



Penn Engineering

“The most impressive
new design in the city”



Krishna P. Singh Center for Nanotechnology

“The Singh Center will become a hub for the intellectual side of nanotechnology. New ideas, created through fostered collaboration, will emerge because Penn has created this nanotechnology nexus on campus.”

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Krishna P. Singh Center for Nanotechnology
Stunning New Laboratory Showcases Technological Innovation, Inside and Out



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Pride of Place

At long last, the day arrived! Penn's stunning Krishna P. Singh Center for Nanotechnology was dedicated on the 4th of October. Overseer and Trustee Kris Singh defines himself as "the product of the philanthropy of others." His words about Penn's impact on his life electrified the hundreds of alumni and friends who joined us for the joyful event. The next pages are an attempt at providing a view of this spectacular facility. Any glimpse in print is of course limited, but I know you will find it impressive.

Having access to the fabrication and characterization facilities built into this laboratory represents a turning point for Penn Engineering. The Singh Center is empowering our students and faculty to develop devices and prototypes and to carry out experiments at length scales not previously accessible. As technology continues to evolve on an irreversible and accelerating path towards miniaturization, our laboratories had to evolve as well. We came as far as we could in retrofitting our venerable old buildings, which although beloved, were originally designed for very different purposes. Once we reached the point when experiments focusing on individual atoms or molecules

couldn't tolerate the slightest vibration or the most tenuous speck of dust, the Singh Center became an imperative for the School.

Advanced, impactful and elegant, the Singh Center is still only a means to an end: attracting and serving the needs of the best students and faculty. In these pages you will read about one example—the arrival of Mark Allen as director of this facility and the Alfred Fitler Moore Professor of Electrical and Systems Engineering. Mark, one of the country's foremost authorities in micro- and nanofabrication, has returned to his alma mater, bringing with him expertise from years of running an impressive facility at Georgia Tech. These are very complex and expensive operations; it is good to know that ours is in such great hands.

This issue, like the ones that have preceded it, will show the breathtaking scope of the activities of our students, faculty and alumni. Don't miss Titan Arm (page 26), a project that received the 2013 international James Dyson Award for design. We are constantly stimulated by such happenings. Please visit us soon and experience the excitement! 🇺🇸

Krishna P. Singh Center for Nanotechnology

**Stunning New Laboratory Showcases
Technological Innovation, Inside and Out**

By Amy Biemiller



The vibrant, centralized public spaces in the Singh Center were designed with collaboration in mind. Here, scientists in engineering, chemistry and physics work together to advance fundamental research and commercial applications.

The Krishna P. Singh Center for Nanotechnology is unforgettable. One hundred thousand square feet of pleated metal, pattern-etched glass, and a third floor cantilevered above a cleverly crafted green space leave no doubt: This building, with its present-day purpose and a futuristic perspective, is designed to stimulate scientific efforts that are already advancing nanoscience.

“The building’s architecture is not just a marvelous design statement, but it also makes accommodation for future initiatives,” says Eduardo Glandt, Nemirovsky Family Dean of Penn Engineering.

“From nanoparticle drug delivery and new materials for use in solar panels, to next-generation computer hardware, the research happening in the Singh Center is critical to advancing both fundamental discovery and commercial applications.”

Design for the building was shaped by very precise technical requirements and a goal to create a compelling campus identity for science and engineering, explain the Singh Center’s architects, Marion Weiss and Michael Manfredi.



“The Singh Center was an invitation to design across the gradient of the urban campus scale to the incredibly precise scale of nanotechnology,” says Weiss. “We were delighted with the challenge and are equally delighted by the result.”

Like the science conducted in the building, everything about the Singh Center pushes the envelope of creativity. The utmost in cleanroom and nanotech lab facilities sports an block-long marigold-colored glass wall that effectively protects the research from ultraviolet light, but also allows visitors to observe the scientific activity. Glass-enclosed conference rooms frame

green outdoor vistas. Even the spaces not visible to the public—such as the Nanoscale Characterization Facility sheltered deep underground from vibrational, acoustic and electromagnetic interference—incorporate architectural detail and natural light.

“In the concept and design of this building, we have succeeded in creating a beacon,” says Glandt. “Here, we welcome scientists and researchers from both the School of Engineering and Applied Science and the School of Arts and Sciences who work collaboratively with industry partners to prototype new nanoscale devices.”



Marigold-colored glass effectively protects research from ultraviolet light and gives passersby a warm glance into the advanced science performed within the Singh Center.

Celebrating Ingenuity and Vision

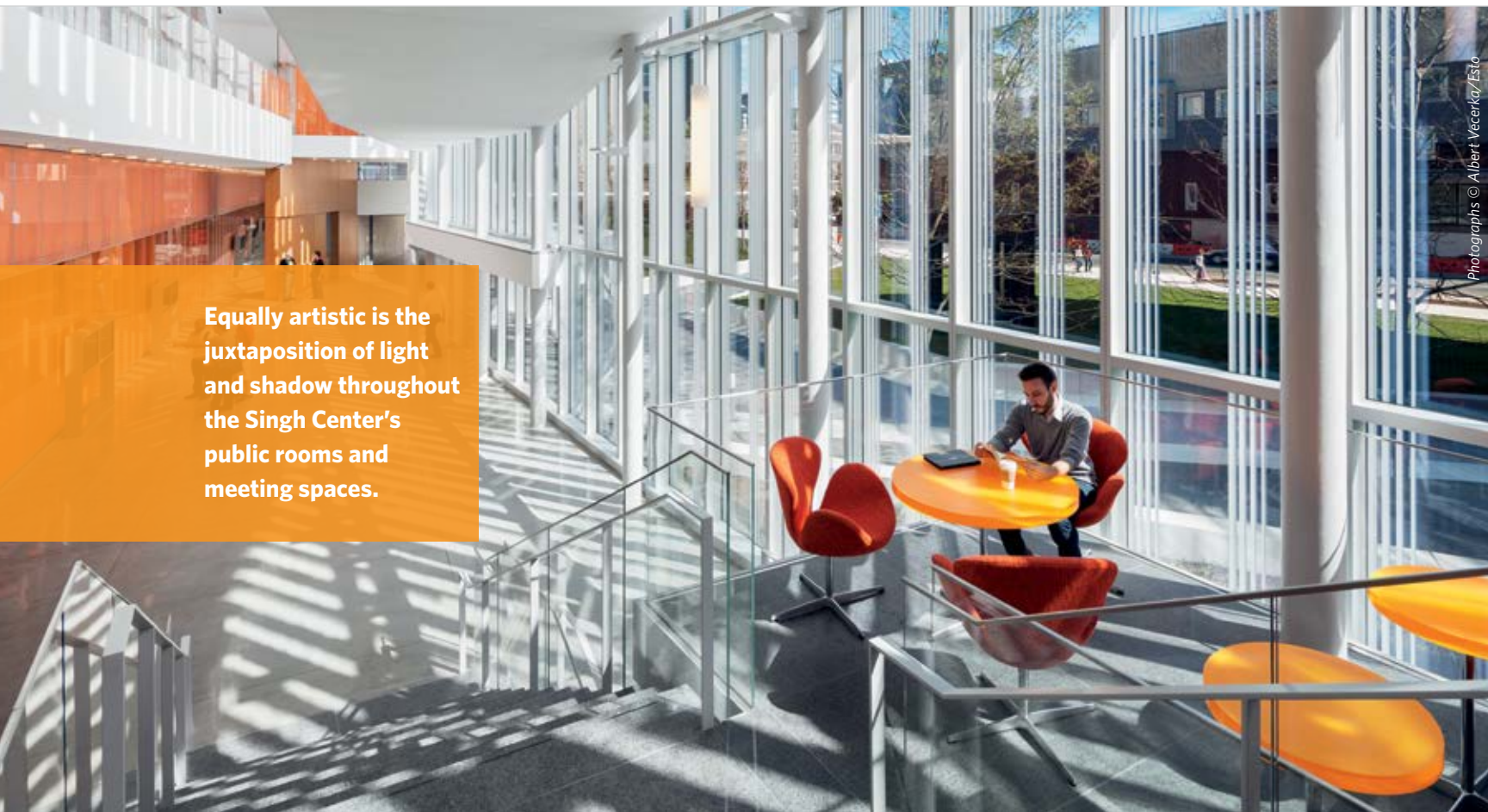
Sometimes, art imitates life. In the case of the Singh Center, it serves to inspire nanotechnology. Sculptures and paintings are thoughtfully installed throughout the building, beginning on the central green space bordering Walnut Street. There, visitors see American artist Tony Smith's *We Lost*, a 10-foot open cube of painted steel. Its mathematically inspired design last graced Penn's campus in 1999, when it was removed from College Green for conservation.

Inside, carefully selected artwork that enhances the various levels of the Singh Center includes Jaume Plensa's *Endless III*, a stainless steel seated subject crafted from an amalgamation of alphabet letters and symbols from a variety of cultures, located in the lobby near the Monumental Staircase; Hilla von Rebay's

abstract oil on canvas, *Gavotte*, outside the Glandt Forum; and Tommi Grönlund and Petteri Nisunen's kinetic sculpture, *Flow of Matter*, encompassing steel balls on an anodized aluminum plate, housed in the lobby of the Laboratory for Research on the Structure of Matter.

