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“The School raised a transformative $180.5 million, $30.5 million over the goal.”
The Times They Are a-Changin’

In my time, which in all candor is long behind us, the blackboard was the main interface, the looking glass, the essential medium through which knowledge reached engineering students. Today, we still have blackboards and we still use chalk, brimming with minerality. The white dust that invariably covers lecturers’ hands and sometimes even much of their clothing continues to be a matter of professional pride and perhaps even a worthy occupational hazard. But everything around and beyond the blackboard is changing dramatically and for the better because of the technology available to us. We talk about “flipping the classroom,” we share and partake in videos, readings and slides to enhance traditional lectures, and we encourage hands-on learning in a technology-rich collaborative environment. Penn Engineering is now a much noisier place and sometimes feels like a frenzied factory that surely does not fit any image of quiet cloisters of academia.

These changes are here to stay and they have bred a new culture among our graduates. Predictably, all of this requires abundant new resources for our students and faculty and boundless amounts of space. We are fortunate that this is also the time when our School is going through a parallel transformation, having just completed our Making History Through Innovation campaign.

In this issue we report on this coming together of thousands of generous alumni and friends, led by Penn Engineering’s visionary Board of Overseers. You will read of the newly endowed student and faculty support, which could not be more welcome at this moment. One could single out the Raj and Neera Singh Program in Networked & Social Systems Engineering or the Rachleff Scholars Program, both of which propel many of our best students into activities of invention and innovation. One of the most profound transformations is the opening of the Krishna P. Singh Center for Nanotechnology. This futuristic combination of fabrication and characterization is also architecturally futuristic. A beautiful glass origami object, accented in burnt orange, appears to have landed on the north side of Walnut Street in the site of a previous parking lot, and is poised to welcome you as you arrive at Penn. Visit us soon—we can’t wait to show you all these wonders. ☕️
A Biological Universe in a Drop of Blood

By Elisa Ludwig

It is no surprise that a chemical engineer would study liquid flowing down a pipe. What may be unexpected is that Scott Diamond, the recently named Chair of Penn Engineering’s Department of Chemical and Biomolecular Engineering, studies human blood, one of the most complicated fluids on the planet, as it flows through an essential pipe, the coronary artery. When things go well, blood flows smoothly. But dangerous clotting events can cause heart attacks and strokes, still the nation’s deadliest killers.

Diamond uses liquid-handling robots, originally developed for the pharmaceutical industry, to run thousands of measurements on a small volume of an individual’s blood. “Each person’s blood has a unique personality, a phenotype, in the way it responds to all the many different stimuli present during a clotting event,” Diamond says. His team uses these data sets to train computer models to predict the severity of a heart attack given one’s blood profile. These computer simulations help identify the patient-specific benefits or risks of a particular drug therapy.

His fascination with human biology began during his undergraduate years at Cornell University in the mid-80s, just as the first recombinant protein, a blood clot dissolving enzyme called tPA, was being developed by Genentech. Intrigued by the body’s own production of tPA, Diamond discovered during his Ph.D. work at Rice University that fluid mechanical forces could actually activate the tPA gene inside endothelial cells lining blood vessels.

Training for Diverse Careers

As faculty member and Chair, Diamond continues to approach chemical and biomolecular engineering as a discipline that synthesizes knowledge and demands collaboration. “The compelling aspect about chemical engineering is that our graduates can go on to work in energy, biotechnology, pharmaceuticals, electronic materials, or any number of wide-ranging areas,” says Diamond. “Our goal at Penn is to provide specialized curricula and concentrations so that by the time students graduate, they develop profound knowledge in their interest areas.”
Scott works with scientists from every corner of this campus,” says Eduardo D. Glandt, Nemirovsky Family Dean of Penn Engineering. “He is equally fluent with biologists, clinicians and computer scientists.” An elected Fellow of the Biomedical Engineering Society, Diamond has been honored with the George Heilmeier Award for Excellence in Faculty Research from Penn and the Allan P. Colburn award from the American Institute of Chemical Engineers. Diamond is the founding director of the Penn Center for Molecular Discovery, an NIH initiative established in 2005, and the director of the Penn Biotechnology Master’s Program, one of the largest of its kind in the country.

“It’s fascinating how the classic engineering tools of fluid mechanics, transport physics and reaction kinetics are now applied to today’s problems,” notes Diamond, the Arthur E. Humphrey Professor. “In a recent conversation with Dr. Humphrey, the founding Dean of our School, Arthur noted that his career was focused on running a single 1,000-liter fermenter. In a given week, our lab runs thousands of different one-microliter reactions simultaneously. Our capacity as scientists to generate novel data and insights has skyrocketed.”

“The ability to manage high-dimensional data sets and apply computer skills for implementing creative ideas is something our undergraduates need to learn,” says Diamond. “Our goal is to encourage students to get involved in discovery and research early on, and we’re creating more opportunities to do that.” For instance, students can grapple with high-dimensional data sets.

On the research front, Diamond develops microfluidic devices that recreate the body’s fluid mechanics, which his lab uses to test small volumes of blood.
in a course he teaches on the chemical screening technologies that are used to find new drugs.

Breaking Through

On the research front, Diamond also develops microfluidic devices that recreate the body's fluid mechanics, which his lab uses to test small volumes of blood. Recently, his team made a fascinating discovery: when a sample was resistant to aspirin treatment, his team identified a previously unknown genetic mutation. The result was published in the prestigious journal *Blood*.

Tom Colace, a fifth-year Ph.D. student, has coauthored several studies with Diamond, including the *Blood* paper. “I have really enjoyed having him as an advisor, not just because he was working in an area that interested me but because he offered students the perfect balance of freedom to explore our own ideas and the accessibility to meet with and guide us as needed,” Colace says.

Diamond lives with his wife Jessica, a scientific writer, and their teenage son and daughter in suburban Philadelphia. When he’s not advising students, researching or teaching, Diamond enjoys downhill skiing, a hobby that allows him to enjoy the outdoors. “When you’re skiing, you’re exactly in the moment of getting down the slope. Pennsylvania has the mountains. We just need more winter.” 🥾
Films made of nanoparticles are a crucial component found in everything from lithium ion batteries and solar cells to the next generation of display devices and anti-fogging coatings for automobile windshields. One vexing problem facing engineers is that cracks routinely form in nanoparticle films during formation, interfering with their ability to work properly. Traditional techniques to prevent crack formation, such as adding substances to make the films stronger, can also compromise their function.

