reflecting innovation
FROM THE DEAN

Reflecting Innovation

In his book *The Wisdom of Crowds*, New Yorker columnist James Surowiecki examines a surprising idea: large groups of people thinking independently are smarter than a few brilliant experts. They are better at resolving problems and arriving at the right conclusion. The current stampede to engineering disciplines is yet another manifestation of this phenomenon.

We are witnessing a great surge in the number of students applying to engineering programs, making engineering the “new liberal arts.” They are choosing courses in all areas of engineering, from chemical to mechanical, materials science to computer science, bioengineering to electrical and systems. This is not a case of herd mentality, but an insightful awareness that the tools of an engineer produce novel processes and products, and thus innovation and wealth.

Penn Engineering is ahead of this curve: our undergraduate applications have skyrocketed and our enrollment has risen steadily since 2005. We are currently fully enrolled at 1600 students. At the same time, our master’s enrollment has grown by 65 percent. Through this impressive surge, we have not sacrificed quality. Our graduates emerge with cutting-edge knowledge, prepared for the careers of today and of tomorrow.

Just as good grades and test scores are not sufficient for admittance into Penn Engineering, good performances in a strong curriculum do not suffice to differentiate a school’s graduates from their peers. Their differentiation, their advantage is in an additional realm: imagination, enthusiasm for their work and an ability to innovate.

In this technology-driven era, it is easy to instill enthusiasm for a career in engineering. Scientists and engineers can be “cool” (*The Social Network* and *The Big Bang Theory* notwithstanding). Today, technology and the so-called “alpha geek” engineer are embraced and are inextricably part of our culture. The world looks to our profession for the next innovation in networks, artificial organs or autonomous vehicles.

The ability to innovate begins with both knowledge and enthusiasm but must be fostered by inspiring faculty and peers. Senior Design projects are a natural opportunity for technical creativity. Our Weiss Tech House, a paradise for techies, offers a venue where students can explore their ideas outside the academic program.

How does this level of excellence happen? How do we recruit and retain world-class faculty, design and build outstanding facilities and support the breadth of our programmatic initiatives? Penn Engineering is shaped by the support of our alumni and friends. This year we hope to achieve another “first” by reaching the $1 million mark in Annual Giving. Making that goal a reality will indeed be sweet, and I hope we can count on your assistance.

In the following pages you will enjoy a brief snapshot of the vibrant life of our School. You will see robots that fly and explore terrain too dangerous for humans, you will meet students whose achievements belie their ages, and you will read about faculty whose research will change our world.
Amazing Roam Penn
Some dart through flying hula hoops like hummingbirds on crack. One rocks out on an electronic keyboard, drum and cymbal. Four others are global soccer stars. Ten more prep for an Australian rendezvous where they will work together to find simulated hidden bombs. Robots like these, digital denizens of Penn’s General Robotics, Automation, Sensing and Perception (GRASP) Laboratory, zoom through lobbies, lecture halls and courtyards around Penn Engineering.

Their agility and group problem-solving skills are an apt metaphor for the GRASP Lab, which has built a global reputation in the rapidly-evolving field of robotics since it was founded in 1979. Kostas Daniilidis, GRASP director and professor of Computer and Information Science, attributes the lab’s growing influence and funding, $15 million, to the “multi-disciplinary way we address broad research questions.” Unlike most university robotics programs, GRASP has no physical and academic barriers: its 7,000 square-foot open lab is shared by faculty, graduate and undergraduate students in computer science, electrical and mechanical engineering.
Collectively, GRASP submits close to one grant proposal every week and publishes more than one peer-reviewed article per week—a productive pace for its 15 faculty members, 73 Ph.D. students, 16 postdoctoral researchers and 50 master’s students.

Collectively, GRASP submits close to one grant proposal every week and publishes more than one peer-reviewed article per week—a productive pace for its 15 faculty members, 73 Ph.D. students, 16 postdoctoral researchers and 50 master’s students. “GRASP is one of very few robotics labs to participate in so many big projects simultaneously and to have such a breadth of funding and research outcomes,” says Daniilidis. “Our interdisciplinary integration of theory and practice is unusual and offers huge benefits. Robotics, an experimental science, poses questions so big you cannot answer them using one discipline. It requires collegiality and collaboration.”

By contrast, says Nathan Michael, Ph.D., and GRASP Lab research scientist, “You can go to a lot of other universities and see a fractured environment where people are walled off. What happens in their lab stays in their lab. At Penn, people with different backgrounds and areas of expertise all talk to each other. Being able to prove and refine algorithms on the theoretical side to catch and fi x bugs before turning a robot on accelerates the path to discovery by orders of magnitude. The time between having an idea, developing a simulation and getting a robot running is often on the scale of hours.”

“No other lab in the U.S. or elsewhere trains students the way we do, balancing a fundamental emphasis on science with an eye toward its application,” says Vijay Kumar, Penn Engineering Deputy Dean and GRASP director from 1998 to 2005. “Despite keen competition among labs nationwide, GRASP now manages to attract the top Ph.D. candidates.”

HULA HOOPS & FLIPS

Daniel Mellinger never imagined he would spend so much time with hula hoops. A fourth-year Ph.D. student, Mellinger works with quadrotor aerial robots (plus sign-shaped gizmos with four rotors). His research will eventually lead to the engineering of flying devices to explore and create detailed maps of buildings or landscapes when the environment is too dangerous for humans, for instance, after natural disasters, infectious disease outbreaks or in time of war.

“It’s not just simulation and math,” says Mellinger. “We’re working on real systems in real life that involve theory, math and application of control and engineering tools.” His research began in December 2009 and progressed rapidly. He programmed the quadrotors to hover by February and to fly a defined trajectory by March.

By May, Mellinger’s quadrotors could execute quick flips and zoom ultra-fast through tilted window frames. A YouTube video of these feats has attracted 1.2 million viewers so far. By June, the quadrotors zipped through hula hoops thrown in the air—a complex trajectory no living creature would venture. Another video in which teams of quadrotors gripped and carried objects was cited in a New York Times article “Five Robots to Watch.”