"These pieces serve to visually transition a visitor from the present to the future, inspire scientists to be creative and remind us that science is smart and interesting," says Glandt. "They celebrate ingenuity and vision, as does the science happening under this roof."

Equally artistic is the juxtaposition of light and shadow throughout the Singh Center's public rooms and meeting spaces, a particularly gratifying outcome for the building's architects. "There were many moments of satisfaction during this project," says Manfredi. "For



Equally artistic is the juxtaposition of light and shadow throughout the Singh Center's public rooms and meeting spaces.

instance, when the gallery stairs and etched glass were installed, we realized that the play of light and shadow in the building was more animated and kinetic than we had imagined. Natural light is so much more beautiful and surprising than can be depicted by even the most sophisticated computer renderings.”

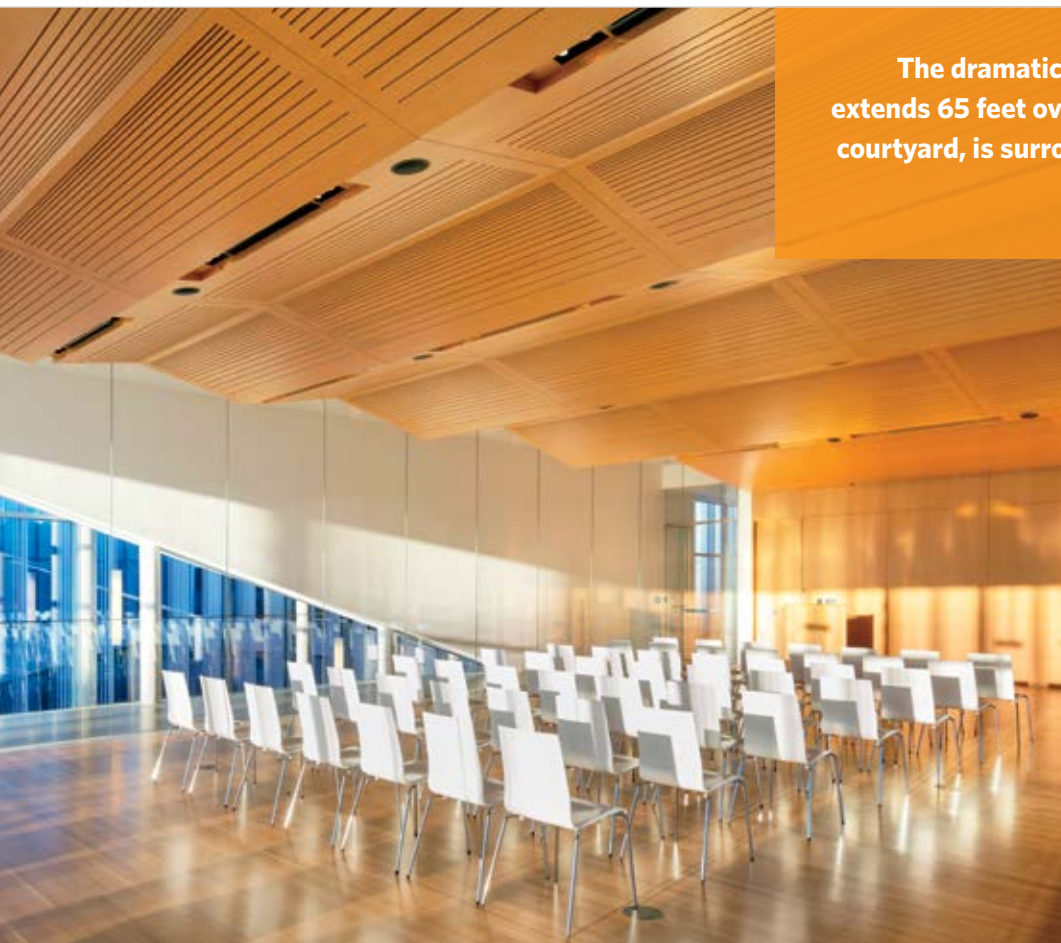
Light, air, space and energy fuel the collaboration that perpetually transpires throughout the building. “This building overflows with collaborative public space,” says David Hollenberg, University Architect. “Everywhere we could dedicate to gathering, we did. Stairwells, landings and nooks are all very purposefully crafted to incorporate views of the natural environment.” Even the third-floor green roof welcomes people to gather on its cedar boardwalk and at stainless steel tables

and chairs. From this vantage point, visitors have a clear view onto the central green space, and those on the green space can see up onto the roof, where native grasses and magnolia trees bloom.

Forward-thinking Donor

The building’s exuberant architecture is a long way from the childhood home with three rooms and dirt and concrete floors where Krishna P. Singh (M.S.’69, Ph.D.’72) grew up. Singh contributed the building’s \$20 million naming gift.

“The first time I saw the design, I was struck by its architectural majesty,” says Singh, who is the founder and Chief Executive Officer of Holtec International. “This building is shining evidence that my alma



The dramatic cantilevered Glandt Forum, which extends 65 feet over the Singh Center's ground-floor courtyard, is surrounded by glass on three sides and crowned with an oak ceiling.



Mark Allen

mater is poised to play an essential role in nanotechnology development, which has emerged as a critically important component of scientific advancement in this century.”

While Singh confesses a sense of satisfaction with the building that bears his name, he is quick to give credit to two others: University President Amy Gutmann and Dean Glandt.

“Mine is a small contribution among many who continue to support the University, but the true credit goes to Amy Gutmann and Eduardo Glandt,” he says. “Eduardo’s passion, energy and dedication to Penn Engineering, and Amy’s belief in the importance of engineering as a cornerstone of a world-class university were the impetus for this project. Amy’s and Eduardo’s commitment to strengthen Penn Engineering finds its utterance in this magnificent building.” 🍷



Penn's New Nano Idea Man

Mark G. Allen, the inaugural scientific director of the Singh Center, has big expectations for himself as well as for the science occurring in the building he now calls home.

"I believe that the Singh Center will become a hub for the intellectual side of nanotechnology; that new ideas, created through fostered collaboration, will emerge because Penn has created this nanotechnology nexus on campus," he says.

To help make that happen, Allen is actively pursuing three rigorous personal goals: successfully transitioning scientists and advanced equipment into the building; immersing himself in the nanotechnology initiatives already underway and identifying where those strengths can be further augmented; and smoothly migrating his own research group from Atlanta to Philadelphia. "We have an outstanding team working in the Singh Center, and I am highly confident that we can quickly acquire and install the suite of new, state-of-the-art tools that will give our researchers what a mentor of mine once called an 'unfair advantage' in nanotechnology," he explains.

To achieve his second goal of acquainting himself with the richness of nanotechnology research currently being performed at Penn, Allen is leveraging his natural skills in collaboration and ambassadorship. "I am meeting many new colleagues across campus and having stimulating discussions, some of which have already spawned some potential new research directions and collaborations," he says. "But there are many more people to meet and many more ideas to absorb and exchange over this first year."

Allen, who studied chemistry, chemical engineering and electrical engineering at Penn, is a pioneer in the field of micro-electromechanical systems (MEMS) and nanofabrication technology. Prior to being named scientific director of the Singh Center, he was the executive director of the Georgia Institute of Technology's Institute for Electronics and Nanotechnology.

As a researcher at heart, transitioning his own work from Atlanta to Philadelphia could be the most challenging of his goals.

"I do intend to keep an active nanotechnology research program of my own while helping the Singh Center realize its full potential," he says. "So my third goal involves transitioning people, infrastructure and ideas, and hybridizing those ideas and my former institution's research culture with Penn's," he says.

Allen is also Penn Engineering's Alfred Fidler Moore Professor of Electrical and Systems Engineering. With a full year of coursework and leadership activities already outlined, reflecting on his past as an undergraduate at Penn Engineering and then as a faculty member helps Allen gain perspective.

"I'd like to say that I planned all this out because micro- and later nanotechnology was my passion. But these fields were just emerging when I was an undergraduate at Penn," he says. "I was lucky that my chemistry and engineering background allowed me to grow and contribute as the emerging field of nanotechnology gained tremendous momentum."

Allen expects his transition from Atlanta to Philadelphia to be bittersweet. "It was not easy to leave my previous position at Georgia Tech. I started there just as it was emerging as a leading research institution, and in some ways I feel that we both grew up together," he explains. "But when I learned that Penn was planning to open a facility of the caliber of the Singh Center, with all of the potential opportunities it presented, I saw an interesting new path for my life—and one that had the additional benefit of coming home to my alma mater. Luckily my new colleagues at Penn felt the same way!" 🍷

GOOOOOOOAL!

Penn Wins at RoboCup 2013

By Patricia Hutchings

The UPennalizers, Penn's robotic soccer team, want a piece of the dream: By 2050, a soccer team of 11 robots will gather on the pitch in a match against the human World Champions—and win!