With the goal of developing stronger, tougher nanoparticle films, Daeyeon Lee, assistant professor of Chemical and Biomolecular Engineering, recently reported a new method to tackle this problem. By stacking multiple, thin nanoparticle layers while making films, he discovered that it’s possible to prevent the formation of cracks. Lee is also exploring ways to enhance the damage tolerance of nanoparticle films using non-spherical nanoparticles. He envisions this approach being useful for the development of flexible solar cells and batteries as well as other electrical and optical devices that can resist cracking in response to mechanical stress.

Despite the technical nature of this research, Lee loves to give playful summaries of his own work, according to Ph.D. candidate Kwadwo Tettey, who joined the lab in the spring of 2009. “Recently, he gave a talk at a venue in Philadelphia entitled Beers, Bubbles, and Beyond,” Tettey says. “It’s interesting to see that he could break down his research to a very broad audience. He does this really well, and with a sense of humor.” Lee’s enthusiasm for science is contagious in the lab, Tettey adds. “He’s a really engaging person and very passionate about research in general. This attitude rubs off on his students and keeps them motivated.”

Tettey is also inspired by Lee’s approach to scientific problem solving. “He likes to know why something
The Lee Research Group has developed a unique method to control the flow of multiphasic fluids to generate emulsions and bubbles. Shown above is the production of highly monodisperse double emulsions using a capillary microfluidic device.

works, he doesn’t want to just make something work,” Tettey says. “That changed my perception of how I should approach science, and made me try to figure out the fundamental behavior of what I observe. As a scientist, that’s a very important curiosity to have, because it gives you better control of the end product.”

“God Particles” to the Rescue
To better control the end product in another research project, Lee has turned to a special type of particle named after the Roman god of beginnings, transitions and endings. Similar to its namesake, a Janus particle has “two faces,” that is, two surfaces with distinct physical properties. For instance, one half of its surface may be hydrophilic, while the other half is hydrophobic. At fluid-fluid interfaces, such as those that form in mixtures containing oil and water, the water-loving region of a Janus particle spontaneously faces the water side of the interface, while the water-hating region orients itself toward the oil side.

Because of their unique two-faced property and strong attraction to fluid-fluid interfaces, Lee believes that Janus particles are ideal for producing thermodynamically stable mixtures consisting of different fluids that stay evenly dispersed rather than separating into distinct layers. By understanding and ultimately controlling the behavior of Janus particles at fluid-fluid interfaces, he hopes to optimize the properties of a range of soft materials, from vaccines and mixture-based medicines to detergents and microreactors for biofuel conversion.

To study Janus particles, Lee often first develops numerical models to predict their behavior at
fluid-fluid interfaces, and then observes their behavior under the microscope to confirm these predictions and generate new information to further develop the theories. “The biggest challenge is that we cannot see everything that’s happening, so it’s very difficult to come up with the exact mechanism to describe what’s leading to the macroscopic properties or phenomena that we observe,” Lee says. “That’s why we need to have this crosstalk between modeling and experiments.”

Lee has discovered that by tweaking the shape of Janus particles, morphing them from spheres to snowman-like particles, and then modifying the relative size of the snowman’s hydrophilic head compared with its hydrophobic body, he can control their orientation, behavior and interactions at fluid-fluid interfaces. Lee’s calculations for guiding the synthesis of non-spherical Janus particles can be used to stabilize fluid mixtures, thereby extending the shelf life of food, medicine and personal hygiene products, and also enabling enhanced oil recovery from oil fields.

**Synergistic Impact**

Lee grew up in South Korea and earned his bachelor’s degree in chemical engineering at Seoul National University in 2001. Encouraged by his undergraduate advisor to become a scientist, Lee decided to come to the United States for the best opportunities to pursue his dream. While earning his doctoral degree in chemical engineering at the Massachusetts Institute of Technology, he initially focused on polymers and then started to apply techniques in polymer science to soft nanomaterials.
These diverse research experiences prepared Lee for joining the Penn faculty in 2009. “If I were at another place, it would be difficult to imagine how my research could impact people in other fields, but collaboration is so natural at Penn. I now have several projects with the medical school,” he says, pointing out its close physical proximity with Penn Engineering.

One of his collaborators is Rebecca Wells, associate professor of Medicine, who is interested in the role of proteoglycans, collagen and tissue stiffness in liver fibrosis. After hearing Lee give a presentation at a Center for Engineering Cells and Regeneration luncheon a few years ago, she approached him to discuss a potential collaboration. Since then, Lee has worked with Wells to develop a new kind of cell culture system that consists of a collagen matrix whose stiffness and proteoglycan content can be tuned, mimicking the cellular environment of the liver. “These kinds of culture systems are going to enable us to understand cell behavior in a much more realistic way,” Wells says.

Lee’s innovative work has not gone unrecognized. In 2011, he received the coveted National Science Foundation CAREER Award to study electrostatic interactions in non-polar solvents for the assembly of nanostructured thin films for alternative energy applications. “I work on the fundamental side, but I always have in mind how my research could influence new applications. I think the areas where my research will have the greatest impact are energy storage and conversion, biomedicine and water purification,” Lee says. “The value of being a scientist is that you get to do something that you love to do, and you can also have a positive impact.”
Architecture as Emissary

By Amy Biemiller

The style of any given building or space on Penn’s campus is not so much defined by a rigid guide or set of rules. Rather, one simple statement of principle defines the look, tone and feel of architecture on campus. That statement—to exemplify the best architecture of its time—is elegant in its simplicity and inspiring in its magnitude.

“At Penn, leadership is very much interested in architecture as a legacy,” says David Hollenberg, University Architect. “When we meet to discuss the design of a building or space, we only discuss two things: Is the design as good as it can be, and is it good for Penn?”

The application of those queries has served to provide Penn with buildings and spaces that proclaim its diversity of character and its identity as a world-class university. Over the past 10 years, those two questions have been asked frequently as the University has built and expanded its physical footprint in Philadelphia. They have also underpinned the hubbub of building activity over that same decade for Penn Engineering, which has completed Levine Hall, Skirkanich Hall and the soon-to-be-open Singh Center for Nanotechnology.

“Any one of these buildings would be considered a major accomplishment,” says Hollenberg. “But all three in 10 years is a masterful coup. These projects have what I consider the ‘Eduardo Factor.’ That means that they harness the vision, values and energy of a man who is committed to sharing the innovative science that happens at the School with the rest of the world.”

