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EQuad News

Winter 2011
Volume 22, Number 2

IN THE SERVICE OF ALL NATIONS

PRINCETON
School of Engineering
and Applied Science

EQuad News
Winter 2011
Volume 22, Number 2

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EQuad News is published twice a year by the Office of Engineering Communications in collaboration with the Princeton University Office of Communications. It serves the alumni, faculty, students, staff, corporate affiliates and friends of the Princeton University School of Engineering and Applied Science.

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Note on alumni class years
EQuad News follows a Princeton University convention in noting the year of graduation for alumni: A person's name followed by an apostrophe and class year indicates an undergraduate degree; an asterisk followed by a class year indicates a graduate degree, either master's or doctoral.

DEAN'S MESSAGE

ENGINEERING IN THE SERVICE OF SOCIETY

Woodrow Wilson, former president of this University and nation, rarely strayed far in his writing and speaking from the subject of service. His 1896 speech, "Princeton in the Nation's Service," provided a guiding principle to this day, and in 1913 he famously reminded students at Swarthmore that, "You are here to enrich the world, and you impoverish yourself if you forget the errand."

That ethic of service underscores one of my favorite Wilson quotes. In honoring George Goethals for his leadership in constructing the Panama Canal, Wilson said, "the magic of the engineer is that he can change the face of nature and show the work of his hands, and that it is in some deep sense creative in character."

For Wilson, prerequisites for both service and creativity were the pursuit of not only deep thought in a chosen field but also a broad liberal arts education. He was fascinated by

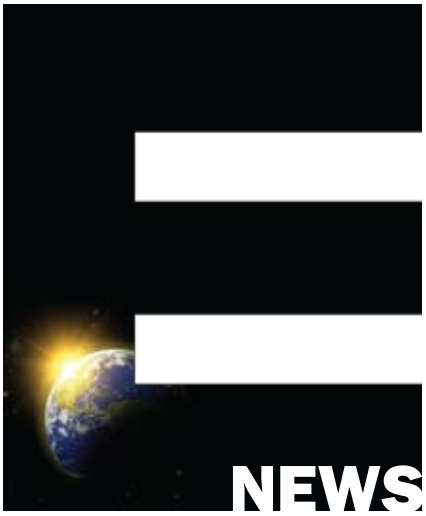
> *"this complex interdependence and interrelation of all the processes which prepare the mind for effectual service: this necessity that the merchant and the financier should have travelled minds, the engineer a knowledge of books and men…"* [Princeton inaugural, 1902]

And so, we have one of the driving tenets of Princeton Engineering: The role of an engineer is to use science in the service of society, from developing sustainable energy to improving global health. Yet the major problems facing the world cannot be solved by technology alone—each demands knowledge and collaborations that cross boundaries. And each requires the creative minds of men and women with varied backgrounds and perspectives.

This magazine can only touch on the innumerable ways Princeton engineers are bringing these ideals to life every day. Please visit us online at www.princeton.edu/engineering or in person to find out more.

H. Vincent Poor *77
Dean and Michael Henry Strater University Professor of Electrical Engineering

An article in the Summer 2010 edition about a breakthrough in quantum materials science incorrectly stated the position of researcher Chen Huang; he is a graduate student.



Emily Carter, prominent scientist and engineer, to lead Andlinger Center

Photo by Bentley Drezner

Dean of Engineering H. Vincent Poor with Emily Carter, founding director of the Andlinger Center for Energy and the Environment, near the site of the center's future laboratories.

Emily Carter, a Princeton professor of engineering and applied mathematics, and eminent physical chemist, has been appointed the founding director of the University's Andlinger Center for Energy and the Environment.

"Emily Carter is just the right leader for the Andlinger Center as it steps up its activities and tackles some of the most urgent and complex problems of our time," said President Shirley M. Tilghman. "She is a highly accomplished scientist who cares passionately about not only addressing the interlocking energy and environmental challenges that face us, but also training and inspiring the next generation of leaders in this field."

