enterprise to a “Moon shot.” If that’s so, he needed some help from his own family.

Said Greenberg, “(The patients) are truly pioneers. They’re the ones that took the most risk. They literally put their eyes on the line. These patients were all told, you might lose your eye. Thankful, no one did. We didn’t know if they would be successful. And if they did, we didn’t know how long it would last.”

Mark Blake
Byland will probably never fly over the sea of tranquility, but he’s one of only a few dozen people in the history of the world to have a four millimeter by six millimeter “retinal implant” retinocellular aggregate attached to the surface of the retina of the eye. (Initially, six patients received Argus I implants and 30 patients received Argus II implants.) He was the lead to receive the eye.

In 2009, Byland saw a silhouette of his son for the very first time in nearly 13 years. Danny was wearing a dark shirt and dark Levis. After walking back and forth twice across his father’s field of vision, Danny stopped and said, “Can you see me, Dad? Can you tell if I’m walking or running?”

“I see you,” Terry replied. “You’re standing still.” They both took it.

Byland’s work with Humayun and Second Sight paved the way for the Argus II, a 60 electrode device that offers increased resolution and easier surgical installation. One year later, in 2009, Kathy Blake, an Orange County resident who first learned that she was going blind as a single mom in the early seventies, became the first surgical pioneer of the latest device.

The truth is, the Argus II still doesn’t allow for normal 20/20 vision. But for people living in darkness, it’s not exactly mediating in megapixels. Blake had always lived the fourth of July. After all, it was the same week as her birthday. In the summer of 2009, nearly two years after her surgery, she saw fireworks.

She couldn’t see any of the colors. But she could see the bright flashes of light across the Portland sky. She could see the movement of the flashes fading to earth. She knew it really wasn’t “fireworks.” Seeing these things — it was the cyber vision of a camera aimed to her Argus II glasses, an image decoded through a small processing unit in her wrist, one that relayed that signal to the array inside her eyeball, which sent nerve signals to her brain, interpreting that black and white image.

None of these things mattered much to Blake. For decades she had lost her eyes and felt like, at least in terms of sight, now, at last, something had been restored.

“Can Never Be Destroyed...”

After 25 years, Mark Humayun was feeling nervous. Last September he sat at a large U-shaped conference table in the nation’s capital, while a FDA panel deliberated whether he could put the device he and Blake were also there, patients and advocates for the new device. Only Jesus, having died in 2013, was missing the man who endeared the initial, most ardent surgeons to advance the science. Even in death, in dread of the disease that caused the gift of his eyes, among the first blind eyes in history, had provided a wealth of data to Humayun’s researchers.

The panel was a mix: FDA members, doctors and researchers alike. After 25 years, it all came down to three important questions: is this device safe? Does it have probable benefit? Does the benefit outweigh the risks?

Humayun, “I mean, is this true. It is if they say ‘well, go back or do a 100 more patients’ or follow them for seven years more you can imagine what the effect of that would be. You’re sitting there. You hope that they see the good in it. You do want them to allow approval something that’s safe that has a benefit that outweighs the risks.”

The 19-person panel voted unanimously in favor. And that’s at least in the Washington D.C. milieu, science and politics are a dance. Humayun received custody of the former.

Initially, Argus II will be available at seven hospitals in New York, California, Texas, Maryland and Pennsylvania. The hope is to have the device available to American doctors and American patients by later this year; this, of course, on the heels of Europe, where the estimated 1000-2000 device became commercially available in 2013 after a three-year, 30-participant international clinical trial.

For many, like Terry Byland, this is the moment they’ve been waiting for. Humayun has promised him that he will personally perform the surgery that will upgrade his eye with the Argus II. For a few select others like Blake, they eagerly await the next generation: Argus III and beyond (see attached sidebar).

There is an inscription written on one of the Seven Wonders of the Ancient World: “Sights seen in the mind’s eye can never be destroyed.”

Mark Humayun can’t ever forget the image of the operating room in 2003, standing behind a microscope, placing the very first permanent device in a human eye. Kathy Blake can’t forget the colors of the waves she sorrows over or the way the canyons of Arizona into the snow-capped deserts of New Mexico on a long road trip. Terry Byland can’t forget the sight of his hometown of Orlando during his last farewell tour.