The buildings that define Penn Engineering are intricate structures that unite inquiry and learning, innovation and collaboration.
The vision of Eduardo D. Glandt, Nemirovsky Family Dean, is driven by a keen understanding that modern, welcoming and inspiring spaces serve the School in many ways. They stimulate the exchange of ideas, which fuels learning. They also reinforce the School’s mission to demonstrate excellence and innovation and attract top-notch students and scholars.

“During his tenure, Dean Glandt has overseen the evolution of the School’s precinct from a quiet, recessive enclave of turn-of-the-century background buildings to a confidently expressive, integrated center of academic energy,” says Mark Kocent, University Principal Planner.

Cleverly Uniting Two Historic Buildings

Even before ground was broken for Levine Hall, the 48,000-square-foot, six-story home of the Department of Computer and Information Science had a big deliverable: unite The Moore School, built in 1912, and the Towne Building, built in 1906. While no easy task, the architectural design of Levine cleverly meets that deliverable in multiple ways. For example, the corner where Levine and Towne meet features masonry blocks that alternate with glass windows in a zipper-like pattern, and Levine’s six-story glass façade is divided into smaller sections that relate to the fenestration of nearby buildings.
While the exterior design successfully melds historic with contemporary aesthetics, Levine’s interior features modern design and technological innovation. Its soaring loft spaces replete with natural light are the result of a post-tensioned concrete structure and a ventilated aluminum frame curtain wall system that, prior to Levine, had never before been used in the United States.

Transformational Vision

While Levine connects Towne and Moore on 34th Street, a new building project was initiated in 2003 to do the same on 33rd Street. Completed in 2006, the 58,000-square-foot Skirkanich Hall is home to the Department of Bioengineering and includes a grand entrance to Penn Engineering.

From the outside, Skirkanich eschews the academically traditional red-brick façade for one that glimmers greenish-gold against cantilevered shingled-glass panes and zinc panels. Inside, Canadian granite and polished concrete define interior paths and courtyards that successfully link the disparate floor plans and elevations of Towne and Moore. State-of-the-art teaching labs and research facilities, office space, and a top-floor conference room with panoramic views of the Penn campus and Philadelphia skyline are juxtaposed.
against unique outdoor spaces, including the Quain Courtyard, which features the Colker Fountain.

“Few would remember that this site B.E. (Before Eduardo) was once an uninspiring asphalt paved service court for truck deliveries and surface parking,” says Kocent. “His vision here has been transformational and lasting.”

**Building a Grand Statement**

Where Levine Hall and Skirkanich Hall bridge historic space with modern, the Krishna P. Singh Center for Nanotechnology stands on its own, rising in a symphony of sparkling glass and aluminum on Walnut Street. It blurs the delimiters of indoors and out, form and function.

“This is exuberant architecture with a purpose,” says Hollenberg.

The Singh Center’s façade of patterned glass elegantly entices visitors to stop and appreciate not only the beauty of the building, but the innovation of the science happening behind that glass. The invitation shines at night as well, when the amber-tinted glass of the clean room, which encompasses the entire first floor of the building, produces a warm glow visible from the street.
But that elegance transcends what is seen. In the lower level of the building, where sensitive electron microscopy will occur, labs are enclosed in aluminum plate shielded with Teflon® to protect equipment from electromagnetics interference. To minimize vibration and protect sensitive equipment, the concrete floors of the building reach down to bedrock.

“This has been a ferociously complicated and technologically demanding building,” says Hollenberg. “Of course the science that is conducted in this building could be performed just as well in a windowless block, but Dean Glandt wanted to celebrate the science and make a grand statement about it.”

Kocent agrees. “Passing by the building, one senses the spirit of innovation alive within its transparent skin and hovering over Penn’s Walnut Street gateway, a spirit that Dean Glandt has inspired in his architects, faculty, researchers and students. This spirit to dare and dream will be an enduring legacy to future generations of Penn citizens.”

Both form and function drive the design in laboratories and common spaces in the newest additions to the Penn Engineering campus.
ESE students Sarah Dean and Atul Tiwary
Atoms, Bits, Circuits and Systems

By Jana Moore

Nanotechnology. Robotics. Photonics. MEMS. Power grids. Stochastic processes. The fields encompassed by the Department of Electrical and Systems Engineering (ESE) have become so broad and complex that even professionals find keeping up difficult.

Freshmen could easily feel overwhelmed by the scope and breadth of ESE, until last fall, when the Department took the rare step of offering ESE 111: Atoms, Bits, Circuits and Systems (ABCs), a class proposed and partially designed by senior Kevin Conley and his fellow Teaching Assistants (TAs).

“To get excited about the fields in ESE, it’s important that freshmen get hands-on work and a flavor of the different things you can do, and no one course gave them that,” says Nick Howarth, one of the seven TAs who made an impassioned plea for the new overview class a year ago. Daniel Lee, professor of Electrical and Systems Engineering, had an additional goal: “I wanted them to see how they could change the world after understanding the underlying theories.”

A New Kind of Intro Class

Lee and Siddharth Deliwala, Undergraduate Lab Manager, decided the lectures needed to take a far different tack from traditional introductory courses. “Instead of just teaching an overview, we wanted to utilize energetic and engaging guest speakers,” Deliwala says. “We focused on particular discrete areas as representative of entire subjects.” Lee addressed a wide spectrum of topics during lectures, from mathematical models of circuits and semiconductor physics and processing techniques to abstractions and analysis of large-scale systems. Guest speakers examined the application of microelectronics outside of computing, the potential of nanoparticles and the complexities of power grids.

For the midterm, the students analyzed the Apple vs. Samsung touch-screen lawsuit from an engineering and technological perspective.

Hands-on at a High Level

The labs, primarily designed by Howarth and fellow TA Sam Wolfson, roughly matched the focus of the lectures while introducing a variety of concepts, some of which are normally reserved for juniors. The first lab began with simple circuits but ended with MATLAB, powerful software used to analyze and plot large data sets and control complicated experimental setups. Later, the students learned how to program the Arduino, an inexpensive open-source microcontroller platform popular worldwide.

The use of sensors, LCDs, accelerometers, data acquisition, signal processing and wireless communication followed, along with constructing a portable USB charger. All the labs built up to the final project, designing and building a networked pedometer that interfaced with MATLAB and was capable of sharing data with users.
The course was evenly split between class and lab time, as the TAs had proposed. “Most of the students chose electrical engineering because they like to build things, and they were disappointed when they got theory and software first and hardware implementations later,” Deliwala says.