HERE COMES THE SUN

For sheer charm and engineering significance consider the “Personal Robot,” known to all as PR2, which arrived at GRASP in July. PR2 can plug itself in to recharge and can even deliver and open bottles of beer. It’s also a harbinger of open source robotics—harnessing a diverse scientific community to accelerate the development of robots to be used in everyday life.

In April, GRASP won the opportunity to spend two years developing open source code for the beta PR2, which is on loan free to Penn but retails at $400,000. Only ten universities and one company were selected from 78 global applicants to the beta program. Developed by the innovative company

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Willow Garage, PR2 is the first platform for collaborative robotics hardware and software development.

“The more we have open source tools, the less we have to reinvent the wheel,” says Daniilidis. Penn researchers have written PR2 code for door opening and are developing code for grasping clear glassware, refining human-robot interactions and using a tool belt to change its gripper.

“When you know your code will be used by thousands of people it’s a great motivator for students and faculty,” says Daniilidis. Case in point: Ph.D. student and GRASP’s PR2 administrator Benjamin Cohen says, “The benefit of open source is that everyone can duplicate results which weeds out bad research.” Cohen and two friends welcomed the PR2 when it arrived with a 48-hour code-writing binge, programming PR2 to perform *Here Comes the Sun* by the Beatles on keyboard, drum and cymbal—and winning third place in a Willow Garage video contest.
OUTBACK HEROES

Penn will be a contender in yet another global robotics competition near Adelaide, South Australia, in November as one of six teams in the final round of the Multi Autonomous Ground-Robotic International Challenge (MAGIC 2010). Two GRASP faculty and four Ph.D. students will fly to the competition where their ten 25-pound unmanned vehicles will face a challenge: map a village in three hours and find simulated bombs with minimal human interaction. Co-sponsored by the Australian and U.S. Departments of Defense, MAGIC 2010 will be an opportunity to showcase Penn’s reputation for developing robots that cooperate autonomously. The competition’s goal is to advance the development of ground vehicles that could work without human intervention in dangerous locations.

“It says a lot that Penn made it into the final six,” says the team’s leader, Dan Lee, Evan C Thompson Endowed Term Professor for Excellence in Teaching. Twenty-three teams from five countries entered the competition. “This was a test to see which organizations and universities can show the latest algorithms and cutting-edge techniques that could be used to reduce danger to people in hostile environments.”

ROBO SOCCER

With their shuffling, slow-motion soccer playing, the UPennalizers, GRASP’s 24-inch soccer stars, epitomize the role of fun in enticing students to study robotics. Players suffer indignities—being pulled off the field by the head for repairs or inadvertently playing for the opposing team. Still, these 15-pound athletes ranked in the quarter-finals at the global RoboCup competition in Singapore in June. Four bots (known as Lysol, Febreze, Clorox and Mr. Clean) traveled there with six undergraduates plus Lee, thanks to a generous donor.

“We have a lot of fun. And we use a lot of mathematics, programming and modeling,” says Lee. “When students see their skills translated into a high-performing system they connect the dots between what they’ve learned in class to something real. Many undergraduates who compete with the UPennalizers go on to enroll in graduate school.”

The RoboCup league hopes to field a team of 11 autonomous robots that could beat human soccer champions by the year 2050.

LOOKING AHEAD

Robotics has come a long way since GRASP was founded. “The time between maturation of ideas and finding those ideas in industry prototypes is now pretty short,” says Kumar. “Our funding allows us to address basic research problems, but it’s an increasing challenge to stay one step ahead in a field that is so close to technology.”

GRASP’s future will embrace that dialectic. “Robotics is shifting from the stage of innovation to the stage of commercialization. You have to experiment and try new things, to innovate without being sure something will work,” says Daniilidis, citing a quote attributed to 1933 Nobel Prize-winner Paul Dirac, “Scientific progress is measured in units of courage, not intelligence.”
John Crocker studies “squishy stuff.” A researcher at the nexus of soft-matter physics and cell biology, Crocker employs various methods to develop new materials, to determine how soft (or squishy) a material is, and in the case of living cells, to learn how they determine the squishiness of their own surroundings.

Crocker’s research group measures mechanical forces at the nanoscale and uses DNA as an “adhesive” to create new compounds from scratch. As an associate professor in the Department of Chemical and Biomolecular Engineering (CBE), Crocker spends each fall semester guiding Penn Engineering’s CBE seniors through that “rite of passage” currently known as CBE 410: Chemical Engineering Laboratory.

A required course of CBE undergraduates, CBE 410 is an all-laboratory course focused on the application of concepts learned throughout the curriculum, such as heat and mass transfer, thermodynamics, fluid mechanics, and separation processes.
Students find themselves in the same space where decades of alumni have taken the course: Room 116 Towne Building. It is a space that exudes chemical engineering in its arrangement of glassware, tubes and wires, the hissing of steam from the two-story-high distillation column and an industrial-grade catwalk made of welded steel.

In this Unit Ops course (“unit operations” to the uninitiated), students are divided into small groups and spend eight hours per week in the lab and another six or seven hours outside the class analyzing data and planning their assault on each lab station. With very little instruction, students spend two weeks per station to determine how to use, manipulate and reconfigure the equipment to achieve success in each process. At the beginning of the semester, students are understandably apprehensive, knowing they not only need to remember and apply years of theory, but also figure out how the equipment they are using even works.

Matthew Louie, BSE ’10, notes that “it is universally the most dreaded course in the CBE curriculum, but it ended up being one of my favorite classes at Penn. The hours and mental capital it demands are grueling but you come out of it with a much better understanding of the practical applications of what you’ve learned throughout the program.”