This ambitious mission was envisioned in 1997 by the organizers of RoboCup, a robotic soccer competition now held annually in venues around the globe. Penn's UPennalizers have been a steady, and in the past few years, dominant presence since 1999, with a short hiatus in '07 and '08.

In June, the UPennalizers travelled to Eindhoven, the Netherlands, for the week-long RoboCup 2013 competition. They were among 2,500 participants (3,500 if you count the robots), who were both their competitors and their collaborators in the long-range vision. Teams from 40 countries were in the mix, along with seven American colleges and universities, MIT and Carnegie Mellon among them.





Penn's Team DARwIn, a collaborative effort between Penn and Virginia Tech, emerged as the top team in RoboCup's Humanoid Kid-Size League. Kid-Size games are played between two teams of three autonomous robots, 30 to 60 centimeters in height. Designed in human form, a humanoid's "game face" masks Wi-Fi modules and wide-angle cameras that facilitate action.

Coaching in a Style as Relaxed as it is Effective

How did the UPennalizers manage to navigate the chaos of a competition this size and return to campus trophy-in-hand? Speaking for the team, Steve McGill, EE'10, GEN'11, and current Ph.D. candidate, cited the cool wisdom of their experienced faculty advisor, Daniel Lee, professor of Electrical and Systems Engineering, as

the UPennalizers' lodestar. Lee, also the director of the General Robotics, Automation, Sensing and Perception (GRASP) Lab and a trustee of the international RoboCup Federation, coaches in a style "as relaxed as it is effective."

Culture shock for the Penn team in Eindhoven was mitigated by a fortuitous connection initiated by a member of the Netherlands Wharton Alumni Club—yes, Penn is everywhere! Although a larger club-sponsored



As the robots perfect their moves on the soccer field, they are ultimately being programmed for tasks that Steve McGill, in a BBC interview, described as “too dangerous, dull or dirty” for humans.

meeting wasn't possible at the time, the alum showed the UPennalizers the lay of the land and instilled confidence with a friendly and edifying welcome.

As the UPennalizers entered their competitions, sleep was a trivial pursuit; constant tweaks, adjustments and coding changes were necessary to counter problems arising in the robotic realms of machine vision, multi-agent collaboration, and sensor-fusion. McGill described the rarefied environment and technological focus at Eindhoven as so intense that he was momentarily mystified by the appearance of a family of ducks outside the team's campsite bungalow one morning. “Oh yeah, nature,” he was able to recall.

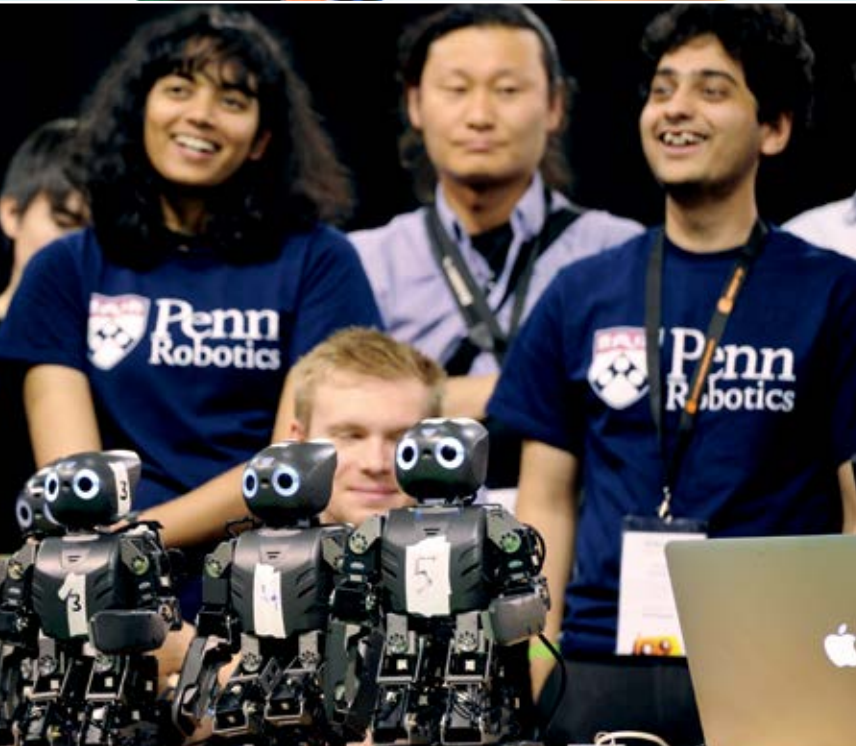
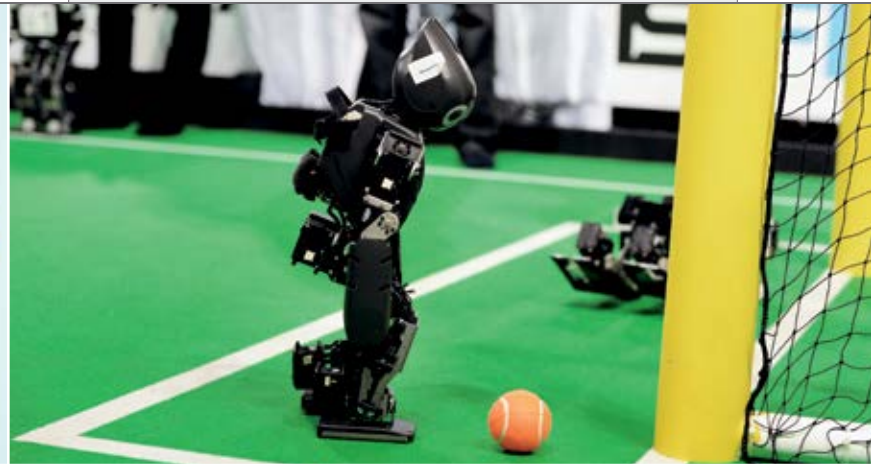
A Player's 'Game Face' Masks Wi-Fi Modules and Wide-angle Lenses

RoboCup is organized into leagues determined by type, skill-level and size, and range from non-humanoids to adult-size humanoids. Penn's Team DARwIn (a collaborative effort between Penn and Virginia Tech) emerged as the top team in the Humanoid Kid-Size League. Kid-Size games are played between two teams of three autonomous robots, 30 to 60 centimeters in height. Designed in human form, a humanoid's “game face” masks Wi-Fi modules and wide-angle cameras that facilitate action. Human referees manage the

game by communicating with a centralized computer. Team DARwIn's opponent in the championship match, an Iranian team from Tehran Polytechnic, was defeated with a final score of 7 to 4.

Team DARwIn, or “Dynamic Anthropomorphic Robot with Intelligence,” was diverse in its members' majors and degree levels. Along with McGill (whose Pennthusiasm alone seems capable of propelling a soccer ball past any opposing goalkeeper), the team included Penn Engineering undergraduates Alan Aquino, Dickens He and Tatenda Mushonga; College undergraduate Chris Akatsuka; Systems master's student Yida Zhang; Robotics master's students Richa Agrawal, Samarth Brahmbhatt and Vibhavari Dasagi; and postdoctoral fellow Seung-Joon Yi.

As the UPennalizers' robots and their fellow international androids perfect their moves on the soccer field, they are ultimately being programmed for tasks that McGill, in a BBC interview, described as “too dangerous, dull or dirty” for humans. Penn Engineers are keenly aware that the hardware and programming challenges encountered and surmounted in the competitive robotic soccer arena are critical to building the larger world they imagine in 2050—a world in which, among other wonders, World Cup soccer-playing robots are the winners. ♥



Lee's natural talents as a teacher can best be observed as he leads aspiring engineers and roboticists in competitions like the Defense Advanced Research Projects Agency (DARPA) autonomous vehicle challenge and RoboCup, the international robotic soccer competition.

Physicist, Roboticist, Engineer...Coach?

By Patricia Hutchings

When the decision is made to redirect one's career path, it is often in response to a subliminal calling or subtle nudge from a teacher or mentor. For Penn's Electrical and Systems Engineering professor and GRASP Lab director Daniel Lee, it was a red alert inside a nuclear reactor that sparked a change.

While deep into his doctoral research in condensed matter physics at Brookhaven National Laboratory late one night, a power outage forced the Long Island reactor into lockdown mode. As alarms shrieked and control rods lowered toward the reactor's core, Lee called upon his inner Hollywood stuntman; his narrow escape to the outside was made with an acrobatic drop and roll underneath a massive closing door. Once safely back at MIT in Cambridge, Lee began to explore research in fields that didn't require large amounts of time in nuclear reactors.

With his MIT Ph.D. in hand and a B.A. in Physics from Harvard in his toolkit, Lee was encouraged by friends and fellow former physicists to join them at the illustrious Bell Labs. When Lee began his career there as a postdoc in 1995, Bell Labs had been home to 11 Nobel Laureates and could claim 26,000 patents filed under its aegis. Lee remained at Bell Labs for six years as a researcher in the departments of Theoretical Physics and Biological Computation. Then, while not as dramatic as a nuclear reactor alarm, the changes in the culture at Bell Labs after the telecommunications bubble burst signaled another career change for Lee.