Seeing the Course Through Students’ Eyes

The participation of the upperclassmen in helping to design the course sent it in a far different direction than if professors and instructors had designed it alone, Deliwala says. “You can really miss what students want unless the upperclassmen are involved. This was a lesson we learned by accident.” Because of the success of the class, George Pappas, the Joseph Moore Professor and Chair of ESE, says he plans to engage students in designing the curriculum more often. “You can teach foundations with technology relevant in the ’80s, as the textbooks do, but students want to see how it’s relevant today,” he says. “Their input will help redefine courses.”

With ESE 111, the TAs insisted on de-emphasizing traditional exams and grading, giving students the opportunity to explore and learn without fear. Freshman Atul Tiwary said the tactic worked as the upperclassman envisioned. “With no memorization, we learned for the sake of learning,” he says.

The upperclassmen also wanted the students to get exposure to peer learning and interact with others in ESE to form a good picture of what to expect during their undergraduate years. The freshmen heard from sophomores and juniors about their research, and the class TAs acted more like mentors than instructors. “I got to know the TAs and could ask them about other classes and professors,” says freshman Sarah Dean. “I really liked that contact.”

The upperclassmen also strongly suggested the course include entrepreneurship as a way to connect students with careers. The last guest speaker, Jeff Babin, Senior Lecturer and Associate Director of the Engineering Entrepreneurship Program, took interaction and entrepreneurship to a level not envisioned by the upperclassmen or Lee and Deliwala.

Learning How to Learn

Babin described the difference between a device, such as the students’ networked pedometer; and a product, a device that meets a need and lends itself to effective marketing. As part of the final project, he challenged each student to envision 40 different products, and with the help of a group, narrow the number to two. The students then paired off, picked the best idea, and prepared presentations that addressed the entrepreneurship tenets that Babin outlined.

The products ranged from an alarm that would wake a student who had inadvertently dozed off to a player that matched a jogger’s pace to music. One student developed a prototype of a product that would warn riders via Facebook if their bikes were stolen. “The TAs weren’t involved in making the prototypes,” says Howarth, who will work for the computer company Oracle after he graduates in May. “I was really proud of them.”

Deliwala says the use of initiative might have been the most important element of the course. “The pace of electrical engineering has become so fast, you can’t teach everything,” he says. “You try to equip undergraduates with the knowledge of what is possible and arm them with the ability to learn on their own.”

ESE 111, Atoms, Bits, Circuits and Systems, offers freshmen a hands-on opportunity to explore the underlying theories of electrical and systems engineering.
Professor Dan Lee works with Teaching Assistants Nick Howarth and Sam Wolfson to set up sensors and microcontrollers on a wheeled robot used for demonstrations in ESE 111.
Deadpan delivery and a running sight gag added a touch of whimsy to the hefty intellectual content in Michael Kearns’ largest class ever, “Networked Life,” with 44,000 students registered on Coursera.

Kearns, National Center Professor in the Department of Computer and Information Science, appeared before Independence Hall in the first lecture and Boathouse Row in the second, and said: “Greetings and salutations from the University of Pennsylvania. Broadcasting live from beautiful downtown Philadelphia, I’m Michael Kearns and this is Networked Life.” All 23 lectures in the six-week course began with Kearns offering this welcome, speaking as if on location before a series of ridiculous studio backdrops: a giant iceberg, inside a prison, and (the class favorite), a trash-strewn alley.

These quirky intros sparked an esprit de corps in the largest class that Kearns, an innovator in the emerging math and science of network structures, has ever taught. Students of all ages and occupations hailed from more than 50 countries.

“So much of my Networked Life class at Penn is about online phenomena, their adoption and how to study them, that it felt like I was morally obligated to be one of the first movers on campus to create a Coursera course,” says Kearns, founding director of Networked &
Social Systems Engineering (NETS). NETS is Penn’s technically rigorous, interdisciplinary networked science, engineering and math major, which prepares students for careers at technology companies, startups and in quantitative finance.

Networked Life is among the first set of 20 courses offered by Penn on Coursera that has attracted 720,000 registered students so far. “The numbers are phenomenal,” says Edward Rock (L’83), Penn’s Director of Open Course Initiatives and Saul A. Fox Distinguished Professor of Business Law. “People here care about teaching. To reach that many people is an intoxicating prospect.”

Inflection Point

Penn was among four inaugural universities when it joined Coursera in April 2012. “We’re being incredibly proactive because we view this as an inflection point in education,” says Rock. “Creating and disseminating knowledge as widely as we can is core to Penn’s mission. The Internet is where we want to be.” By February, Coursera had 62 university partners and 2.7 million students from 196 countries.

“Our presence on Coursera will be a net positive because Penn has the brand and great teachers and researchers,” says Rock. Penn plans to add up to 12
online classes every semester. Eleven will launch by next fall, and another nine will begin by early 2014, including three engineering courses: Linear Algebra, Introduction to Algorithmic Thinking, and Probability.

“Penn’s involvement with Coursera has jumpstarted a conversation about integrating technology into the classroom,” says Rock. “We’ve been waiting for years to figure out how the Internet changes education. One of my fondest dreams is to blow up the 19th century lecture and replace it with better ways to teach. If all Coursera does is that, it will be worth its weight in gold.”

Jump into the Fray

“Online education is part of our future. You can worry about it and hope it goes away. Or you can jump into the fray and work on making it as good as possible,” says Kearns. “Coursera will drive more and better students to Penn because instead of just seeing a slick brochure showing our beautiful campus, you can really sample the wares.”

One student finished every online Networked Life lecture and quiz successfully within 36 hours, then applied to NETS. “If every year Coursera inspires 10 to 20 successful applicants, that’s a huge win,” says Kearns. Created with funding from Rajendra and
Neera Singh in 2011, NETS now has more than 30 undergraduates and will be capped at 40 incoming students annually.

Kearns devoted much of last summer to producing six hours of content. He perfected explanations of complex concepts, yet stayed off camera to use the screen to present information-rich concepts visually. He hopes to tap Coursera’s vast reach for his research, an approach that builds upon experiments conducted with Penn students. Influenced by the 2008 Democratic primary between Hillary Clinton and Barack Obama, he explored the link between network structure and how groups reach unanimity. His research, published in *PNAS*, demonstrated that a small but well-connected minority can systematically control the outcome of decision-making against the will of the majority.