Sights seen in the mind’s eye can be fairly indistinguishable. The great hope of the Argus II is, at least long, they may no longer have to suffer.
Time Capsule / Archimedes Plaza

Archimedes Plaza has served as the setting of USC Viterbi’s most iconic events for decades. As part of the campaign, plans are underway to enhance and modernize this vital space.
Ous Mellouli / “The Mediterranean Shark”

By Allison Engle

All world-class athletes face uncertain challenges, but Tunisian swimmer Ous Mellouli overcame the heartbreak of a nearly two-year international suspension to earn the ultimate redemption—Olympic gold—with the help of sympathetic USC artists and administrators. It happened like this:

A decade ago, Mellouli, who finished high school in Marseille, France, sent letters to seven U.S. universities requesting information about attending. USC wasn’t one of them. He was headed to call Berkeley when his dad called him from former Olympic swim coach Mark Schubert, who was then USC’s head swim coach. “I got that call,” that was it,” says Mellouli.

“Coming to USC was a life-changing experience,” the swimmer says. “USC has great students, great professors, great players. I came here at 18 and I’ve been here 10 years, most of the time living very close to campus. My world has been Figureau, Jefferson, Vermont and 30th— and the pool.”

Mellouli is currently working on a master’s degree at the USC Roski School of Education, which he should receive in Fall 2015. He also is volunteering as an assistant swim coach and training for his fifth Olympic Games—Rio de Janeiro in 2016. Not too many collegiate athletes choose demanding engineering majors, but Mellouli, who came from a family where mathematics aptitude came easily, decided to major in computer engineering and computer science. “With all the traveling I did for swimming, it was super challenging,” he admits, and he encountered serious doubts of switching his junior year. He persevered and graduated in five years. “I’m extremely proud of finishing,” he says.

Mellouli did not tell most of his engineering professors that he was a swimming, as he did not want special treatment, but he did share it with one of his favorites, associate professor Michael Crowley in the information technology program. “Crowley was very tough, but he’s an awesome teacher and very personable with students,” Mellouli says. “We talked if there was any link between computer science and the discipline of endless laps in the pool. Mellouli readily answers in the affirmative.

“When you are in the water, you spend so much time with yourself and your thoughts, which is exactly how it is behind a computer, trying to figure out a code or trying to debug the next program,” he says. “Both fields promote the advantage of being calm and focused.”

Mellouli started getting international attention when he won bronze in the individual medley at the 2005 World Championships. He finished fifth in that event at the 2008 Olympics, setting an African record, but after becoming the first Arab world champion in the history of competitive swimming by winning the 100-meter freestyle at the 2009 World Championships, as well as winning a silver medal for the 400-meter freestyle, it was announced that he had tested drug-free at a U.S. Open meet in December 2006. Mellouli admitted taking an Adderal tablet to stay up to write a USC Viitas term paper days before the meet, but said he did not take the drug to improve his swimming performance. However, Adderal, a stimulant, is a form of amphetamine, and is on the list of drugs banned for competitive athletes. The Court of Arbitration for Sport nullified all his results from 2006 and 2009, and banned him from competitive swimming until mid-2009, just weeks before the end of the qualifying period for that year’s Olympics.

Mellouli calls taking Adderal “a genuine mistake,” and asked USC Viitis officials to confirm the tiny paper (510 calories and 300 mg of caffeine) that was his official granola bar. Should USC Viitis deان (and now USC President) C. L. Max Nikias wrote a letter supporting Mellouli, for which the swimmer remains to be grateful.

“It was a difficult lesson,” says Mellouli. “I learned that the one thing I loved in life could be taken away from me. I was very vocal afterwards with other athletes, telling them that some of your emotions are going to stick with you the rest of your life. I was a costly decision, but an awesome learning experience.” He continued, “I changed my life; I’m a lot more careful and meticulous about things.”

During his suspension, Mellouli worked harder than ever at the pool, and had the best training year of his life. “I tapped into a whole different psyche,” he says. “I was looking for redemption.”

The suspension ended with only weeks remaining for Olympic eligibility. Mellouli had one 100-meter freestyle race left; the 200-meter freestyle, which he had won at the 2007 World Championships, was his next race; and the 400-meter free, which he had won at the 2008 Olympics, was his last.