The Andlinger Center was created in 2008 with the support of a $100 million gift from international business leader Gerhard Andlinger, a member of Princeton's class of 1952. Its mission is to build on Princeton's strengths in environmental science, materials science and policy to develop sustainable sources of energy that satisfy the world's energy demand in a way that preserves natural resources and the health of the environment for future generations.

Carter, the Arthur W. Marks '19 Professor of Mechanical and Aerospace Engineering and Applied and Computational Mathematics, has been a leader in developing and applying methods based on quantum mechanics to understand and design molecules and materials. In recent years she has focused on applying her research tools toward improving energy technologies, including the harnessing of solar energy to generate electricity and produce fuels.

Carter said her vision for the center is for it to become a vibrant intellectual community that engages people from many academic disciplines, as well as experts from industry and government.

"Any scientist or engineer who has the expertise to contribute to this field ought to be working on it," said Carter. "The scale of the problem is immense.

"It's going to take many different approaches and many people in different disciplines working in parallel and with a lot of cross-fertilization," said Carter, whose own research group consists of students from six different departments and programs at Princeton.

"I also want our work at the center to be done in tandem with economists and public policy experts who examine the technologies we're working on and discuss with us how different solutions could fit into the marketplace and what sort of government policies are needed to allow these new technologies to take off and create new industries and jobs," Carter said. **–Steven Schultz**

New search method tracks down influential ideas

Photo by Frank Wojciechowski

Princeton computer scientists David Blei (left) and Sean Gerrish have developed a new method to search academic journals and other collections of documents, such as websites, to trace the origins and spread of ideas.

Princeton computer scientists have developed a new way of tracing the origins and spread of ideas, a technique that could make it easier to gauge the influence of notable scholarly papers, buzz-generating news stories and other information sources.

The method relies on computer algorithms to analyze how language morphs over time within a group of documents—whether they are research papers on quantum physics or blog posts about politics—and to determine which documents were the most influential.

"The point is being able to manage the explosion of information made possible by computers and the Internet," said David Blei, the Princeton assistant professor in computer science who led the project. "We're trying to make sense of how concepts move around. Maybe you want to know who coined a certain term like 'quark,' or search old news stories to find out where the first 1960s antiwar protest took place."

Previous methods for tracking how language changes accounted for how a group of documents influenced a subsequent group, but were unable to isolate the influence of individual documents. Blei said their new model was not meant as a replacement for citation counts but as an alternative method for measuring influence that might be extended to finding influential news stories, websites, and legal and historical documents.

"We are also exploring the idea that you can find patterns in how language changes over time," he said. "Once you've identified the shapes of those patterns, you might be able to recognize something important as it develops, to predict the next big idea before it's gotten big." **–Chris Emery**

New sensor derived from frogs may fight bacteria and save wildlife

Princeton engineers have developed a sensor that may revolutionize how drugs and medical devices are tested for contamination, and in the process also help ensure the survival of two species of threatened animals.

To be fair, some of the credit goes to an African frog.

In the wild, the African clawed frog produces antibacterial peptides—small chains of amino acids—on its skin. Princeton researchers found a way to attach these peptides, which can be synthesized in the laboratory, to a small electronic chip that emits an electrical signal when exposed to harmful bacteria, including pathogenic E. coli and salmonella.

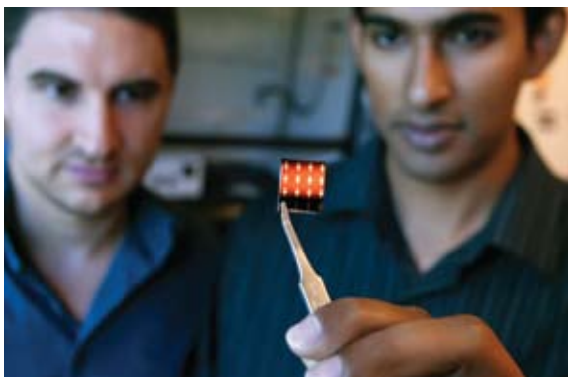
"It's a robust, simple platform," said Michael McAlpine, an assistant professor of mechanical and aerospace engineering. "We think these chips could replace the current method of testing medical devices and drugs."