“Those experiments injected energy and new material into the classroom, and generated published scientific articles that illustrated concepts for subsequent students,” Kearns says. He currently is developing the Warren Center, a new graduate program and research initiative in network science funded by Robin and Frederick Warren, a Penn Engineering alumnus and Overseer. “On campus and online, together we’re pioneering the science of this field,” says Kearns.
Reinventing Calculus Education Online

Zippy, engaging, colorful yet substantive hand-drawn animations are among the first things people notice about the way Robert Ghrist teaches “Calculus: Single Variable” on Coursera.

“I love mathematics. I love engineering. And I want to communicate that enjoyment to my students and everyone else,” says Ghrist, Andrea Mitchell University Professor of Math and Electrical and Systems Engineering. His clear, nuanced explanations and soothing voice have attracted 50,000 students to his class.

Part of the appeal is that he has developed a new way to teach calculus. “There are wonderful math textbooks out there. But they’re static. The videos I’ve created are text-like but dynamic. That’s important in calculus. The mathematics of motion and change is best illustrated in motion.”

Instead of simplifying concepts for online use, Ghrist uses Coursera to present advanced topics. “My bonus lectures are a hint, ‘here lies something wonderful,’” he says. “If I put it out there suitably illustrated, students may find it appealing, try to figure it out, rewind and delve a little deeper.”

In February, the American Council on Education announced that it evaluated and recommended college credit for five online courses for the first time, including Ghrist’s calculus course, testifying to its rigor and scope. Penn might someday license use of these lectures to high schools or colleges to be supplemented with in-class instruction and participatory activities.

“Changes are coming quickly and in rapid succession,” says Ghrist. “We will all have to adapt—students, educators and publishers.”

Robert Ghrist
Facebook. Instagram. Twitter. Flickr. If you have a smartphone, you’ve probably taken a picture or video and posted it, messaged it or shared it without thinking of what it takes to power your device. Meet Marc Loinaz (EE’88), one of the engineers behind the technology that allows smartphones to capture our lives and interconnect us so powerfully, and who has helped bring this technology to market.

Loinaz is as excited today about exploring engineering topics as he was as a young researcher at Penn. His advice to young engineers? “Nurture your curiosity, and fearlessly seek intellectual growth.”

From the Lab to the Cloud

A sense of wonder leads Marc Loinaz to help transform our world

By Stephanie Sayago Bell

In the mid-1990s the idea of ubiquitous cameras and high-speed networks that could be used to freely circulate pictures and video traffic had been envisioned, but not realized. The technology we have today is the result of thousands of engineers and business people relentlessly pushing the limits of what could be done with electronics, photonics and software. Loinaz worked in the forefront of the development of both low-cost CMOS (Complementary Metal-Oxide Semiconductor) imagers and optical networking components using chips. Loinaz sees the rise of today’s cloud-based computing infrastructure with the use of technologies he has worked on as the most exhilarating period of his professional life. “There is a sense that everything we worked on is coming together and truly changing the way we live,” Loinaz says.

Laying the Groundwork

The seeds of engineering entrepreneurship were sown early in Loinaz’s career while he was still an undergraduate at Penn. His father (a Wharton MBA) had “brainwashed” him into majoring in engineering because it involved learning quantitative analysis. But during his junior year, the late Fred Ketterer, Electrical Engineering Professor, introduced him to “the fun and wonder of designing electronics-based systems.” As a senior electrical engineering student, Loinaz engaged in the research and design of silicon chips. His senior project, designing a full-custom CMOS chip for use in a neural network-based vision system, was undertaken for basic research without thought to commercial use. Yet, this project laid essential groundwork for
As a senior electrical engineering student, Marc Loinaz engaged in the research and design of silicon chips. His senior project was the design of a full-custom CMOS chip for use in a neural network-based vision system. Understanding the kind of research and design that can lead to the commercial application of engineering work, the project was supervised by Professor of Electrical Engineering Jan Van der Spiegel and the late Paul Mueller, M.D., of the School of Medicine, both of whom he credits with showing him that it is “cool and fun to be a researcher.” After graduating with a bachelor’s degree in electrical engineering, Loinaz continued his academic career at Stanford, earning a doctorate in the same field.

**From Academia to Practice**

From there, Loinaz put theory into practice at Bell Labs in New Jersey. He says being at Bell Labs “was like earning another Ph.D.,” so intense and fascinating was the work. There he did the seminal exploration that led to the development of the camera chips now found in cell phones, receiving multiple awards for his work. When Bell Labs expressed little interest in the development and marketing of this technology, Loinaz felt frustrated.

In the early 2000s high-speed fiber optic communication was “all the rage,” he says, and he joined friends from graduate school to start a company focused on building components for optical networking.

**A Leap of Faith**

Thus began the most harrowing and exciting period of his career. In 2001 Loinaz quit his job, sold his house in New Jersey, and moved to Silicon Valley to join his group of cofounders. The group, armed with only PowerPoint slides, raised the venture capital from New Enterprise Associates. Their fledgling company, Aeluros, Inc., began designing, manufacturing, and marketing the CMOS 10Gb/s Ethernet communication chips now used in the data centers of some of the world’s largest web companies to interconnect their multitudes of servers. In 2007, after achieving dominant market position in 10Gb/s Ethernet transceivers, Aeluros was acquired by NetLogic Microsystems, where Loinaz continued to serve as Director of Integrated Circuit Design. Last year, Broadcom Corporation acquired NetLogic and Loinaz continues to manage a team of circuit designers pushing the limits of high-speed analog and digital electronics.

Loinaz is as excited today about exploring engineering topics as he was a young researcher at Penn. His advice to young engineers is to “nurture your curiosity, and fearlessly seek intellectual growth.”
As a major contributor to the extraordinary goal-shattering success of the University’s Making History fundraising campaign, Penn Engineering made history in its own right at the notable conclusion of Making History Through Innovation in December. The School raised a transformative $180.5 million, $30.5 million over the goal.

In 2007, with $150 million as its target, Penn Engineering launched a campaign informed by strong and passionate leadership, a shared mission with the University and clear priorities. Engineering alumni and friends of all ages, experience and financial ability were urged to harness their unique powers of imagination to envision and help create the school of the future. Funding to build and renovate facilities, faculty support, undergraduate and graduate student financial aid, student programs and unrestricted giving provided the framework for campaign outreach.