As part of the CBE “technical writing” requirement, the course also ensures that students graduate knowing how to communicate effectively through writing. Crocker assigns lab reports to be written to the standard of a publishable research paper so that students develop the writing skills expected of them in the careers they will pursue in both industry and academia. “While being great at science is one achievement,”
Crocker states, “students need to know that they will get much further by being able to quantify and express their logic and ideas effectively to others.”

“As an educator,” states Katherine J. Stebe, Richer and Elizabeth Goodwin Professor and Chair of CBE, “John emphasizes independence of thought, the thrill of discovery, smart experimentation, strong analysis and clear communication on the part of students. He gets them to take initiative to perform each lab unit as a project, which is particularly important as students prepare to launch into professional careers or into post-graduate programs.”

Room 116 Towne has seen much, from when it was originally a mechanical lab housing giant pieces of machinery to its conversion to the lab space that has turned out generations of chemical engineers. “Until this class,” Crocker relates, “students have learned the theory of the chemical reactor and distillation column and what its affiliated equations predict. But they have not yet sat in front of one and had to figure out how to operate it and make it work to prove those equations. It is through this effort that students truly become engineers.”

As an engineer, Crocker’s own research extracts mechanical measurements and builds new nanoscale materials, and his findings inform the research of biologists and engineers searching for novel therapies and devices.

It is learning how cells gauge their surroundings that has Crocker intrigued. While understanding how a cell reacts to a chemical is not difficult, discovering how a cell senses mechanical forces or the mechanical properties of its surrounding tissue is far more challenging. “Until we can explain these determinations, there is a void in the cognizance of diseases like cancer, where cells are mutated and fail to determine that the mutation has occurred or that they have metastasized to a distant organ,” reasons Crocker.

Crocker’s ongoing research also includes the use of DNA as an adhesive to cause microscopic particles to spontaneously assemble themselves into new unique materials. This is achieved via the use of the DNA double-helix’s predictable pairings of adenine with thymine and guanine with cytosine. Once a string of these pairs is designed, the double-helix is “unzipped” and each half is attached to one of the two particle types that the Crocker lab is planning to combine. When mixed in solution, the halves find one another and “zip” together, forming a new particle alloy. According to Crocker, “we won’t be constructing buildings out of these materials anytime soon,” but several scientists at Penn and other institutions are testing the usefulness of these new materials and their potential future applications in optics and electronics.

Crocker marvels at the history of the School and his role in the future of CBE education and research. Poised at a new frontier of cell biology science and excited to cultivate the next generation of chemical and biomolecular engineers, Crocker represents much more than the two words “squishy stuff” imply. He is part of the vibrant tapestry of learning, teaching, innovation and discovery that is unique to Penn Engineering. 🌐
HARRIS ROMANOFF’S OFFICE AT WORK IS TIDY AND UNCLUTTERED.

HARRIS ROMANOFF

A PASSION FOR ORDER

BUT ROMANOFF’S HOME WORKSHOP IS MESSY, THE EMBODIMENT OF HIS CREATIVE MIND.
HARRIS ROMANOFF’S office at work is tidy and uncluttered. That is what you would expect from a 1999 Penn Engineering graduate who is the EVP of Engineering at a company that helps people get organized. NeatReceipts, and its outgrowth, NeatDesk, is a scanner and digital-filing system that assists people, especially small-business owners, in achieving the often impossible goal of clearing their desks.

But Romanoff’s home workshop is messy, the embodiment of his creative mind. “I like a lot of things out so I can see them,” he says. It is here that Romanoff salvages parts from discarded consumer electronic products, like an old inkjet printer or DVD player, and transforms them into something new.

A lifelong practitioner of disassembling and reassembling, Romanoff began at Penn as a pre-med student, but found himself stimulated by conversations with engineering majors. In a likely next step, he switched to majoring in bioengineering, and then transitioned to electrical engineering because he felt it was where he could combine and express his three passions: creativity, engineering and human interaction. Working at the GRASP Lab in robotics as an undergraduate helped Romanoff sharpen his focus.

As an undergraduate, Romanoff also started a business to provide unique lighting for the numerous dot-com launch events of the late 90s. His equipment was made from the flotsam and jetsam of college life, including discarded fans left on campus when students left for the summer and empty beer cans. “It was a great entrepreneurial experience,” he recalls, which provided his first real taste of product development.

Upon graduation, Romanoff visited California, hoping to find employment in the entertainment-electronics and animatronics industry. When he saw firsthand how rapidly the industry was transitioning to digital animation, he came back to Philadelphia and took a job as an electrical engineer at Ballinger, an architecture and design firm. “While I worked there I found I was very interested in entrepreneurship,” he says. “I wanted to learn more about business and how to get products ‘out there.’”

Which is what he did, working next as a business analyst and software engineer at Strategic Management Group, a company that develops simulation software to teach business strategy. “I know our product is just a paper scanner and some software,” he says. “We are not saving the world or curing cancer.” But when Romanoff hears from grateful customers, he realizes his work is indeed valuable. For instance, a man whose business was washed away in Hurricane Katrina was reimbursed by his insurance company only because NeatReceipts could provide a copy of his receipts.

At this point in his career, Romanoff is humbled by the prospect of winning the Young Alumni Award of Merit later this year. “It is gratifying to think my work is viewed so positively. The award is a nice nod that I’m doing things right.”
In Dan Gianola’s universe, the Earth is about the size of a marble.
Daniel Gianola is working at the nanoscale, with materials that are about a thousand times smaller than the diameter of a human hair. Using a sophisticated set of electron microscopes and his talent for developing novel ways to manipulate and test samples, Gianola is discovering uncommon properties, such as deformation at or near theoretical strengths, and forging new understandings about the relations between atomic structure and performance of materials at the nanoscale.

“A lot of science is about seeing how far you can go, and exploring extreme outer regions, where distance is measured in light-years,” says Gianola, Skirkanich Assistant Professor of Materials Science and Engineering (MSE). “What we’re doing is the opposite. We’re trying to see what’s on the inner edges. What happens when you go below an atom? And how can we, as engineers, exploit that? Can we design new materials with new functionality and new properties?”