As a witness to the synergy created by the cross-fertilization of disciplines at Bell, Lee did not limit himself to the field of physics as he considered opportunities in academia. And where better to explore the intersection of scientific, biological and engineering disciplines



Daniel Lee

Directed by Dan Lee, the General Robotics, Automation, Sensing and Perception (GRASP) Lab was founded in 1979 and has grown into a \$16 million research center that draws upon the collaborative energies of computer scientists, mechanical engineers and electrical engineers, among others.

than Penn Engineering, home to the General Robotics, Automation, Sensing and Perception (GRASP) Lab.

GRASP was founded in 1979 by Ruzena Bajcsy, then a Penn Engineering faculty member in the Department of Computer and Information Science and a pioneering, award-winning researcher in machine perception, robotics and artificial intelligence. GRASP has grown into a \$16 million research center that draws upon the collaborative energies of computer scientists, mechanical engineers and electrical engineers, among others.

Lee came to Penn in 2001 as an assistant professor in Electrical Engineering and soon found his intellectual home in the GRASP Lab, working in concert with other faculty and students. He describes his research as centered around “learning representations that enable autonomous systems to efficiently reason about real-time behaviors in an uncertain world.” In April, he was appointed director of the Lab, following Kostas Daniilidis, professor in Computer and Information Science and Associate Dean for Graduate Education at Penn Engineering. Citing Lee’s “energy, creativity and commitment to collaboration,” Eduardo Glandt, Nemirovsky Family Dean, foresees him leading GRASP to new heights.

The Affable and Youthful Lee is a Self-described “Coach”

Lee’s natural talents as a teacher can best be observed during robotic team competitions between Penn and other universities. The affable and youthful Lee is a self-described “coach,” who has been known to sleep on the floor while traveling “on the cheap” with his teams. He has led aspiring engineers and roboticists in the Defense Advanced Research Projects Agency (DARPA) autonomous vehicle challenge and RoboCup, the international robotic soccer competition. While Lee sees the success of “Little Ben” in the 2007 DARPA Urban Challenge and Team DARwIn, Penn’s winning RoboCup humanoid soccer-playing robots as exciting and rewarding, he is just as proud of the ways in which the challenges and ensuing solutions benefit the larger scientific community. Importantly, his hardworking students learn to manage the stress inherent in competition and come to appreciate the rewards of collaboration as they raise the bar of innovation.

And what of Lee’s own life lessons learned as a grad student after almost being trapped in the Brookhaven nuclear plant all those years ago? The harrowing experience has come full circle with an ironic twist: one of his projects these days is to develop robots that can perform search and rescue operations in disabled reactors. 🇺🇸

Putting an End to Chronic Pain

By Janelle Weaver

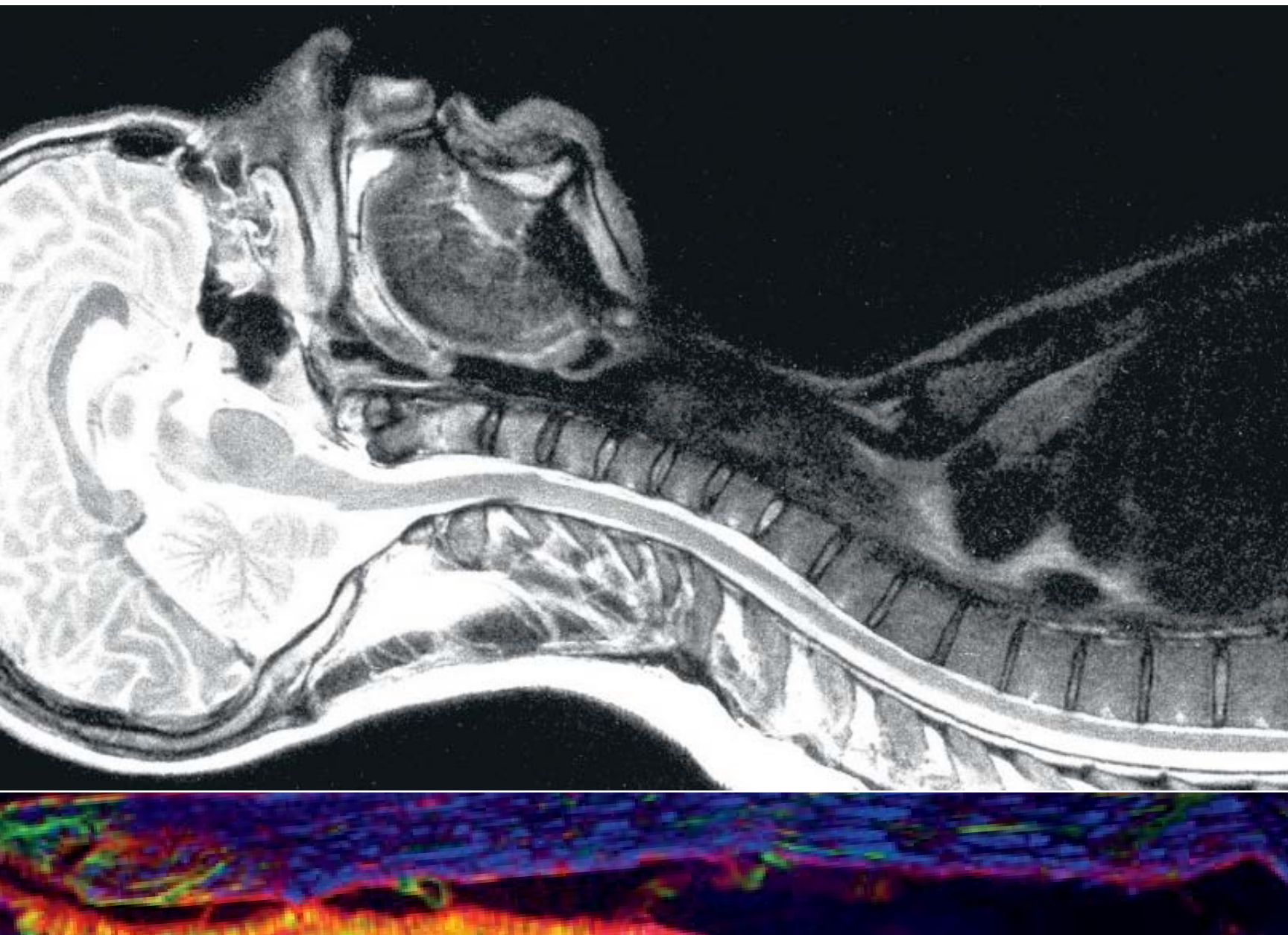
Chronic pain is the most common cause of long-term disability, and nearly one-third of all cases involve neck pain. Despite the prevalence of this condition, relatively little is known about the underlying molecular causes. Moreover, diagnostic imaging tools and biomechanical measures are often not sufficient for localizing painful injuries, and medical treatments are still not always effective.

Beth Winkelstein (B.S.E.'93), professor in the Department of Bioengineering, is determined to fix this problem. "The challenge with understanding painful conditions is that they often don't manifest with obvious signs on clinical imaging," she says. "We're never going to be able to prevent all injuries from happening, so one of our goals is to identify which tissues are injured, determine when that occurs, and define physiological signatures to identify them in the lab and the clinic."

Shortly after Winkelstein received her Ph.D. in Biomedical Engineering from Duke University in 1999, she decided to focus her research on combining biomechanical and neuroimmunological techniques to understand how injury causes chronic pain. Since joining the Penn faculty in 2002, she has developed



Beth Winkelstein



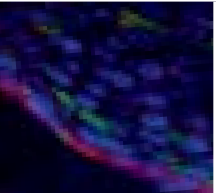
novel animal models to study the molecular pathways and cellular responses involved in chronic neck pain resulting from trauma and nerve damage in the spine and other joints in the body. She integrates engineering approaches to define tissue loads and strains, as well as the kinetic and kinematic relationships between macro- and microscale tissue responses.

“Beth has made a tremendous impact in understanding and translating treatments for chronic pain in the cervical area of the spine, which up until now has been poorly studied,” says Kelly Jordan-Sciutto, chair and associate professor of Pathology at Penn Dental

Medicine, who is working with Winkelstein to study the role of inflammation in pain cascades. “She has made therapeutic inroads into understanding the underlying mechanism, so she really walks the line between translational medicine and basic science.”

Treatments Through Teamwork

To investigate the molecular and cellular causes of chronic pain, Winkelstein collaborates with experts in a range of fields. “This kind of interdisciplinary interaction exemplifies research at Penn,” says David Meaney, the Solomon R. Pollack Professor and chair



Reversing nerve degeneration after axonal injury can help restore function and prevent the physiologic cascades that lead to chronic pain. In this slide, the injured axons are labeled in blue.

of Bioengineering. “Penn is a place where faculty in medicine and engineering naturally meet with a common goal,” he says. “Beth’s work is one of the great examples where collaborations between people with different backgrounds pave the way for accomplishing a major goal—understanding the mechanisms of chronic pain to develop new treatment strategies for one of the leading causes of disability in the population.”

Through collaboration with Paul Janmey, professor of Physiology, Winkelstein recently discovered that proteins found in fish blood could alleviate chronic pain when applied to the site of injury. Unlike its

mammalian counterpart, fibrin derived from salmon is non-toxic, and it lasts longer and promotes more neuron growth.