Campaign funds from across the University have already transformed Engineering’s corner of campus. The George A. Weiss Pavilion and Fox Fitness Center at Franklin Field and the open space of Shoemaker Green have enhanced the surrounding landscape, and a quick cut-across now leads the way to lunchtime pick-up games of soccer at Penn Park.

Penn as an Intellectual Powerhouse in Nanoscale Research

The Krishna P. Singh Center for Nanotechnology, on track for an October 2013 dedication, is expected to establish Penn as an intellectual powerhouse in nanoscale research. Singh Center architects, Weiss/Manfredi, did not allow the demanding specifications of nanoscale research to limit their creative aspirations, and the facility is a head-turning attraction on Walnut Street near 33rd Street. Contributions supporting the Singh Center totaled close to $55 million, with gifts naming the nanofabrication facility, individual and microscopy laboratories and the rooftop garden.

At the same time, loyal alumni and friends of the Towne and Moore School buildings designated their dollars to carefully revitalizing Penn Engineering’s historic spaces with all of the amenities of the 21st century.

While the campus around them changes in exciting ways, Penn Engineering students remain focused on the work at hand, taking advantage of newly established programs designed to even better prepare them as innovators and shapers of the future. Campaign gifts for student programs reached 285 percent of the goal, establishing unique resources like Advancing Women in Engineering (AWE), the Rachleff Scholars Program, the Rajendra and Neera Singh Program in Networked & Social Systems Engineering (NETS), and the Warren Center.

The Penn Engineering deanship, newly endowed by Ofer and Shelly Nemirovsky and held by Eduardo D. Glandt, guarantees that the School will continue to attract distinguished leaders of like talent and ability.

Importantly, gifts in support of financial aid bolstered the University’s all-grant, no-loan undergraduate policy and graduate aid, guaranteeing that all qualified students with the talent and ambition to succeed are ensured access regardless of socioeconomic background.

By Patricia Hutchings
The Penn Engineering deanship, newly endowed by Ofer and Shelly Nemirovsky and held by Eduardo D. Glandt, guarantees that the School will continue to attract distinguished leaders of like talent and ability.
By Jessica Stein Diamond

Juliet Sjöborg (BSE’85, W’92), is a local hero of the most unexpected sort in Podlugovi, a village in Bosnia and Herzegovina, 20 minutes from Sarajevo.

Sjöborg runs a solid wood flooring factory, Xylon Corporation, that provides a livelihood for up to 1,000 people, taking into account its 130 employees, subcontractors, suppliers and their families. Commuting to the region from her home in London, Sjöborg led a remarkable infusion of capital and expertise, bringing the firm back from the brink of collapse just seven years ago. Today the company supplies oak flooring to customers throughout Europe and the Middle East, with plans to enter the U.S. market. This was no small feat in a region recently torn apart by ethnic conflict and where few businesses offer a steady paycheck.

“You never know where life will take you,” says Sjöborg, a member of Penn Engineering’s Board of Overseers. “Having an engineering degree has been incredibly valuable and allowed me to do a remarkable range of things most people would find daunting.” Case in point: as one of her first assignments when she joined the European Bank for Reconstruction and Development (EBRD) in 1992, Sjöborg evaluated the electricity supply and demand of entire countries.

Intellectual Agility

Without an engineering degree, that’s not the first job you would get out of business school,” she says. “You have to understand how electricity is generated, transmitted and distributed to households and industry as well as the economic and business issues unique to that country.”

Sjöborg’s intellectual and linguistic agility served her well in her post as Head of the EBRD office in Zagreb, Croatia. She managed a portfolio of more than €500 million in food, pharmaceutical and electric companies. “Going to production facilities was always my favorite part of that job,” she says. “When you just look at the
numbers, you don’t understand the guts of the company. But when you see the production line, and evaluate a manufacturing process from beginning to end, then you can really discuss what’s going on.”

The flooring venture came about unexpectedly. Sjöborg had retired as a senior investment officer with EBRD in 2003, and then had her third child. Her husband, Mattias Sjöborg, head of their family investment company, Plena, was considering shuttering the flooring factory, a recent investment, due to growing management and production issues. Instead, he asked her, “Why don’t you go down and see if you can fix this one?”

Fix This One

Luckily for him, Sjöborg had been raised to speak Croatian fluently by her parents, who had emigrated to the U.S. in the 50s from Zagreb, in the former nation of Yugoslavia. She had led high-level business meetings among Serbs, Bosnians and Croats during her years with EBRD, which she found surprisingly productive given the legacy of ethnic and religious conflict in the region in the early 1990s.

“Since there are such complicated issues here, it is great to contribute to a business environment where we work with everyone and vice versa,” says Sjöborg, who today is a director of Plena. “Everyone wants to make money and be successful, and that’s a healthy thing for this country. Being part of a winning team and receiving a steady paycheck gives people hope.”

With her wide-ranging career, Sjöborg offers valuable insights to the Board of Overseers on the increasingly global nature of technology leadership. “Technology innovation is a unifying skill that can be applied anywhere in the world. Engineering is a training of the mind that’s very useful internationally,” says Sjöborg. “As an undergraduate, you can’t begin to imagine where it will lead you.”
PLEASE JOIN THE MANY INDIVIDUALS who have helped to shape the character of Penn Engineering through a planned gift. A planned gift can ensure that your philanthropy not only maximizes the benefit of available tax incentives, but creates a lasting legacy, ensuring that you make a difference in areas important to you and for future generations.

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http://www.seas.upenn.edu/giving/planned-giving.php
New Faculty

Igor Bargatin
Class of 1965 Term Assistant Professor of
Mechanical Engineering and Applied Mechanics

Ph.D. in 2008 in Physics and Electrical Engineering,
California Institute of Technology
Postdoctoral Fellow at Stanford University

Dr. Bargatin’s research interests are focused on micro- and
nanoelectromechanical systems (MEMS/NEMS) for new
applications in energy conversion, optics and smart
materials. He applies his knowledge of physics and
engineering disciplines to design and test new types of
devices, such as microfabricated thermionic energy
converters, which convert heat directly to electricity at very
high temperatures by literally boiling electrons off a surface
and using them as a “working fluid” in a heat engine. The
Bargatin Group engages in interdisciplinary research at the
intersections of mechanical engineering, electrical
engineering, materials science and applied physics.