Gianola, a mechanical engineer with degrees from the University of Wisconsin-Madison and Johns Hopkins University, arrived at Penn in the summer of 2009. He brought with him innovative techniques and experimental tools that he’d developed during his Ph.D. research and his work as an Alexander von Humboldt postdoctoral fellow in Karlsruhe, Germany. The results of his research into the mechanical behaviors of nanowires and nanocrystalline materials are proving significant to the engineering of small devices such as thin films, integrated circuits, micro- and nanoelectromechanical systems (MEMS and NEMS), and advanced power devices.

At Penn, Gianola is designing and conducting experiments in situ—inside electron microscopes. “It’s what we see as a frontier,” he says, “We devise a test to stretch something, or pass a current through a sample, or heat it inside the microscope. This allows us to see simultaneously the atomic scale structure, how atoms are packed, and how they’re modified by the influence of the test. We want to see those dynamics.” The ability to concurrently image and run an experiment—to view and measure shifts in atoms that might cause defects, or to catch the point at which a dynamic behavior manifests itself—is reducing some of the educated guesswork of interpreting results. “It’s like having box seats to a baseball game instead of listening to play-by-play action on the radio,” Gianola explains. “Now you can watch the action and see what’s going on.”

Penn’s electron microscopes contain a series of electromagnetic lenses that focus electrons generated within the microscope down a column at a fraction of the speed of light, shortening their wavelengths and enabling magnification anywhere from one thousand to two million times or more. These microscopes are equipped with what are unofficially but universally known as some very cool tools. A focused ion beam functions like a pair of scissors to remove material at the atomic level; targeted deposits of metals, delivered by organometallic molecules and decomposed by focused electron and ion beams are used to bond or tape materials together; gas chemistry can be introduced within the microscope’s chamber to react with the material; and teleoperated controls and computer code written by Gianola and his students regulate the conditions of the experiment and capture results. Yet another tool, a state-of-the-art environmental scanning electron microscope makes it possible to change the temperature, relative humidity, and pressure regimes inside the chamber so that tests can be run in a variety of environmental conditions, which is necessary to test many materials whose properties are very sensitive to their environments.

In a lab where three hours is the time to beat when it comes to moving five nanowires into position in a microscope, one of Gianola’s goals is higher throughput, economizing on materials and time and maximizing the outcome of experiments. He and his group leverage common forces and interactions in unique ways to manipulate nanomaterials. For instance, piezoelectric motors, which are controlled by a voltage that can stretch and contract atomic bonds, precisely control the position of a tiny tip attached to a robotic arm to harvest nanomaterials. “This is like grabbing the Golden Gate Bridge at one end and maneuvering it to pick up a toothpick at the other end,” comments Gianola. Another example includes nanowires which, given their mass (or relative lack thereof), are not swayed by gravity, and the group is experimenting with electric fields to coax nanomaterials into position. One approach is dielectrophoresis, the application of an alternating electric field that will interact with nanoparticles and drive them to a device.
“It’s not gravity, it’s not our fingers,” Gianola says of the techniques known as self-assembly. “It’s letting these natural, or somewhat synthetic forces interact with the material while we have our hands behind our backs. If we’re clever enough as engineers, we can figure out just how to design our system so that materials go just where we want them to.” Further increasing throughput for experiments, Gianola and his students are developing combinatorial techniques that will help them produce more data by using a gradient of chemistry to test properties across a single sample.

When he’s not working on his own experiments, Gianola is in the classroom and the lab with his undergraduate and graduate students. “Dan is particularly adept at developing new platforms for simultaneous testing and observation of his materials,” says Peter K. Davies, Professor and Chair of MSE. “He’s a superb communicator and teacher, with a natural gift for explaining complex phenomena in an intuitive and easy way. And he’s already a big hit with our students.” In addition to an upper-level class on the mechanical behavior of materials, Gianola teaches an undergraduate nanoscale materials lab, centered around experiments that cover the fundamental concepts of materials science. “I try to keep one foot in the lab,” Gianola explains, “because I love it and because my students run into so many challenges along the way. If I’m too distant from it, I don’t think I’d be an effective advisor for them.”

Demonstrating the patience required of a nanomechanical engineer, Gianola estimates that the results of his lab work will be evident in the mainstream within a few decades. “A lot of what we do is really trying to uncover new fundamental insights that will spur innovation down the road,” he says. Many of tomorrow’s advances in energy generation and conversion and computer memory devices will be traced back to Dan Gianola’s laboratory.

USING A SOPHISTICATED SET OF ELECTRON MICROSCOPES AND HIS TALENT FOR DEVELOPING NOVEL WAYS TO MANIPULATE AND TEST SAMPLES, GIANOLA IS DISCOVERING UNCOMMON PROPERTIES, SUCH AS DEFORMATION AT OR NEAR THEORETICAL STRENGTHS, AND FORGING NEW UNDERSTANDINGS ABOUT THE RELATIONS BETWEEN ATOMIC STRUCTURE AND PERFORMANCE OF MATERIALS AT THE NANOSCALE.
**PENN ENGINEERING**

Do you want to make a real difference in an undergraduate’s life? The Penn Engineering Mentoring Program seeks alumni who are interested in mentoring first-year undergraduate engineering students to:

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The time commitment is minimal, but the rewards can be enormous. For more information and to register, visit [www.seas.upenn.edu/alumni/events/mentoring.html](http://www.seas.upenn.edu/alumni/events/mentoring.html).

**OTHER WAYS TO GET INVOLVED**

The Engineering Alumni Society offers alumni many other great opportunities for getting involved with the School and the University at large. For more information, visit our website at [www.seas.upenn.edu/alumni/alumnisociety/index.html](http://www.seas.upenn.edu/alumni/alumnisociety/index.html).