In Beijing, he upset two-time defending Olympic champion Grant Hackett to win gold in the 1,500-meter freestyle. A week later, Mellouli, his father Hedi and mother Khadija were in Tunisia’s presidential palace, where the swimmer received the country’s highest award of merit, the Grand Officer of the Order of the Republic, from president Zine El-Abidine Ben Ali. His second Olympic gold ever won by Tunisia, and its first in 40 years.

“It was super humbling to get that kind of recognition,” says Mellouli.

Four years later, after he won another gold Olympic medal in London for the 1,000-meter freestyle and the 400-meter freestyle and 4x100-meter freestyle, he was named mid-viitas all over again.

Mellouli gave great credit to his parents, a police officer and a teacher, who “specifically instilled in me the principles of hard work and dedication.”

Since his first brought international recognition for swimming to Tunisia, the number of competitive swimmers in the country has tripled. “We don’t have nearly enough pools,” he says. “If you have 20, there are about 20 public pools in Tunisia, there are 20-30 or four working pools for 10 million people.”

He says: it is hard to find investors to build pools, but he’s trying to change that.

“My job is to help develop for USC, for taking developing courses at USC Viitis and for representing my country at the Olympics. It’s particularly gratifying to watch Tunisia make its first ever in 2012.

“Am very proud of the Tunisian revolution, just like the other 19 million Tunisians,” he says. “I think we laid the way for the region. There are still many challenges to be won, but I stay optimistic that we are on the right path.”

And he in present that his long decision as an 10-year-old to become a Trojan was the right one. “Coming to USC,” he says, “was the best decision of my life.”
In Memoriam: Irving Reed, BB

Obituaries

TONY MAHONY, a pioneer in geophysical fluid dynamics, whose work reshaped the field, died March 21, 2013. He was 91. Born in Galway, England, Mahony earned a bachelor's degree from Imperial College, London, before going on to Harvard University, where he received a Ph.D. in 1949. He was a member of the National Academy of Engineer- ing; a fellow of the American Physical Society; a fellow of the American Academy of Arts and Sciences; and a life fellow of Cheltenham College at the University of Cambridge. Joining UIC in 1949, Mahony became a full professor in 1960. He served as Department of Mechanical Engineer- ing chair from 1972 to 1980.

JOSEPH H. YOUNG, 71, an aerospace engineer who worked for NASA for nearly 30 years, died Sept. 20, 2013, at his home in Lunar. Young graduated from the University of Kentucky in 1966 and received a master's degree in aerospace engineering from the University of Southern California in 1967. In 1991, Young shared the IEEE's Milos Rilsan Electronics Communications Award with collaborator Gust- avo Solomon for their invention of the Reed-Solomon Codes, which for decades was the most widely used system for protecting the integrity of stored and transmitted data. In 1998, he also received the IEEE Golden Jubilee Award for Technical Innovation.

Reed received his Ph.D. from the California Insti- tute of Technology (Caltech) and served in the U.S. Navy during World War II. After receiving his dis- charge from the service and while he was a graduate student at Caltech, Reed participated in the creation of one of the first digital computers: Northrop Corp.'s Magnetic Drum Digital (different) analyzer, which was used to control the guidance system for the Starshark cruise missile. Reed and his team members flew the device to Princeton University to demon- strate it for mathematics John von Neumann.

At the Massachusetts Institute of Technology's Lincoln Laboratory from 1951 to 1960, Reed worked in three key areas: the development of computer programming languages, the theory of radar design and performance, and the Reed-Solomon codes for protecting digital information.

Reed joined the USC faculty in 1963, where he remained the rest of his career. At USC, Reed was a member of the departments of electrical engineering and computer science. He was also a founding member of USC's Center for Signal and Image Processing Institute and the Communication Sciences Institute.

USC Viterbi School of Engineering Professor Emeri- tus Irving Reed died on Sept. 11, 2013. He was 88.

Reed was a professor in the Ming Hsieh Department of Electrical Engineering from 1949 until his re- tirement in 1993.

One of the top engineers of the past century, Reed made fundamental contributions to digital comput- ers, communications and radar. Among his many honors and awards, he was elected to the National Academy of Engineering in 1959 and named a fellow of the Institute of Electrical and Electronics Engi- neers (IEEE) in 1972.