Joseph Devietti
Assistant Professor of Computer and Information Science

Ph.D. in 2012 in Computer Science & Engineering,
University of Washington

Sequential programming has become steadily safer and easier
over time, but parallel programming, despite its importance
with today’s ubiquitous multicore processors, has made much
more limited progress. Dr. Devietti works on identifying new
safety properties for parallel programs, precisely defining their
guarantees and exploring efficient implementations employing
a range of hardware and software mechanisms. A recent
project demonstrated how to automatically and precisely
identify concurrency bugs in parallel programs. Dr. Devietti
has also conducted research showing how to simplify parallel
programming by automatically eliminating the nondetermi-

nisim that arises from current multicore architectures and
programming models. With nondeterminism removed, parallel
programs behave like conventional sequential programs that
are much easier to write, debug and understand.
New Faculty

David Issadore  
Assistant Professor of Bioengineering

Ph.D. in 2009 in Applied Physics, Harvard University  
Postdoctoral Fellowship, The Center for Systems Biology, Massachusetts General Hospital

Dr. Issadore’s research focuses on the development of micro- and nanoscale molecular sensors and their applications to high impact problems in medicine. His lab takes a multidisciplinary approach, integrating technology from microelectronics, microfluidics, nanomaterials and molecular targeting into portable, low-cost hybrid microchips. Using these miniaturized systems, Dr. Issadore envisions that medical diagnostics can be liberated from the labor-intensive, centralized facilities in which they are currently housed and brought directly to the clinic, thus offering tremendous benefits for patients.

In his previous work, Dr. Issadore has developed an electronically programmable microfluidic platform that controls individual cells, a portable NMR system that detects bacteria in sputum samples and a micro-Hall chip that sensitively measures circulating tumor cells in blood.

Ladislav Kavan  
Assistant Professor of Computer and Information Science

Ph.D. in 2007 in Computer Science, Czech Technical University  
Researcher, Disney Interactive Studios and ETH Zurich

Dr. Kavan explores new approaches to real-time computer graphics and animation. In his most recent work, he studied how to take a standard physics-based deformation model and transform it into a geometric “deformer,” i.e., a simple closed-form algorithm that can produce virtually the same result, several orders of magnitude faster than the original formulation. In his previous work, he applied techniques from abstract and linear algebra, spectral methods and finite elements to improve upon technology used in the game and film industries. One such example is dual quaternion skinning, an algorithm for skeletal shape deformation which corrects for deficiencies of previous linear blending methods.
Honors and Awards

NATIONAL ACADEMY OF ENGINEERING ELECTS THREE PENN ENGINEERS AS FELLOWS

The School of Engineering and Applied Science at the University of Pennsylvania is pleased to announce that three Penn Engineers, Dawn Bonnell, Vijay Kumar and Krishna P. Singh, have been elected to the National Academy of Engineering (NAE).

Election to the NAE is among the highest professional distinctions accorded to an engineer. Academy membership honors those who have made outstanding contributions to “engineering research, practice, or education, including, where appropriate, significant contributions to the engineering literature," and to the “pioneering of new and developing fields of technology, making major advancements in traditional fields of engineering, or developing/implementing innovative approaches to engineering education.”

Dawn Bonnell, Trustee Chair Professor and Professor of Materials Science and Engineering

For development of atomic-resolution surface probes, and for institutional leadership in nanoscience.

Vijay Kumar, UPS Foundation Professor and Professor of Mechanical Engineering and Applied Mechanics

For contributions in cooperative robotics, networked vehicles, and unmanned aerial vehicles, and for leadership in robotics research and education.

Krishna P. Singh, Penn Engineering alumnus, member of the Engineering Board of Overseers and University Trustee, is founder, president and chief executive officer of Holtec International, an energy-technology company based in Marlton, N.J.

For engineering and business leadership for increased power plant efficiency and improved safety of spent nuclear fuel storage worldwide.
Daniel Lee, Professor of Electrical and Systems Engineering, has been named Director of the General Robotics, Automation, Sensing and Perception (GRASP) Laboratory, effective April 1, 2013. Lee replaces Kostas Daniilidis, Professor of Computer and Information Science, who has taken on the role of Associate Dean for Graduate Education at Penn Engineering.

In his announcement, Dean Eduardo D. Glandt noted, “The GRASP Lab is a jewel of Penn Engineering, one that integrates computer science, electrical engineering and mechanical engineering in a vibrant, collaborative environment that fosters interactions between students, research staff and faculty. Dan’s commitment to GRASP and his energy, creativity and leadership will drive GRASP to new heights.”

Dr. Lee received his Ph.D. in condensed matter physics from the Massachusetts Institute of Technology, and spent six years with Bell Laboratories before joining Penn in 2001. Drawing from the ways in which biological systems compute and learn, Dr. Lee and his lab look at computational neuroscience models and theoretical foundations of machine learning algorithms to construct real-time intelligent robotic systems, with an ultimate goal of designing machines that understand what we want them to do.

Haim Bau, Professor of Mechanical Engineering and Applied Mechanics, has received the 2013 Provost’s Award for Distinguished Ph.D. Teaching and Mentoring. A colleague writes, “A world-renowned scholar in the fields of heat transfer, mass transfer, and fluid mechanics, he is in his lab daily to talk with his students, review their progress and make suggestions for their research.”

Jonathan Fiene, Senior Lecturer and Director of Laboratory Programs in the Department of Mechanical Engineering and Applied Mechanics, has received the 2013 Provost’s Award for Teaching Excellence. One student writes, “A firm believer in learning by doing, he developed a ‘MEAMpalooza!’ showcase of student projects and launched an epic Robockey (robotic hockey) tournament that is the culmination of everything we’ve learned during the semester.”

Robert Ghrist, Andrea Mitchell University Professor and Professor of Electrical and Systems Engineering and Mathematics, is the recipient of the 2013 Chauvenet Prize, a prestigious award for mathematical expository writing.
 Honors and Awards

Katherine Kuchenbecker, Skirkanich Assistant Professor of Innovation in Mechanical Engineering and Applied Mechanics, presented “Touch Technology,” a description of research in haptics, at the 2012 TEDYouth conference in November. The TEDYouth conference is a day-long event that features speakers and hands-on activities for high school students.

Daeyeon Lee, Assistant Professor of Chemical and Biomolecular Engineering, is the recipient of a 3M Nontenured Faculty Award for his proposal, “Bubble-Derived Light-Weight Materials with High Strength and Toughness.” This award was created by the 3M Company to support new faculty in their path to tenure.

Benjamin Pierce, Henry Salvatori Professor of Computer and Information Science, has been named Fellow of the Association for Computing Machinery (ACM) for “contributions to the theory and practice of programming languages and their type systems.”