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The young women of Penn’s Society of Women Engineers (SWE) are dedicated to promoting the presence of women in engineering. Mirroring the national parent organization, they run a multifaceted, nonprofit program that offers young women (and men!) opportunities for outreach, advocacy, professional networking and fun.

Now completing its 60th year, the national Society of Women Engineers held its first formal gathering in May 1950 at The Cooper Union’s Green Camp located in New Jersey. Approximately 65 engineering graduates and students from the East Coast were present. (By contrast, SWE at Penn can claim a head count of 60 or more in its general body meetings.) During this meeting, Beatrice A. Hicks was elected the Society’s first president. A pioneer for women in engineering, Hicks was the first female employee of Western Electric and later became president and chief engineer of Newark Controls Company. Under Hicks’ leadership, the Society embraced “achievement” as part of the triad of its stated mission: Aspire-Advance-Achieve. But even as more schools began admitting female engineering students, women’s stature in the professional realm remained static. Advancement did not come easily, no matter how high their aspirations. Consequently, SWE members came to understand the usefulness of mentorship early on, and in 1952, they issued their first career guidance publication. Two years later, SWE instituted student chapters to interface with their founding professional groups, creating a successful synergy that spread across the country.

Beth Winkelstein, BSE ’93, faculty advisor for the last seven years to Penn’s chapter of SWE, credits the longevity of her leadership to the highly-motivated and capable young women of Penn Engineering. Oversight of SWE has been a unique and enjoyable addition to Winkelstein’s rigorous schedule as an award-winning researcher and associate professor in both Bioengineering and Neurosurgery at Penn.

Penn SWE is proud of its historical roots in the organization’s charter region, and Penn members were delighted to have won the privilege of hosting the Mid-Atlantic Regional Conference, SWE@60: A Strong Foundation for Engineering Success. The
event was held on both the Penn campus and the Sheraton University City Hotel. The three-day gathering unfolded without a hitch, and showcased the range of SWE’s core issues and group goals. As hosts, Penn SWE gained national recognition and welcomed close to 350 attendees and 100 volunteers.

Melissa Cedarholm, bioengineering major and student co-chair, attributed the overall high marks for the conference to the “phenomenal engineers,” including Penn Engineering former dean and Alfred Fitler Moore Professor of Engineering Joseph Bordogna, who addressed the group. The keynote speaker was Alma Kuppinger Forman, described by Melissa as one of SWE’s “founding mothers.” The first woman at the Drexel Institute of Technology (now Drexel University) to receive a degree in civil engineering, Forman is a charter member of SWE and its Philadelphia Section.

Forman was the first SWE Regional Conference Chair and presided over the first Eastern Regional Conference—held in none other than Houston Hall—in 1949. She received a standing ovation at the Saturday welcoming session, attesting to the present members’ respect for their intellectual heritage. Nominated by the Philadelphia Section, Forman will soon be honored as a SWE Fellow.
Like Melissa, Sheetal Rajagopal, Penn SWE’s president, is another multitasker, seemingly in perpetual motion. Sheetal, who majors in chemical and biomolecular engineering (CBE), is an avid recreational distance runner who has competed in local races, and is on the Student Advisory Board of Advancing Women in Engineering (AWE) at Penn (See Penn Engineering, Fall 2008). Sheetal and Melissa are roommates and the high regard with which they speak of one another is a testament to SWE’s power to deepen relationships and generate mutual respect among young women.

With the bar raised high by the Regional Conference, Sheetal is now gearing up for the organization’s annual capstone event at SEAS, the SWE Corporate Dinner. While male attendance is somewhat unpredictable at gatherings throughout the year, the dinner, to be held at the Hilton Inn at Penn in February, is one event at which SEAS men always show up in numbers equal to women. Accordingly, the female members of SWE find it a perfect opportunity to demonstrate their talents as students, organizers, and future professionals, gaining a great deal of recognition and respect from their male peers.

Corporate sponsors and attendees have, in the past, included Merck, L’Oreal, Microsoft, Accenture and SIG, and company representatives and students network throughout the evening. Matches between students and corporate representatives are made via an online resume book, and the dinner has resulted in many summer internships and full-time positions for Penn Engineering students.

One graduate student who will be in attendance is Alexis Wallen, a Ph.D. candidate in CBE at Penn. Alexis has experienced the academic-corporate interface from both sides, having served as the Professional Chair for the Regional Conference in March and currently serving as Penn SWE’s Professional Counselor. She was active in SWE as an undergraduate at Stanford, the alma mater she shares with Penn SWE’s new faculty advisor, Skirkanich Assistant Professor of Innovation Katherine Kuchenbecker.

After graduating from Stanford, Alexis spent five years as a chemical engineering researcher at Merck. She aspired to make more of an impact in her field and returned to academia at Penn for advanced study. She received her master’s in 2008, and is in her third year of CBE doctoral studies. During this time, Alexis has been enthusiastically involved in SWE outreach and is passionate about inspiring women from “K to College” to envision engineering in their futures.

Bringing other young women into the vital and expanding network of female engineering students at Penn, both socially and academically, is a priority shared by Melissa, Sheetal, Alexis and the faculty advisors of SWE. Mentoring is central to the organization’s dynamic, and occurs naturally and informally. Passing along advice, forming enduring friendships, and advancing professionally is what the SWE life at Penn is all about.
David Lyman: Capitalizing on Social Media

David Lyman, EAS ’03, and his best friend Mark Schmulen, C ’03, always knew they would start a business together. But it took a circuitous route from Houston to Philadelphia to Ghana and back before the business was born.

Lyman and Schmulen co-founded NutshellMail, a free web-based service that aggregates activity from multiple social networks into one email digest. Their shared ‘a-ha’ moment was based on a common need to productively access and manage personal email and social network accounts through one inbox. They invented NutshellMail to simultaneously improve productivity and enable access to personal messages in the workplace in a way that would not violate or compromise most corporate IT policies.