“Current clinical treatments involve using joint injections or radiofrequency to ablate damaged neurons, but those treatments usually require repeated dosing and multiple hospital visits, and they give only temporary relief,” Winkelstein says. “Using novel biomaterials is promising because we can develop treatments that are non-immunogenic, simple and very safe, and you can tune their mechanical properties to promote recovery, making them even more effective.”



Beth Winkelstein with Ph.D. student Sijia Zhang

"Current clinical treatments involve using joint injections or radiofrequency ablation, but those treatments give only temporary relief," says Beth Winkelstein. "Using novel biomaterials, we can develop treatments that are non-immunogenic, simple and very safe, and you can tune their mechanical properties to promote recovery."

Another branch of the Winkelstein lab focuses on developing a new optical technique to track in real time the onset and location of ligament damage well before a rupture can be seen. This method involves passing polarized light through ligament tissue and collecting images to create a map showing abnormalities in the alignment of collagen fibers. Unlike traditional approaches based on mechanical measures, Winkelstein's method can directly localize microstructural damage in tissue as it occurs.

"Our goal is to develop quantitative polarized light or other imaging techniques for clinical use in humans," she says. "The potential impact is that it could reveal damage that would otherwise be undetectable and make it easier for clinicians to know where in the body to treat."

Admirable Advisor

Beyond discovering better ways to detect and treat painful injuries, Winkelstein is on a mission to improve undergraduate education. Through her role as

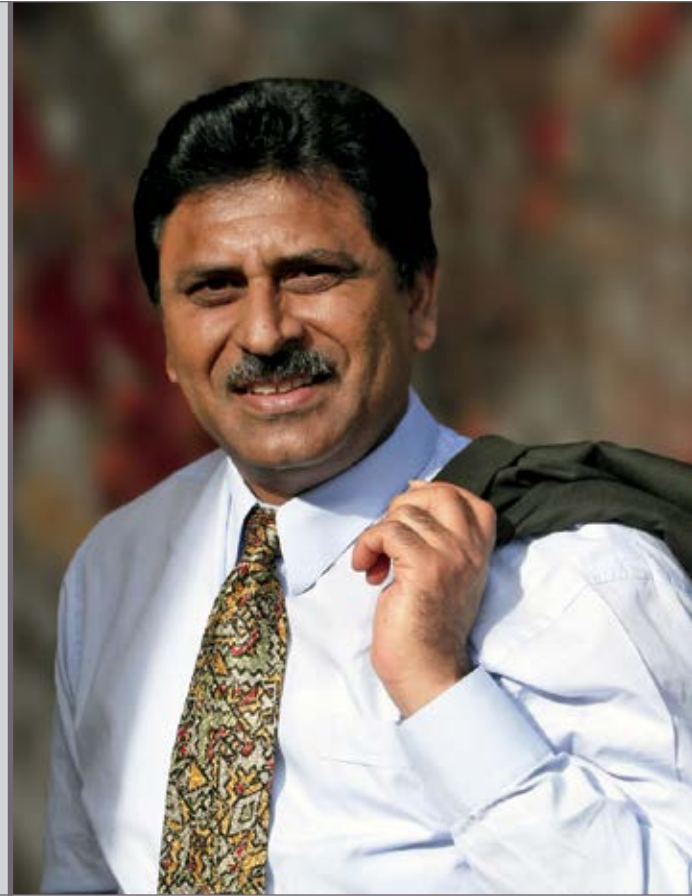
Associate Dean for Undergraduate Education at Penn Engineering, she has revamped the year-long Senior Design project to encourage students to think more creatively, work more independently and take more risks. She is also teaming up with Dennis DeTurck, Dean of the College of Arts and Sciences, to lead an undergraduate STEM education initiative at Penn to enhance learning in science, technology, engineering and mathematics, in part by increasing online course options, bringing active learning to the classroom and developing more facilities on campus for laboratory and hands-on activities for students and faculty alike.

Winkelstein's enthusiasm and commitment to students has not gone unnoticed. In 2006 and 2013, she earned the Ford Motor Company Award for Outstanding Faculty Advising. "She is really dedicated to and passionate about education, and she really wants to do the best by students," Jordan-Sciutto says. "Her level of commitment to students is what all mentors should aspire to achieve." ☐

"Today, of course, you see GPS in almost everything, whether you know it or not, and it has really had a major impact on our day-to-day lives," says Kanwar Chadha. "My daughters don't even know how to read maps. We take it for granted that we can find our way to anyplace by simply entering an address or point of interest. In 1995, that was just a dream."

Meet Mr. GPS

By Janelle Weaver



In the summer of 1986, Kanwar Chadha decided to go to Disneyland with relatives visiting from India. He was told to arrive early to avoid long lines, and when they got there at 8 a.m., the parking lot was almost empty. But by the end of the day, they were lost in a sea of thousands of cars, and it took them about 30 minutes to find their own vehicle. That experience inspired an innovative idea later in life: What if regular people could use a satellite-based navigation system to find their way around in their everyday lives? Bringing the Global Positioning System (GPS) to the mass market was Chadha's mission when he co-founded SiRF Technology in 1995.

"When we started SiRF, nobody had really worked on optimizing GPS for the mass market," says Chadha, (MBA/M.S.'83). "But as we moved into the mobile space, we knew that GPS technology could become a very important aspect of our lives."

Military to Mass Market

GPS was originally developed by the Department of Defense for military purposes, so SiRF had to overcome several challenges to adapt the technology for mainstream use. For example, ships and aircraft typically receive unobstructed signals from space-based satellites, but this is not the case for individuals sitting at home, walking in forested areas or driving through cities dense with skyscrapers.

To deal with this obstacle, SiRF developed sophisticated signal processing algorithms that could lock onto GPS satellites quickly and track very weak signals. The company made GPS radios and processors that could power portable navigation systems and other devices such as smartphones, introducing these products to the mass market in 1999.

"Today, of course, you see GPS in almost everything, whether you know it or not, and it has really had a major impact on our day-to-day lives," Chadha says. "My daughters don't even know how to read maps. We



take it for granted that we can find our way by simply entering an address or point of interest. In 1995, that was just a dream.”

Fostering a Fascination

After earning his bachelor's degree in Electrical Engineering from the Indian Institute of Technology in New Delhi, Chadha applied to The Wharton School to receive a top-notch business education. But after only one semester in the program, he decided it was “too much fun,” so he approached Aravind Joshi, then the chair of the Department of Computer and Information Science, to ask about simultaneously working on an advanced engineering degree. Taking advantage of the flexibility offered at Penn, he enrolled in the master's degree program in Computer and Information Science while focusing on marketing courses at Wharton.

With this diverse educational background, Chadha went on to work at Intel on processors, and then used the skills he acquired to start his first company, called AQuEsT, which developed multimedia subsystems. These experiences led to an interest in wireless

communication between different devices, such as PCs and TVs. A meeting with his SiRF co-founder, who had worked on military GPS, eventually fostered his fascination with GPS.

Finding Your Way Around

Chadha is now on to his next entrepreneurial venture. Last year, he founded Inovi, with the vision of enhancing high-bandwidth connectivity using wireless technology to support a vast amount of multimedia data, which traditional mobile wireless networks were not designed to handle. “My goal is to build companies and develop new ideas and technologies that can have a major impact on the everyday lives of consumers around the world,” Chadha says.

His Penn education has been vital to accomplishing this goal. “It gave me the confidence to solve problems creatively in an unstructured environment where you don't have all the information you need, which is very important if you're starting your own company and you have to find your own way around.” 🍷

Leading the Charge

Reinventing Computer Science at Penn

By Andrew Clark

Rapid change. That's the trademark characteristic of the discipline of computer science. Should you need proof, just think about entire encyclopedias, books and music all in a single device in the palm of your hand. Then consider the spectrum of people who thrive using these advances. With the ability to do countless functions and operations just by pressing our fingertips to a screen, we routinely use technology that just short years ago was still theory. Rapid change is the result of computer science's ability to constantly push boundaries and bring us the novel devices and tools we will rely upon in the years to come.

"To me, the constant change and excitement is associated with the 'outward face' of computer science," says Sampath Kannan, the newly named chair of the Department of Computer and Information Science (CIS). "It is increasingly the key partner in unlocking the mysteries of so many other disciplines as information technology becomes integral to every aspect of our lives."

Penn Engineering's CIS department is a leading force in this change. In less than a decade, an undergraduate degree in Networked and Social Systems Engineering

and master's degrees in Robotics, Embedded Systems, and Computer Graphics and Game Technology have all been added. Years ago, finding a university that offered these types of courses was a tall task, but now, thanks to pioneering efforts of computer scientists at Penn, they've become an integral part of both the field and its curricula.

The groundwork may already have been laid, but to Kannan, the Henry Salvatori Professor in CIS, this is just the beginning. "More new degrees are in the works," he notes. "At the same time, we are always on the lookout for bright new stars in these ever-evolving research areas to join our faculty."