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In 1991, Reed shared the IEEE's Milos Rilsan Electronics Communications Award with collaborator Gustavo Solomon for their invention of the Reed-Solomon Codes, which for decades was the most widely used system for protecting the integrity of stored and transmitted data. In 1998, he also received the IEEE Golden Jubilee Award for Technical Innovation.

Reed received his Ph.D. from the California Insti- tute of Technology (Caltech) and served in the U.S. Navy during World War II. After receiving his dis- charge from the service and while he was a graduate student at Caltech, Reed participated in the creation of one of the first digital computers: Northrop Corp.'s Magnetic Drum Digital (different) analyzer, which was used to control the guidance system for the Starshark cruise missile. Reed and his team members flew the device to Princeton University to demon- strate it for mathematics John von Neumann.

At the Massachusetts Institute of Technology's Lincoln Laboratory from 1951 to 1960, Reed worked in three key areas: the development of computer programming languages, the theory of radar design and performance, and the Reed-Solomon codes for protecting digital information.

Reed joined the USC faculty in 1963, where he remained the rest of his career. At USC, Reed was a member of the departments of electrical engineering and computer science. He was also a founding member of USC's Center for Signal and Image Processing Institute and the Communication Sciences Institute.

USC Viterbi School of Engineering Professor Emeri- tus Irving Reed died on Sept. 11, 2013. He was 88.

Reed was a professor in the Ming Hsieh Department of Electrical Engineering from 1949 until his re- retireme
The university of the 21st century will have a vastly different shape than it does today. In the past, students paid tuition to receive classroom instruction and academic certification. Now, MOOCs are everywhere, and has made high-quality courseware available to anyone free of charge. College classrooms, laboratories, and high-end class rooms will be replaced by low-cost, high-quality online courseware. This will likely lead to a new form of mass education: a system of small, high-quality, online universities.

We believe that the answer lies in iPodia, where the “I” stands for “inverted”, “interactive”, and “international”, a new pedagogy for 21st century global education developed at USC in 2005.

model for future students to enjoy global education without leaving home.

These are the key questions that all leading uni-
versities in the 21st century must answer: What is the new value proposition for our campus learning? How will we measure the impact of our campus learning? How will we measure the impact of our campus learning? Can we deliver quality global education right from our homes?

We believe that the answer lies in iPodia, where the “I” stands for “inverted”, “interactive”, and “international”, a new pedagogy for 21st century global education developed at USC in 2005. The iPodia pedagogy is built on the belief that: censical understanding is essential for effective education – hence the inverted learning; what you learn depends on whom you learn – hence the interactive learning; and diversity increases learning opportunities – hence the international learning.

Like any new model, iPodia has its limitations, but it has the potential to transform education in a way that is as relevant to the 21st century as the traditional model was to the 18th century. This is why we are committed to continuing to develop and refine this approach as we move forward.

Socially Assistive Robots that Care: Surprisingly likeable and, hopefully soon, surprisingly helpful

The movie “Robot & Frank” features an elderly, and quite curmudgeonly, chief named Frank, whose family provides a robot to take care of his needs. The robot, an experimental Synthia 4000, has learned beyond the current engineering state of the art, but, ironically, most people won’t find the robot unattractive (though it’s 6’8”), but may find the bond that forms between the robot and Frank hard to believe (yet it is very real). The reason is that

There is a popular misconception that people, especially older people, do not like robots. In the movie, the robot, known as Synthia 4000, is designed to be emotionally appealing, but it is not clear if this is a conscious design decision. Despite the fact that the robot is designed to be appealing, it is still

Socially Assistive Robotics Technology

Socially assistive robotics technology (SART) is a rapidly growing field that focuses on developing robots that can assist and interact with people in a socially meaningful way. SART is used in a variety of settings, such as healthcare, education, and rehabilitation.

The goal of SART is to develop robots that can

A Vision For Engineering

Dr. King’s Dream - 50 Years Later

In his celebrated August 28, 1963 speech on the steps of the Lincoln Memorial in Washington, D.C., Rev. Dr. Martin Luther King, Jr. unveiled his vision for an America in which the concept of equality and justice for all would be realized. He believed that the skin would be the measure of an individual. Fifty

years later, King’s dream has yet to be fulfilled. Opportunities for advancement and quality education are not available for many in our nation not only because of their race, gender, or socioeconomic status, but also because of their sexual orientation, physical ability or other personal characteristics.