“We started throwing around a lot of ideas after graduation; I was in Houston working for Accenture and Mark was in New York working for JPMorgan Chase,” says Lyman. By 2007, the pair regrouped in Houston and left their jobs to work full-time developing the concept that would become NutshellMail. “We self-funded the business and raised a small seed round from our families,” explains Lyman. The pair was then joined by Lyman’s EE lab partner, Nirav Batavia. Three years later Constant Contact® purchased the enterprise.

At cursory glance, the team’s ascent into successful entrepreneurship was meteoric, but retrospect shows patience, hard work and flexibility. “Technology startups rarely experience a smooth path from initial vision to successful business. More typically, you throw something out to the world, see what people like and pivot in that direction,” he says. “The three years before selling to Constant Contact® were extremely challenging but exciting.” The friends are now set to lead the West Coast operations of the company and will play a key role in helping the company achieve its mission of making social media marketing simple for small businesses.

“One of the reasons why Mark and I were so excited about joining Constant Contact® is that we were impressed with CEO Gail Goodman, another Penn grad,” says Lyman. Engineering skill was critical in laying the foundation for NutshellMail, as well as refining the model, Lyman adds. “Engineers are taught to explore and have the confidence to break out of their comfort zone; that is a critical mentality within a startup.”

Lyman credits his Penn experience, especially the time he spent in a summer program in Ghana and his Senior Design project, as the foundational elements of his success. In Ghana, Lyman led a group of students in the University’s digital divide initiative, teaching trainers about basic computer use, system administration and computer maintenance. “The Ghana trip had a lot of logistical problems that were out of our control, and I learned that when things are going poorly, you had to work harder and dig yourself (and your team) out of the hole. My EE Senior Design project (a vestibular rehabilitation controller) taught me that you can come up with an idea and then figure out how to execute it.”

Also critical to the team’s success was the mentoring they received along their entrepreneurial way. “The help and advice was invaluable, so we like to give back however we can,” he says, adding that he enjoys talking with future entrepreneurs and sharing insight. “Teaching is a great way to continue learning.”

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ENGINEERING DELIVERS THE ADVANTAGE IN protecting children
“Susan's work is yet another outstanding Penn example of merging engineering with medicine. It is rare for individuals to have the background necessary to attack and solve these types of complex medical problems, and Susan is a model for building a research program with important societal impact,” says David Meaney, Solomon R. Pollack Professor and Chair of Bioengineering.

Susan Margulies seeks to determine the mechanisms of injury to enhance diagnosis and treatment of head trauma in children.

A tumble down the stairs, a fall from a bike, a jerked arm or an abusive strike are all actions that can cause traumatic brain injury (TBI) in children. One million children in the United States sustain TBIs annually, sending 165,000 children to the hospital. According to the National Center for Injury Prevention and Control, TBI is one of the leading causes of acquired disability and death in infants and children. It’s those horrific outcomes that Susan Margulies, professor of Bioengineering and Neurosurgery, is in the business of preventing.

“I first studied the different types of injuries in children at different ages and under various circumstances as a graduate student. I learned that there are gaps in our understanding of the biomechanics of pediatric injury and children’s tolerance to withstand forces of impact. When we become successful at determining the mechanism of injury, we can enhance diagnosis and treatment—an incredibly important goal,” Margulies says.

A blow to the head—adult or child—causes movement of the brain. The impact and movement can injure brain cells, nerves and blood vessels, which in turn can negatively affect short- and long-term physical, mental, social and emotional abilities. While it is evident that children’s heads are smaller and their tissues are different from adult tissues, Margulies’ research shows that a child’s physiological response to head trauma is different from that of an adult.

“Susan’s work is pivotal for understanding how to treat and prevent devastating injuries in children,” says David Meaney, Solomon R. Pollack Professor and Chair of the Department of Bioengineering. “Brain injuries are considered a silent epidemic in our society, and children suffering traumatic brain injuries face a lifetime of recovery. Susan’s research will contribute to improving treatments to help the recovery process, and will also establish guidelines on how to protect children from suffering these injuries in the first place.”

Much of the work evaluating the causes of injury and developing preventive measures and treatment is a product of Margulies’ leadership of the Injury Biomechanics Lab. “This is where we work to understand what happens inside a child’s head during rapid rotations and impact,” she says.

Margulies and her team employ an integrated experimental approach toward understanding of pediatric injury: the team uses animal studies, computer modeling and anthropomorphic dolls equipped with sensors to estimate diffuse patterns of strain and injury in infants. Funded by the National Institutes of Health, the U.S. Department of Transportation and the Centers for Disease Control and Prevention, her research has implications for the design of protective equipment for children, how health practitioners diagnose and treat children who have suffered TBI, and how social workers and medical professionals distinguish between accidents and violence-related injuries.
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As seminal as her work is in the protection of children, Margulies sees it simply as a product of good engineering. “As an engineer, I try to use basic discovery and translate that to real-world applications,” she says.

Key to the success of her research is the collaborative approach she has cultivated over 17 years with fellow engineers, physicians, forensic pediatricians and social workers. Engineering and clinical students, staff and postgraduate trainees meet with Margulies almost every Friday afternoon to discuss recent research findings and to plan new studies that will give insight into TBI in children.
“The medical professionals are my heroes. They are the ones who are faced with constantly making life-altering decisions,” says Margulies. “It is the physicians who must decide to send an injured child home with parents or call social services. If they miss signs of abuse, they risk sending a child home to a dangerous environment; if they report abuse where there is none, they risk tearing a family apart.”

Cindy W. Christian, M.D., The Children’s Hospital of Philadelphia Endowed Chair in Prevention of Child Abuse and Neglect, is one of Margulies’ valued colleagues and collaborators. “I’ve been working with Susan for over a decade, and our collaboration has been a rich way to approach the problem of pediatric head trauma,” she says. “While bioengineering has advanced all aspects of our work, Susan’s work is different. It helps inform what we understand about abusive and accidental head trauma.”