An Organic Fit

As the field continues this rapid metamorphosis, Kannan will lead the charge in creating new, exciting opportunities, a challenge that he eagerly accepts. To start, Kannan says that a focus on the area of formal methods will result in the creation of techniques to provide future software and hardware systems that are both correct and reliable. "It's obviously crucial when you think of how much rides on these systems,"



Sampath Kannan



“To me, constant change and excitement is associated with the ‘outward face’ of computer science,” says Sampath Kannan, the newly named chair of the Department of Computer and Information Science.

he states, adding that “everything from pacemakers to nuclear plants, from our financial systems to air and spacecraft” can be affected.

When it comes to his peers, the selection of Kannan as chair was well-received. Insup Lee, the Cecilia Fitler Moore Professor in CIS, calls his colleague “the complete package,” while highlighting his managerial, intellectual and interpersonal skills. “Sampath is very optimistic and that can be quite contagious,” says Lee. “We are lucky to have him here.”

Though he’s just settling into his new role, Kannan feels as if his new position is an organic fit, a transition made easier by the faculty and staff around him. “I would not want to be chair of many departments, but this one practically runs itself,” he says. “The faculty

and staff are always ready to take on more than their fair share of responsibilities to make certain that CIS succeeds in its mission. Also, I know I have the good wishes of everyone and that makes this job a pleasure.”

Algorithms as Elixir

Being at the forefront of change is nothing new for Kannan, whose distinguished career has revolved around algorithms and their myriad uses. It doesn’t take long to notice the omnipresent nature of algorithms in our society. The sequencing of the human genome happened because of algorithms, Facebook uses them to recommend friends, and Google’s search engine employs them when guessing what users are looking for. “Even your credit card transaction on Amazon is



kept secure by means of algorithms for encrypting and decrypting data,” says Kannan.

The use of algorithms goes far beyond social media and online shopping, as shown by the spectrum of different topics which Kannan is currently trying to tackle. He continues to return to the question of how to compute reliably with unreliable programs or computers. “My doctoral thesis was on designing helper programs called checkers that would determine whether a program was producing the correct output,” he states.

“I am now working at a much more detailed level to determine how we can build circuits out of gates that can produce the wrong answer with some probability

and maximize the probability of the whole circuit producing the right output.” In addition to answering this question, Kannan is also exploring network tomography and has become interested in the intersection of computer science and economics.

For Kannan, his field serves as a possible elixir for many of the world’s issues. “Algorithmic thinking means not just ‘what the solution is’ but also how one arrives at it in a reasonable amount of time and space. This applies to every aspect of our lives, from cooking dinner to planning for retirement,” states Kannan. “Such thinking can not only find efficient solutions for problems in biology, economics, physics and the social sciences, it can also pose new challenges to usher in the futures of these fields.”



Nicholas McGill

Stronger, Tougher, Smarter

Titan Arm is a Winner

By Elisa Ludwig

Penn Engineering students have many talents, and now they can add superhuman strength to the list. A wearable, motorized upper-body exoskeleton, created by a team of undergraduates for their Mechanical Engineering and Applied Mechanics (MEAM) Senior Design project, has made heavy lifting easier—and opened up a new frontier for medical technology.

Named after the immortal Greek deities of superlative strength, the Titan Arm is an 18-pound untethered suit with a series of backpack-like straps. A robotic limb, powered by an electric motor and driven by a cable system, fits along the human forearm, adding power (the ability to lift about 40 additional pounds) to the wearer's natural capabilities.

Fulfilling a Need

Team members, all MEAM seniors, Elizabeth Beattie and the Three Nicks—Nicholas McGill, Nicholas Parrotta and Nikolay Vladimirov—were looking for a project that would showcase their interests in robotics and serve as a positive contribution to people's everyday lives. "We realized early on that we wanted to do something with a wearable exoskeleton," McGill says. "Through our research, we found out that the existing products were mostly designed for lower body usage, so there was a market need we could fulfill."

The most obvious use for Titan Arm is for people attempting to rebuild strength or improve mobility through physical therapy. Assisted strength can motivate users to continue through what seems like a repetitive and arduous routine. The device features sensors that wirelessly stream feedback about the wearer's range of motion and strength. This data can be used by a doctor to develop custom therapy routines and track improvement.

Beyond physical therapy, Titan Arm's applications might include occupational lifting, where the device can reduce the likelihood of fatigue and injury for warehouse workers, nurses or others who bear heavy loads on a regular basis.

A Team United

Over the course of eight months, the team developed their prototype, using a divide-and-conquer strategy that leveraged their individual skills. "We often talk about the power of teamwork, and in this case it was absolutely clear that positive dynamics made for a better end result," says Jonathan Fiene, the team's faculty advisor and MEAM Senior Lecturer. "They pushed through their challenges as a unit and kept themselves on track."



Elizabeth Beattie and Nicholas Parrotta make adjustments on the Titan Arm wearable exoskeleton, worn by Nicholas McGill.

After many late nights, several early mornings and at least one run-in with a hot glue gun, their hard work was rewarded. After a presentation to a panel of industry experts, Titan Arm won the Judges' Choice Award for Overall Project Excellence at the MEAM Senior Design competition and placed second in Penn Engineering's all-school competition. The team was also invited to compete in the Intel-sponsored Cornell Cup, held in Disney World. They won there, too—but only after coming dangerously close to a tangle with the TSA. "Carrying a robotic device with a few rough edges will get you noticed in the airport," McGill says. "We all wore Penn Engineering shirts and luckily, we got through with no big hassles."

Titan Arm continues to garner loads of media attention. Recently the project was named first runner-up in an NIH Bioengineering competition, and in early November, Titan Arm was selected as the first-place recipient of the 2013 international James Dyson Award. This is the first time that a team from the United States has won the award.

Looking ahead, the team is planning to apply for a patent, and considering next steps to getting Titan Arm to market. "No matter what happens next, the whole experience was fantastic," says Nick Parrotta. "It demonstrates what a small team of highly motivated people can do." 🍷

"There's an analytical rigor to engineering, an understanding of how things work," says Ryan Limaye. "My training as an engineer is just as relevant and useful today as it was two decades ago."

Ryan Limaye

Utilizing Engineering Principles in a Technology-driven Economy

By Jessica Stein Diamond

"I get instant street credibility when I tell clients I have an engineering degree," says Ryan Limaye (ENG'93, W'93, WG'93), Managing Director, Global Head of Communications Technology Investment Banking at Goldman Sachs.

"The engineering skill set, discipline and mentality are extremely helpful in the financial services world," says Limaye, a member of Penn Engineering's Board of Overseers. "Engineering teaches you how to think about problem solving by applying fundamental principles to a challenge you've never encountered before. This skill is absolutely critical in today's fast-paced economy."

Since joining Goldman Sachs in 1994, Limaye's work has been almost entirely in technology-related areas

of the economy. As a result, his corporate clients have primarily been firms whose management teams are led by engineers. In addition to providing clients with equity and debt financing, he offers strategic advice on mergers and acquisitions and other areas of corporate strategy, and participates in selected principal investments directly in technology companies.

Limaye has handled transactions with companies such as Cisco Systems, Microsoft, IBM, HP, AT&T and Oracle and initial public offerings (IPOs) for technology innovators including FireEye, Palo Alto Networks, Ruckus, Rackspace, Riverbed Technology and Juniper Networks. "Over the long run, I've seen massive technology waves and have had the opportunity to be a participant in many of these industry shifts," he says.

“I wish there were a way to capture in print the excitement and innovation on campus and the enthusiasm and passion that is Penn Engineering today.”

Surfing Waves of Innovation

“We’re helping companies react to trends that are driving new company formation. Their needs for growth capital are constantly changing,” says Limaye. “Our clients are constantly evolving because technology is always changing and the role of technology is increasing every day. These industries are very different today from two, four or six years ago.”

Becoming an investment banker wasn’t a career aspiration during Limaye’s years at Penn. Yet it has been a great match with his degree from Penn’s Management & Technology program. “The fusion of Wharton and Penn Engineering is very powerful in the financial services world,” he says. “There’s an analytical rigor to engineering, an understanding of how things work that draws from fundamental principles that reminds me of why my high school emphasized Latin to strengthen grammar and vocabulary. My training as an engineer is just as relevant and useful today as it was two decades ago. For someone like me who hasn’t practiced engineering continuously, this foundational training makes me much more equipped to succeed in today’s changing waves of technology innovation.”

Massive Gravitational Field

Limaye decided to join the Board of Overseers after an inspiring campus tour with Engineering Dean Eduardo Glandt—an encounter he likens to nearing “a massive gravitational field of enthusiasm, passion and energy.” Limaye says, “Once I met with him, I became convinced that serving as an Overseer would be a tremendously valuable experience. Charisma here starts at the top with Eduardo and cascades down. I wish there were a way to capture in print the excitement and innovation on campus and the enthusiasm and passion that is Penn Engineering today. People should visit this campus and see what’s happening. It’s amazing.”

Limaye views Penn Engineering’s biggest challenge as the need to establish more endowed faculty chairs. “As the school grows in prominence and popularity, we need to stay at the cutting edge by recruiting and hiring the most talented faculty.”