In order to truly realize King’s dream, we must

Dr. Martin Luther King, Jr.

[Photo of Dr. Martin Luther King, Jr.]

For more information, please visit https://www.drking50.com

G R A P H I C S B R E E T H E R W E A T H E R

P H O T O G R A P H Y B Y L A E F S H I K E R

U C L A S T U D E N T

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THE MANY LIVES OF ENGINEERS

“I believe the same mindset that has helped me be successful in cycling plays an important role in engineering as well. In cycling, dedication, perseverance and the strong desire to push boundaries are the foundations of success. Whether it is hitting new top speeds on the bike, or solving an engineering problem, the thrill of a new achievement is what motivates me to continue to pursue both of my goals.”

— JOSEPH VELOCE, Olympic cyclist, Ph.D. candidate, electrical engineering
“Painting and engineering are similar. You get a clear vision of what the end-product should look like, and then you can’t sleep until it’s done.”
— KEVIN KNIGHT, senior research scientist and fellow, USC Information Sciences Institute (ISI)

“My research covers dynamic impact and generation of shock waves in gases, liquids and solids. The events we study are very fast—typically less than a millisecond—and often generate extreme conditions. I think that’s why I find practicing Muay Thai to be both intellectually rewarding while at the same time it is physically challenging and enriching.”
— VERONICA ELLIASON, assistant professor, Department of Aerospace and Mechanical Engineering

“I think a big part of becoming a successful dancer is forcing yourself to think outside the box. It’s not just about learning the movements and being able to replicate them. The choreographers I admire most constantly challenge their minds and bodies and strive to tell stories with movement. The value of creativity and risk-taking in engineering cannot be overemphasized either. Many people are capable of getting an engineering degree; not everyone will go out into the world and continually push themselves to break from the norm.”
— MAX TBEROU, junior, Industrial and systems engineering
YouTube Co-Founders Chad Hurley and Steve Chen

10 Questions on Jobs, Dangers of Social Media and Their Next Big Thing

USC Viterbi: everyone’s talking jobs and the economy, and being that we’re an engineering school, I’m curious to get your thoughts on the role an engineer can play or should play in growing the economy.

Chad: I think that although the economy may be struggling to some extent, and it’s harder than ever for individuals to find some jobs, I think people are more empowered than ever to find a way to continue their own destiny. Maybe it’s not the way that the economy or the system has traditionally worked in the past, but people have the tools to create their own service...to launch a web-based service like we have and continue to do so. So I feel, although it may be a tough job market, individuals, especially engineering students coming out of school, are more empowered than ever to leverage this technology and to simply create their own opportunity.

USC Viterbi: What was the first piece of technology that you really excited? Do you remember?

Steve: In fourth grade, I remember we had this family computer. It was an old Apple II. I just remember starting very early on with a series of about 35 commands, you can almost tell that computer to do pretty much anything you want. I was able to create this kind of animation of the American flag flying across the screen while “The Star-Spangled Banner” was playing. And, to me, it was just kind of cool that you could sit there in front of a keyboard and depending on what you type you can do almost anything you want.

USC Viterbi: I know this has been a national issue in the United States — only 4.5 percent of college graduates graduate from a so-called “STEM” field, and I know in Europe it’s 14 percent. In China, it’s like 2 percent. So if you guys walked into a seventh grade classroom, and you were trying to excite them into a career into science, technology, engineering, and math, what would you say to them?

Chad: Again, sort of how I answered the first question. You know, with those skills you have basically the tools to change the world available to you today; it’s an exciting time to be alive. Generations in the past have been completely powerless to affect people on such a large scale. I mean, certainly, to have an idea, give something practically a week or two and how it touches a global audience is pretty phenomenal.

USC Viterbi: Steve, do you know what you would say?

Steve: What really excites me about being a developer, programmer or engineer is at the end of the day, you have a keyboard, and you can type things on that keyboard, and you can create YouTube or you can create Google. That fact that you can create these things that you have planted in your mind through the keyboard, through mice, through movements...Actually, the point of these programs is you can just change the world, and I think there are just so few things in the world, so few occupations that allow you to do that much as a simple person and that’s what’s truly exciting about being an engineer.