David J. Srolovitz, Joseph Bordogna Professor of Engineering and Applied Science and Professor of Materials Science and Engineering and Mechanical Engineering and Applied Mechanics, has been named Fellow by The Minerals, Metals & Materials Society (TMS) “for global leadership in theoretical and computational materials science and groundbreaking and seminal contributions to fundamental understanding of surface and grain boundary phenomena.”

Karen Winey, Professor of Materials Science and Engineering, has been named a 2013 Materials Research Society (MRS) Fellow for “outstanding contributions to the understanding of polymer nanocomposites and ion-containing polymers through rigorous and insightful experiments and for distinguished leadership in the materials community.”

Beth Winkelstein, Professor of Bioengineering and Associate Dean for Undergraduate Education, has been named Fellow of the American Institute for Medical and Biological Engineering (AIMBE) for the class of 2013.
Penn Engineering Teaching Awards

The recipients of the annual Penn Engineering teaching and advising awards are selected directly by Penn Engineering students after thoughtful consideration. The School is filled with gifted educators who inspire students by their dedication and excellence.

Wen Shieh, Professor of Chemical and Biomolecular Engineering, has been awarded the S. Reid Warren Jr. Award, which is presented annually by the undergraduate student body and the Engineering Alumni Society in recognition of outstanding service in stimulating and guiding the intellectual and professional development of undergraduate students. One student noted, “Professor Shieh is the most engaging professor I have had to date at Penn. Taking his class this semester has been extremely rewarding. His preparation for the course is remarkable, with detailed explanations and examples covered in class with even more detail in the textbook-like course notes that he has written online. His passion for the subject is overflowing, and it is clear that he not only wants his students to learn the material, but he also thoroughly enjoys teaching it.”

Beth Winkelstein, Professor of Bioengineering and Associate Dean for Undergraduate Education, has been awarded the Ford Motor Company Award for Faculty Advising. The award recognizes faculty dedication in helping students realize their educational, career and personal goals. One student wrote, “Dr. Winkelstein is a faculty advisor who is always willing to talk to her students about their academic and personal concerns. Not only does she check in with her advisees frequently, but she is genuinely interested in her students’ well-being. From career to curriculum questions, Dr. Winkelstein truly helps her advisees to achieve their potential at Penn!”

Jeffrey Babin, Senior Lecturer in Mechanical Engineering and Applied Mechanics and Associate Director of the Engineering Entrepreneurship Program, has received the Hatfield Award for Excellence in Teaching in the Lecturer and Practice Professor Track. The award recognizes outstanding teaching ability, dedication to innovative undergraduate instruction, and exemplary service to the School in consistently inspiring students in the engineering and scientific profession. A student writes, “Dr. Babin cultivates entrepreneurship at Penn through his EAS 545 and 546 classes, and drives stimulating discussion in the classroom. His approachability outside the classroom has made him a mentor for many of his students, and one of my favorite professors at Penn.”

In Memoriam

Oliver Pacchiana, a junior in Mechanical Engineering and Applied Mechanics, died on March 31 in a rock climbing accident in Namibia. Oliver, 20 years old, was from Greenwich, Connecticut, and was studying abroad at the University of Cape Town in South Africa when the accident happened. He had traveled to Namibia during a spring break trip to Victoria Falls and Botswana.

Born in 1992, Oliver attended Glenville Elementary School, Western Middle School and graduated from Greenwich High School in 2010—all in his hometown of Greenwich, CT. A chess champion in fifth grade, Oliver went on to represent his middle school at the Connecticut state finals in mathematics and won fourth place in the state geography bee. In high school, he was a member of the We The People constitutional debate team that advanced to the finals in Washington, DC. He was an Eagle Scout in Troop 35, played tuba in the school band, competed on the volleyball team and was an altar server at his local church.

During his time at Penn, Oliver was captain of the Penn Electric Racing team and played sousaphone in the marching band during his freshman year. He was a candidate for a BSE and MSE in 2014.

Oliver is survived by his parents, Elaine (C’84) and Douglas; a brother, Nolan; grandmothers Jeanne Pacchiana and Irene Hugick and many aunts, uncles and cousins.
Sevile G. Mannickarottu

Sevile Mannickarottu, Director of Instructional Laboratories in the Department of Bioengineering, provides bioengineering students with hands-on lab experience and training that enhances student proficiency in bioengineering fundamentals.

What is your role in the laboratory?
The most important part of this job is providing an exceptional laboratory experience for our students. This means that we never stop improving our laboratories and our lab courses. I meet regularly with faculty to incorporate their ideas and design experiments that complement the fundamentals our students learn during lectures. On a typical day, I’ll develop new experiments, teach students in a lab class, and meet with student groups to discuss the projects and programs in which they are involved.

What brought you to Penn?
I earned my bachelor’s degree in Electrical Engineering in 1999 from Penn Engineering, and as an undergraduate, I worked for the Electrical Engineering Undergraduate Laboratory. Following graduation, I worked for several years as a Design Engineer for Lutron Electronics. On a whim, I applied for an open position in the Bioengineering lab, recalling how much I enjoyed working in the Electrical Engineering lab as a student. I was offered the position and I have not looked back.

What is the most satisfying part of your job? What is the most challenging?
The best part of my job is teaching and mentoring our amazing undergraduate students. I get to know each one of our students personally as they go through our laboratory program from their freshman through senior years. Having the opportunity to positively affect their lives is incredibly rewarding. Since bioengineering is an interdisciplinary field, the biggest challenge for me is staying on top of the latest changes in technologies and trends related to the field.

What keeps you busy outside of work?
Much of my time is spent pursuing a Ph.D. in Religious Studies here at Penn. In addition, I am actively involved with Penn’s Engineering Alumni Society Board where I’ve helped organize a number of programs to engage alumni and students.
## Penn Engineering Board of Overseers

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<td>Founder</td>
<td>Sage Venture Partners, LLC</td>
<td>Winter Park, FL</td>
</tr>
<tr>
<td>Ms. Sarah Keil Wolf, EE’86, W’86</td>
<td>Retired Investment Banker</td>
<td>Bear Stearns and Company</td>
<td>Scarsdale, NY</td>
</tr>
<tr>
<td>Dr. Michael D. Zisman, GEE’73, GR’77</td>
<td>Managing Director, Operations</td>
<td>Internet Capital Group</td>
<td>Wayne, PA</td>
</tr>
</tbody>
</table>

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