“Endowed chairs allow Penn Engineering to recruit professors who offer the most exciting classes and provide the most effective transfer of knowledge. This translates into greater research prominence and higher levels of funding, and yields better non-classroom opportunities for students to participate in world-class research. All of this reinforces a virtuous cycle that feeds reputation, prominence and funding. Endowed chairs keep that flywheel running.” 🔄



Ryan Limaye



Cristina Sorice

Cristina Sorice is poised to realize her childhood vision of a career in aerospace engineering. Ultimately, she would love to create the next Mars Rover.

Rockets & Robotics

By Stephanie Sayago Bell

“Even before I knew what engineering was, I wanted to be an engineer,” says Cristina Sorice. As a fifth grader, Sorice knew what she wanted to be when she grew up: a rocket scientist. Years later, after reading about the courses offered by Penn Engineering’s Department of Mechanical Engineering and Applied Mechanics (MEAM), Sorice chose to attend Penn. Now a candidate for a bachelor’s degree in MEAM and submatriculant in Robotics, she is on track to fulfill that childhood dream.

Support for Women Engineers

Sorice praises Penn Engineering’s support programs that target new female engineering students. Prior to beginning classes at Penn, Sorice participated in the freshman pre-orientation program hosted by Advancing Women in Engineering, directed by Michele Grab. This program is designed to increase awareness of and interest in engineering, enhancing the overall academic experience of female engineering students. It was this experience that introduced Sorice to other

women in the field, fostering friendships and offering “incredible resources and networking opportunities for women in engineering.”

Summer Experiences Shape Career Goals

Sorice’s summer experiences have allowed her to apply her academic interests to real-world engineering puzzles. In 2011, Sorice returned to the New Jersey Governor’s School of Engineering and Technology at Rutgers University as a counselor, a program she had experienced just two years before as a student. Visiting engineering companies and participating in research in the field, “made me realize that I could do it, that I could be an engineer,” she says. “I could come from a big public high school with no engineering classes, attend a school of engineering, and succeed.”

In 2012, Sorice was chosen as a Rachleff Scholar at Penn, spending that summer under the guidance of

Interested in public education advocacy programs, particularly STEM education, Sorice's passion is apparent when she says, "I want to make sure that wherever I work, if there isn't already an outreach program, I can start one."

Vijay Kumar, UPS Foundation Professor in MEAM, learning about optimization of systems of flying robots accomplishing joint tasks. Summer 2013 found Sorice engaged as a Guidance, Navigation and Controls Intern at Escape Dynamics, an aerospace robotics company in Colorado. There, she created a system that allows a microwave antenna to autonomously track a flying aerial vehicle so that it continually points at the vehicle in order to provide it with a constant supply of energy.

Connecting Learning and Life Skills

Sorice sparkles when she talks about the opportunities in her major. She says she "fell in love with all the cool stuff" in aerospace robotics, only wishing she'd known earlier how much she would love robotics. Sorice found the four courses she took with Bruce Kothmann, Senior Lecturer in MEAM, particularly exciting because his experience in the aerospace industry brought classroom theory to life. When she feels challenged by an engineering problem, Sorice is inspired to work through frustration because Kothmann's examples of industry experience helped her appreciate the connection between the academics of engineering courses and their applications to professional life. She marvels at his ability to "give real-world examples for anything you might encounter in engineering." When she shared her summer project assignment for Escape Dynamics, Kothmann immediately named specific examples of work Sorice had done in class that could apply to the internship work, adding to her confidence in embarking on this opportunity.

Connecting Passions

Engineering is not Sorice's only passion. Interviewed while on the job in Colorado, she cited her current slate of leisure reading: a biography of the poet and activist Lawrence Ferlinghetti, *The Moral Landscape* by Sam Harris, and Chuck Palahnuik's *Stranger Than Fiction*. In addition to her wide-ranging interests, she has outreach plans for post-graduation. She is interested in public education advocacy programs, particularly STEM education. Her passion is apparent when she says, "I want to make sure that wherever I work, if there isn't already an outreach program, I can start one. Outreach really matters to me."

Sorice has also been a voice for academic policy as an active member of the Penn Student Committee on Undergraduate Education, a branch of Penn Student Government. She considers herself fortunate to have been accepted for this position and credits this involvement with rounding out her Penn experience.

Sorice is poised to realize her childhood vision of a career in aerospace engineering. Ultimately, she would love to create "the next Mars Rover or science lab, or send people to Mars." The perfect integration of science, engineering and the arts is embodied by her favorite quote from poet Sylvia Plath: "What I fear most, I think, is the death of the imagination...if I sit still and don't do anything, the world goes on beating like a slack drum, without meaning. We must be moving, working, making dreams to run toward; the poverty of life without dreams is too horrible to imagine." It's a safe bet that Cristina Sorice won't be sitting still. 🍷

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New Faculty**Mark Allen**

Alfred Fitler Moore Professor in the Department of Electrical and Systems Engineering

Ph.D. in 1989 in Microelectronics
Massachusetts Institute of Technology

Combining insights from the worlds of electrical engineering, mechanical engineering, chemistry and materials science, Dr. Allen is a pioneer in the field of microelectromechanical systems (MEMS), and nanofabrication technology. His research allows the creation of structures, sensors and actuators that exploit the unique potential of the small scale. For example, such miniscule devices can sit at the intersection of the biological and the digital, sensing the physical and electrical signals found in the heart and in the brain and transmitting them to computers for processing. He has published approximately 120 journal articles and holds approximately 40 patents. Dr. Allen is the inaugural director of the Singh Center for Nanotechnology.

**Dani Bassett**

Skirvanich Assistant Professor of Innovation in the Department of Bioengineering

Ph.D. in 2009 in Physics
University of Cambridge

Postdoctoral position at the University of California, Santa Barbara

Dr. Bassett's group tackles problems at the intersection of basic science, engineering, and clinical medicine using systems-level approaches in general, and network science in particular. Recent examples include predicting the extent of learning from human brain networks, resolving the evolution of the neuronal synapse via genetic interaction networks, determining bulk material properties from mesoscale force networks, and isolating individual drivers of collective social behavior during evacuations. In these contexts, Dr. Bassett's group seeks to develop new mathematical methods for the principled characterization of temporally dynamic, spatially embedded, and multiscale networked systems, with the goal of predicting system behavior and designing perturbations to effect a specific outcome.



Chris Callison-Burch

Aravind K. Joshi Term Assistant Professor in the Department of Computer and Information Science

Ph.D. in 2008 in Informatics
University of Edinburgh

Modern approaches to machine translation, like those used in Google's online translation system, are data-driven. Statistical translation models are trained using millions of sentences paired with their translations. These data-driven methods have been shown to be extremely successful for translating languages which have large volumes of parallel texts. Dr. Callison-Burch's research focuses on extending these methods to a much wider range of the world's languages. His work examines: improving the underlying translation models through the incorporation of rich syntactic models; using crowdsourcing to translate large volumes of text at low cost, achieving professional-level translation quality using non-professional translators; and exploring new techniques for learning translation without bilingual training data, instead using distributional properties across languages that can be observed in large collections of monolingual texts.



Nadia Heninger

Magerman Term Assistant Professor in the Department of Computer and Information Science

Ph.D. in 2011 in Computer Science
Princeton University

Postdoctoral positions at the University of California, San Diego, and Microsoft Research New England

Dr. Heninger's research takes a mathematical approach to computer security and cryptography. She is particularly interested in problems where mathematical or algorithmic tools can provide insight on the security of real-world systems. Some of her recent projects include discovering widespread cryptographic random number generation vulnerabilities affecting millions of computers on the Internet, discovering a flaw in the Taiwanese national smart ID card, and applying insights from lattice-based techniques in cryptanalysis to develop new algorithms in coding theory. Current areas of interest include network security, privacy, cryptanalysis, computational number theory, lattices, coding theory, and implications for public policy.

New Faculty**Dan Huh**

*Wilf Family Term Assistant Professor in the
Department of Bioengineering*

Ph.D. in 2007 in Biomedical Engineering
University of Michigan

Postdoctoral positions at the University of Michigan,
Harvard Children's Hospital and the Wyss Institute

Dr. Huh's laboratory aims to develop innovative bioengineering tools and technologies using biologically inspired design principles and micro/nanoengineering approaches to improve human health and promote environmental sustainability. Dr. Huh's research primarily focuses on developing microengineered biomimetic models of human organs (organs-on-chips), self-assembled tissue/organ scaffolds, cell-based self-regulating "smart" biomedical devices, and efficient biomimetic transport systems. Dr. Huh explores the use of these bioinspired engineering systems for a variety of biomedical, pharmaceutical and environmental applications.

**Rakesh Vohra**

*George A. Weiss and Lydia Bravo Weiss University Professor
in the Departments of Electrical and Systems Engineering
and in Economics*

Ph.D. in 1985 in Mathematics
University of Maryland

Dr. Vohra's research in mechanism design focuses on the best ways to allocate scarce resources when the information required to make the allocation is dispersed and privately held, an increasingly common condition in present-day environments. His work has been critical to the development of game, auction and pricing theory, for example, the keyword auctions central to online search engines, and spans such areas as operations research, market systems and optimal pricing mechanisms. In addition to more than 70 articles and working papers, he is co-author of *Principles of Pricing* (Cambridge University Press, 2012) and author of *Mechanism Design: A Linear Programming Approach* (Cambridge University Press, 2011) and *Advanced Mathematical Economics* (Routledge, 2004).