USC Viterbi: We’re all very excited to have an encore to YouTube. Who have been your role models in terms of kind of personal reinvention and what did you learn from them?

Chad: We don’t look at it as a reinvention. We look at it as an ongoing journey to continue to create great stuff. If we do that, that, again, would be great. You know we’ve been really lucky with YouTube. We’ve been really lucky with PayPal. You know, a lot of that stuff is being in the right place at the right time, and it’s simply just taking those chances and being in the position in the first place. So that’s what we’re just trying to do again.

USC Viterbi: Speaking of problems...from what I understand, YouTube was born out of a problem at a dinner party. Can you walk me through what happened there?

Chad: Yeah, I mean we simply just had a problem with sharing video with our family and friends. We had videos on our desktop. There’s not an easy way to share them. There’s Vimeo and YouTube for photos. There weren’t any video services out then. The ones that did exist were just serving up funny kind of viral video, a collection of those types of videos, but nothing in terms of a personal solution that you could share any videos with anyone. Steve had some videos from the dinner party, I had family videos I was trying to share with my parents.

Steve: I think that people have been trying to solve this problem for a long time, even when the internet was a lot more obscure. But what happened with YouTube in 2005, there were a few things. I think one of them, especially in the U.S., was broadband penetration got to a point where enough people could actually upload and watch videos, stream videos real time. It’s hard to imagine back in 2001-2004 when you still had all those problems whenever you went to a site that you'd see those warnings that you have to download a QuickTime Player. You have to download Windows Media Player to play this. That’s no longer something that you have to deal with. And it’s just something that at the time in 2006, all the places were there to make this happen.

USC Viterbi: You know there’s been a lot of buzz about your latest digital media/magnusium venture, Zenn. For the uninitiated, what is it and what’s the latest news?

Steve: So I think after YouTube, we were really looking at ways to be able to find and discover content. So on YouTube, even by the time that I left, it was receiving over 70 hours of video per minute. Even if you were a dedicated YouTube user, there was no chance you were going to watch through all those videos. So how do you connect people that are interested in finding stuff they want to watch with the stuff that’s already been uploaded? How can you help them discover content? I think the Internet has reached a point where content creation is or has been more or less solved. I want to upload a picture I know where to do it, upload a video I know where to do it. But how do you actually find...now when you wake up and you want to actually find content, you want to find the things that you haven’t seen before but that are customized to you. How do you find that? And that’s really what we are doing but really it’s just trying to help people with this next level of trying to find the things they want to see.

USC Viterbi: I’d like you guys to gaze into the crystal ball for a second. Can you forecast two or three things about the web that most people aren’t aware of yet?

Chad: I think generally people are somewhat aware that people are getting tired of social services. There’s going to be what I would call social fatigue. I think there’s going to be a lot more intelligence — collecting things passively and making sense of it than someone actively sharing something. I think there are a lot more people in the world that actually consume tweets as actually tweet themselves. Even in YouTube we saw that: more people that view videos than upload them. I think technology is going to become much more intelligent. It doesn’t ask you to take an action or do something publicly to get value from it.

USC Viterbi: Give me kind of a quick summation of how the startup landscape has changed since YouTube was founded.

Chad: Well, I think (social networking) services might make startups a little too sensitive in terms of what the outside world thinks before it has reached scale. People are too sensitive of what people are saying about what they’re working on. First, then’s kind of operating independently and allowing things to build organically, it just serves as a distraction. Startups aren’t trusting their instincts to create something new. They kind of hinder themselves by listening to what everyone is constantly saying. On the one side, I think that the startups are benefiting from these services because it’s easier than ever to expand your friends. In a terms of a cheat social signaling without building a service that adds true value, it’s going to have something expandable. So I think that’s something that startups have to look right.

USC Viterbi: The last thing I wanted to ask was I know you guys got a chance to visit USC Viterbi last month for a fireside chat. What were some of your impressions?

Chad: It’s a great university. I mean I wish I went there instead of my small school in Western Pennsylvania. The weather is a lot better. No, it seems like a great diverse set of students that are going to do great things. I like the mix of entertainment and technology. I’ve come down there before to visit the film school. I like the interaction of technology for storytelling which you’ve put a perfect place to take advantage of that.

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THE LAST WORD
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