Margulies is as engaged in the classroom as she is dedicated to collaborative research and enjoys the balance that teaching brings to research. “With research, it takes a long time to get answers to questions and then see the rewards. When I teach, I get to see the light bulb go off for a student who grasps a concept and applies it to their understanding of how the world works,” she says.

Balancing teaching and research seems to come naturally to Margulies and is a skill appreciated by her colleagues. “In spite of the countless hours spent on teaching and advising, she is an incredibly successful researcher,” says Vijay Kumar, Deputy Dean for Education at Penn Engineering. “Top researchers bring something special with them to the classroom, and this is clearly the case with Susan. Indeed, the number of young undergraduate researchers she has mentored and trained over the years speaks to this special ability.”

“Susan is an incredible mentor to her colleagues and to the students in her lab,” says Christian. “She has a wonderful approach to teaching and is quite unique.” This skill is further evidenced by the awards she has garnered: the S. Reid Warren Jr. Award for outstanding service in stimulating and guiding the intellectual development of undergraduate students and the Ford Motor Company Award for Faculty Advising, which recognizes dedication to helping students realize their educational, career and personal goals.

“Both awards are special because the candidates are selected by students without any input from faculty or administrators,” says Kumar. “It is clear that students like and respect her. It’s not only because she is a gifted educator, but because she cares deeply about her students. As an advisor, she gets students to share their interests and career goals. This requires an extraordinary commitment and the ability to establish a personal rapport that is quite difficult to achieve.”

Kenneth Cavanaugh, chief of the Peripheral Vascular Devices branch of the Food and Drug Administration (FDA), concurs. He worked with Margulies in the Injury Biomechanics Lab as a graduate student. “Susan understands that great professors not only have productive research programs, but also devote appropriate time to their classroom responsibilities. Susan always took her teaching assignments seriously,” he says.

Margulies’ emphasis on skill development has served Cavanaugh well, and it’s an outcome of Margulies’ mentorship that he continues to appreciate. “This past year, we hired another Ph.D. graduate from Susan’s lab, whose performance so far at the FDA has been exemplary and is a further testament to Susan’s ability to instill highly sought-after professional skills in her students,” he says.

For Margulies, teaching, mentoring and researching at Penn Engineering deliver exactly what she desires professionally. “I made my choice to come to Penn because I wanted to be part of an excellent bioengineering department associated with a nationally-recognized medical school. I wanted to take part in an environment that cultivated and supported collaboration,” she says. “Plus, I wanted to combine the immediate gratifications of teaching with the long-term deep satisfactions of research. For me, every aspect continues to be rewarding.”
John L. Bassani studies some of nature’s most fundamental relationships. Exploring atomic connections in a macroscopic world, his research links ideas from different fields. His leadership brings scholars from these domains together to strengthen Penn Engineering’s Department of Mechanical Engineering and Applied Mechanics (MEAM), where he has served as chairman for over ten years.

Bassani, the Richard H. and S. L. Gabel Professor of Mechanical Engineering, began working at Penn 30 years ago. He has seen many changes in his field, but one thing has remained constant. “My work has always been highly interdisciplinary,” says Bassani. After earning an undergraduate degree at Lehigh University, he worked on the prototype for the A-10 Thunderbolt aircraft, also known as the Warthog. The aerospace experience sparked his fascination with the relationship between the physics of materials and mechanics. This interest led him back to Lehigh for his master’s degree, then on to Harvard University for a Ph.D.

As Bassani developed his own research, he continued to combine materials science and continuum mechanics, the branch of physics that treats materials as continuous matter. He applied both specialties to a range of problems such as plastic deformation, fracture of materials, and the formation of nanostructures. His investigations led him to approach questions at the atomic scale.

More recently, Bassani has begun to explore cellular adhesion, or what brings living cells together to form tissues. “Most cells except blood cells are only happy when they are adhered to other cells,” says Bassani. Behind his friendly description of this phenomenon are years of theoretical research involving nanotechnology and biomechanics. He draws from another
discipline, computational modeling, to analyze his findings. Bassani hopes his probing of fundamental behaviors of living systems will lead experimental researchers toward treatments of diseases such as cancer.

Zooming out from the atomic scale to the administrative level, the Department of Mechanical Engineering and Applied Mechanics is no cluster of clinging cells. It is a team of thinkers from a range of realms collaborating under Bassani’s leadership. His experience working across disciplines informs his guidance of MEAM, and he calls mechanical engineering the broadest of the engineering disciplines. “One measure of this is basically every industry employs mechanical engineers,” he says. “Many industries underwent economic and technological upheavals as the century turned, and the attitudes of would-be mechanical engineers changed as well.”

MEAM keeps pace with these shifts by recruiting faculty across various fields, including physics, chemical engineering, and computer science. MEAM researchers are building on the longstanding strength of Penn Engineering’s robotics, materials science, and bioengineering programs with contributions in nanotechnology, biomechanics and haptics, the technology of touch. MEAM’s emerging energy-related initiatives will round out its programs. “This country was pretty much asleep for almost 25 years when it came to energy, but we are starting to wake up,” Bassani says. He finds satisfaction in helping fellow scientists and engineers address critical issues of the day.

Bassani also enjoys supporting educators as they engage today’s students. “From freshman year onward, students spend a lot of time in the lab doing experimentation as well as design-oriented work,” says Bassani. He teaches MEAM 110, Introduction to Engineering Mechanics, so he knows that hands-on learning excites young minds. He notes that the Integrated Product Design (IPD) master’s program also exposes scholars at all levels to finding solutions to practical problems.