Honors and Awards

Dawn Bonnell, *Trustee Professor in the Department of Materials Science and Engineering*, has been named Vice Provost for Research at the University of Pennsylvania.

Provost Vincent Price noted, “Dawn Bonnell is a widely recognized leader in nanotechnology research and has a profound understanding of the opportunities and challenges of the current global research environment. As the founding director of Penn’s Nano/Bio Interface Center (NBIC), she has significant experience integrating knowledge across campus, working with a wide range of departments and colleagues to advance Penn’s distinction in scientific research and interdisciplinary education.”

Dr. Bonnell has taught at Penn since 1988, following two years at the IBM Thomas Watson Research Center. In 2004, she became the founding director of the NBIC, created through an initial \$11.4 million grant from the National Science Foundation, which brings together researchers from across Penn’s schools to study the intersections of technology and biology at the molecular level. NBIC partners with universities around the world to advance path-breaking nanotechnology research, as well as with the School District of Philadelphia to introduce nanotechnology to students and increase scientific literacy in the local community.

An editor of seven books and an author of more than 200 papers, Dr. Bonnell was elected this year to the National Academy of Engineering, the highest honor accorded an engineer; is one of only seven awardees of the Staudinger-Durrer Medal from the Swiss Federal Institute of Technology; and has served as president of the American Vacuum Society and vice president of the American Ceramic Society. Her work has been recognized with a Presidential Young Investigator Award from the National Science Foundation, the Robert B. Sosman Award and the Ross Coffin Purdy Award from the American Ceramic Society, the Distinguished Alumni Award from the University of Michigan and numerous other awards and prestigious national and international lectureships.



Dr. Bonnell’s research focuses on the properties of surfaces, especially at the atomic scale, with wide implications for understanding the behavior of devices ranging from biosensors to solar cells to computer processors. This work includes the first imaging of atoms on oxide surfaces and new methods of harvesting the energy of light, innovating hybrid nanostructures and inventing new probes that reveal the behavior of small structures.

Dr. Bonnell earned her Ph.D., M.S. and B.S.E. degrees in Materials Science and Engineering from the University of Michigan and studied on a Fulbright Scholarship at the Max Planck Institute in Stuttgart, Germany.

The Vice Provost for Research develops and implements policies that promote research excellence across the University; manages key elements of the University’s research infrastructure, including grant administration and research compliance; and guides the strategic efforts of the University in advancing research commercialization. The Vice Provost for Research also serves as a champion for the research enterprise at Penn, leading research collaborations across schools, exploring new areas for research and representing Penn to local, regional and national constituencies.

Honors and Awards



Rajeev Alur, *Zisman Family Professor in Computer and Information Science*, has been named a Simons Investigator by the Simons Foundation. The foundation describes Alur as “a leading researcher in formal modeling and algorithmic analysis of computer systems” who has had a “great impact on both the theory and practice of verification.” Similar to the MacArthur Foundation’s “Genius Grants,” the five-year, \$500,000 prizes come with no restrictions and are intended to enable the researchers to undertake long-term study of fundamental questions in theoretical fields.



Nader Engheta, *H. Nedwill Ramsey Professor in Electrical and Systems Engineering*, is the recipient of the 2013 Benjamin Franklin Key Award from the IEEE Philadelphia Section for “outstanding electrical engineering design, innovation and problem solving.” The Key Award is given annually to an engineer for outstanding technical innovation and technological contributions that have significant practical application.



Portonovo Ayyaswamy, *Asa Whitney Professor of Dynamical Engineering in Mechanical Engineering and Applied Mechanics*, has received the 75th Anniversary Medal from the American Society of Mechanical Engineers’ Heat Transfer Division “in recognition of his service to the heat transfer community and contributions to the field.” Dr. Ayyaswamy’s research is in the area of mechanical engineering, with foci in modeling, simulations and experimentation of multi-phase flow/heat and mass transfer.



Christopher Fang-Yen, *Wilf Family Term Assistant Professor in Bioengineering*, is the recipient of the 2013 Ellison Medical Foundation New Scholar Award in Aging for his proposal, “High-throughput Imaging of Lifespan and Healthspan in *C. elegans*.” This award is given to exceptional new faculty whose work shows the potential for great impact in understanding lifespan development processes and age-related diseases and disabilities.

The University of Pennsylvania and Carnegie Mellon University have received a \$5.65 million U.S. Department of Transportation grant for a joint research center to conduct transportation technology research and development. The two-year grant will allow the Penn-CMU partnership, Technologies for Safe and Efficient Transportation, or T-SET, to continue to develop and implement new technologies. This is the third time T-SET has received the federal University Transportation Center Award. **Daniel Lee**, *Professor in Electrical and Systems Engineering*, has been named the co-director of T-SET.

IN MEMORIAM

Ralph M. Showers, professor emeritus of Electrical Engineering in the School of Engineering and Applied Science, died September 8, 2013 at the age of 95.

Dr. Showers earned each of his degrees from the University of Pennsylvania: a bachelor's degree in 1939, a master's degree in 1941 and a doctoral degree in Electrical Engineering in 1950. He began his professional career at Penn in 1946 as an assistant professor in The Moore School of Electrical Engineering. He was named emeritus professor of Electrical Engineering in 1989.

Since the 1940s, Dr. Showers was active in research on measurement of noise, weapons systems, communications, aerospace microwave technology, space shuttle radio frequency experience, stabilization of cable radiation characteristics and cable coupling models. He was a pioneer of electromagnetics and a founder of the Electromagnetic Compatibility Society.

During his long career, Dr. Showers was the recipient of numerous prestigious awards, including the ANSI Elihu Thomson Electrotechnology Medal, ANSI Astin-Polk International Standards Medal, the IEEE Standards Medallion, the IEEE Steinmetz Award, the IEEE Centennial Medal, the IEEE Fellow Award and the EMC Society Richard Stoddart Award. He was a registered Professional Engineer in Pennsylvania, a life Fellow of IEEE and an honorary life member of the USNC.

In addition to his wife Beatrice, Dr. Showers is survived by his three daughters, Virginia White and husband Chris of Crownsville, MD; Janet Showers Patterson and husband Day of Naples, FL; and Carolin Showers of Norman, OK; and his four grandchildren, Kristin White, Jennifer Harris and husband Joseph, and Thanh and Tien Showers.



Daniel Gianola, *Skirkanich Assistant Professor of Innovation in Materials Science and Engineering*, is the recipient of a 2014 Early Career Faculty Fellow Award from The Minerals, Metals & Materials Society (TMS). The award recognizes a tenure-track assistant professor who has "demonstrated accomplishment in advancing their academic institution and in broadening the technological profile of TMS."



Daeyeon Lee, *Associate Professor in Chemical and Biomolecular Engineering*, is the recipient of the 2013 Nanoscale Science & Engineering Forum Young Investigator Award from the American Institute of Chemical Engineers (AIChE). This award recognizes outstanding interdisciplinary research in nanoscience by engineers in the early stages of their professional careers.



Arjun Raj, *Assistant Professor in Bioengineering*, has been named to *Popular Science* magazine's "Brilliant 10." Dr. Raj was recognized for revealing the inner workings of cells. His research interests include molecular engineering, bioengineered therapeutics, devices and drug delivery, and cellular and molecular imaging.



Chambrel Jones

Chambrel Jones is the Special Assistant to the Dean of Penn Engineering and Executive Manager of the Office of the Dean. She provides high-level administrative support and manages the daily administration of projects coordinated by the Dean's Office.

What is your role?

I like to think that my job helps make Dean Glandt's vision for Penn Engineering a reality. To bring that vision to fruition, I perform complex and varied tasks, including the planning and execution of high-profile and confidential projects, logistical arrangements for a variety of meetings and events, and the organization and facilitation of major programmatic initiatives.

What does your typical day look like?

On any given day you can find me in the midst of coordinating a three-week, multi-continent trip for the Dean and then moving cases of wine across campus for an event. Most of my days are spent in the office where I work with the Dean's support staff on upcoming events and projects. A special event can involve selecting and coordinating vendors, making venue site visits, choosing caterers and deciding on menus, and creating detailed event timelines, name tags, and seating charts. We aim for the flawless execution of every event, so we check, crosscheck, and then check once more.

In spite of all of your planning and preparation, there is always a chance things might not go as planned. Any good stories?

I've learned to always expect the unexpected. If I am doing my job well, no one outside of my team will know that something has gone awry. As far as good stories, the one that stands out is when a caterer set off the fire alarm in the middle of the Dean's remarks during a school event. While the fire and emergency vehicles approached and the alarms screamed in the building, I waited outside with 120 of my colleagues for the Philadelphia Fire Department to arrive, inspect the building and turn off the fire alarm. This moment drove home the fact that sometimes there is not a behind-the-scenes fix. ☹

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