With new programs and new hires, enrollment in MEAM has doubled since Bassani became chair. As of September 2010, there are over 250 undergraduate students and 179 master’s and doctoral degree candidates in the program. Like a successful life form in a challenging environment, MEAM under Bassani’s leadership has adapted to its surroundings and continues to grow. ☑
Robert Riggleman, Assistant Professor in Chemical and Biomolecular Engineering

Robert Riggleman, Assistant Professor in Chemical and Biomolecular Engineering, has been awarded the 2010 NIH Director’s New Innovator Award from the National Institutes of Health (NIH), providing $1.5 million over five years to support his research in improving biological imaging using nanotechnology. The awards are given by the NIH to stimulate highly innovative research that has the potential for significant impact, and to support promising early stage investigators who propose bold new approaches that have the potential to produce a major impact on a broad area of biomedical or behavioral research.

Dr. Riggleman’s research is focused on employed molecular modeling techniques to describe the material properties and phase behavior of polymeric systems. In particular, he is interested in how nanoscale confinement affects the properties of both polymeric and low molecular weight glass-forming organic materials. Additionally, he studies the overcharging (charge inversion) of colloidal particles with oppositely charged polymers and exploiting this phenomenon to drive self-assembly.

Alejandro Ribeiro, Assistant Professor in Electrical and Systems Engineering, has received a prestigious National Science Foundation CAREER Award for his research “Towards a Formal Theory of Wireless Networking.”

David Pope, Professor in Materials Science and Engineering, will be honored at the 2011 Annual Meeting of the Minerals, Metals & Materials Society. A symposium on “Fundamentals of Deformation and Fracture of Advanced Metals” will celebrate Dr. Pope’s legacy and influence in the field.

The University of Michigan recently honored Penn Engineering Professor Emeritus Stuart W. Churchill by creating the Stuart W. Churchill Collegiate Chair in Chemical Engineering. University of Michigan Professor Sharon Glotzer was installed as the inaugural Churchill Chair and presented a lecture “Assembly Engineering: The Shape(s) of Things to Come.” The festivities included a 90th birthday celebration in Dr. Churchill’s honor. Eleven of his former doctoral students were in attendance. At the dinner, Dean Eduardo Glandt presented the opening toast to Professor Glotzer and Professor Churchill. The American Institute of Chemical Engineers was represented by its current President, Hank Kohlbrand of the Dow Chemical Company. The faculty of the University of Pennsylvania Department of Chemical and Biomolecular Engineering presented Dr. Churchill with a photo montage of his 43 years at Penn.

The American Institute of Architects presented an honor award for architecture to Skirkanich Hall “for excellence in architectural design.”
Krishna P. Singh Center for Nanotechnology

Groundbreaking ceremonies for the $80 million Krishna P. Singh Center for Nanotechnology are set for February 17, 2011 to coincide with the spring meeting of the University Trustees. The Singh Center will serve as a prominent gateway to the eastern edge of Penn's campus and will usher in a new era of nanotechnology research for the University and the region. Completion is slated for the spring of 2013.

Made possible by a $20 million naming gift from Dr. Krishna Singh, a Penn alumnus and Engineering Overseer, the center will house microscopy labs, 10,000 square feet of environmentally-controlled clean rooms, general labs and optics labs for research and collaboration spaces. The building will provide needed facilities to nanotechnologists from Penn Engineering and the School of Arts and Sciences, allowing for the exchange and integration of knowledge that characterizes the study of this emerging field. Dr. Singh is the founder, president and chief executive officer of the energy-technology company Holtec International based in Marlton, N.J.

With the gift from Dr. Singh, the School has secured a total of $68 million in committed funds for the facility, with the remaining funds to be raised through donor contributions and naming opportunities (see inset).

“The Singh Center for Nanotechnology will be one of the largest nanotechnology facilities in close proximity to a world-class medical school,” says George Pappas, Deputy Dean for Research and Joseph Moore Professor of Electrical and Systems Engineering. “This will make Penn a nationwide leader in exploring medical applications of nanotechnology. Furthermore, as this will be a state-of-the-art facility in the broader region, it will be an ideal facility for companies, large or small, to venture into this transformative technology.”
As Director of Development, Eleanor “Ellie” Brown Davis fosters relationships, enhancing Penn Engineering’s core mission and strengthening ties within the vast network of the School’s alumni and friends.

What is your day-to-day role as Director of Development?
I work closely with the Dean, the Vice Dean for External Affairs, faculty and senior staff to advance the School’s academic mission. The role of development within the School is to work with our alumni, parents and friends to increase their involvement and support of Penn Engineering. I have a deep appreciation for all areas of development and alumni relations and value every role in our office. We have a great team and each person contributes to our success.

What is your key responsibility?
My primary focus is fundraising. I spend a great deal of time identifying and reaching out to our alumni to support the School’s strategic priorities: undergraduate and graduate student aid, creation of scholarly chairs, and construction and renovation of buildings and laboratories. I am always “on the road,” visiting with alumni to provide updates on School initiatives, learning about each Penn Engineering experience, facilitating ways to become engaged with the School, and making someone’s vision become a reality.

Can you describe the traits that characterize our alumni?
They love Penn Engineering, truly value and appreciate their educational experiences, and are particularly proud of the remarkable transformation of the engineering complex under Dean Glandt’s tenure. Our alumni are eager to get involved and it is easy for me to share the news of the School. I believe so strongly in our mission and the School’s leadership.

Have you always worked in this field? What is the most satisfying part of your job?
Before arriving at Penn Engineering five years ago, I held various development positions in academia, including Director of Major Gifts at Penn Law. The relationships I have cultivated at Penn are a very rewarding part of the job. It is wonderful to be a part of our donors’ important life events, whether it is the birth of a child or an acceptance to college. I think I get nearly as excited as they do!

Your job takes you to some interesting places. Where is your favorite destination?
I spend a good deal of time with alumni in New England; I grew up in Boston and it is one of my favorite cities. The establishment of the Dean’s Advisory Committee has proven to be a tremendous opportunity to engage alumni in the Boston area. The members meet annually and it is a great way to strengthen our relationships with many of our alumni leaders in the region. 🗽
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