McAlpine collaborated with James Link '00, an assistant professor of chemical and biological engineering and graduate students Manu Mannoor and Siyan Zhang.

The current testing method, in use for about 40 years, has a major drawback: It relies on the antibacterial qualities of the blood of the horseshoe crab, a species that is roughly 450 million years old. The horseshoe crab population has declined in recent years, and as a result, so too has the population of the red knot, a bird that feasts on the crab.

The researchers hope that technology based on their electronic chip will eventually replace the horseshoe crab extract as the standard for contamination testing, helping both the crabs and the red knots rebound. **–CE**

Photo by Frank Wojciechowski



Assistant professor Michael McAlpine (left) and graduate student Manu Mannoor were part of a team that developed an ecologically sustainable device for testing drugs and medical devices for contamination.

Award-winning simulation technology streamlines shipping

Scientists have long been able to harness powerful computers to model complex systems such as ocean currents or the migratory patterns of birds. Modeling the complexity of human decision-making, however, has proved far more elusive.

Now Warren Powell '77, a professor of operations research and financial engineering, and Hugo Simao, a senior operations research engineer, have done just that by creating a computer model that optimizes the collective decision-making of dispatchers in the trucking industry.

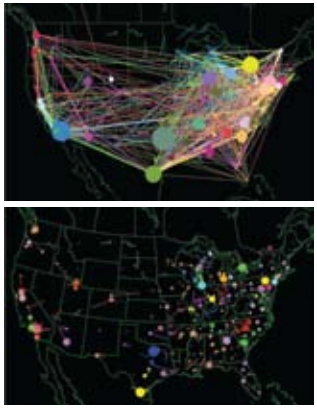
Powell and Simao created the model for Schneider National, Inc., which manages a fleet of more than 15,000 trucks. Powell noted that their algorithm essentially models the "collective intelligence of a group of dispatchers," which involved solving a problem so complex that the number of all possible options and variables to consider has been estimated to equal the number of atoms in 10^{80} universes.

In the end, the model allows Schneider to make changes in the makeup of the fleet, the mixture of loads and the rules that govern the management of drivers. In addition, it makes the best assignment of drivers to loads while minimizing empty miles, meeting service commitments and getting drivers home on time.

Powell noted that the underlying algorithm is the product of 20 years of research and has widespread applications. "Our approach represents a complete paradigm shift in how a problem like this should be solved," Powell said.

For their groundbreaking work on the Schneider simulator, Powell and Simao earned the Daniel H. Wagner Award for Excellence in Operations Research, presented by the Institute for Operations Research and the Management Sciences.

–Teresa Riordan



Research by Professor Warren Powell simulated the collective intelligence of hundreds of dispatchers (below) working in the control room of a large trucking company, whose complex routing is represented in the map above.

Images courtesy of Warren Powell

What *was* the BIG idea?

In the previous issue of *EQuad News*, readers were invited to participate in an online survey asking what future innovation society most needs. The survey was conducted using All Our Ideas, an application developed by Princeton sociologists and computer scientists to collect and rank ideas. In total, 94 ideas were submitted and 5,584 votes were cast. The results were clear—seven of the top 10 ideas related to energy and the environment.

For more about the survey tool and its results see **http://bit.ly/eLzVcL**.

Here are the top 10 ideas:

1 Sustainable energy

2 Clean, renewable energy that is cheaper than coal

3 Green energy

4 A way to live in freedom without force

5 Clean energy

6 A way to end both hunger and obesity

7 Develop equipment to collect all kinds of energy from nature, such as solar, heat, wind, water, etc.

8 Globally acceptable non-military ways of settling inter-group differences

9 Inexpensively obtained clean water

10 An efficient method for creating biofuels from waste materials

AN ENGINEERING GRAD HELPS

SIERRA LEONE HEAL FROM THE RAVAGES OF CIVIL WAR

During her fellowship, Katie Hsih has worked with a nonprofit organization that provides much-needed medical services to amputees and other members of the community in the Kono District of Sierra Leone.

Photos courtesy of Katie Hsih

by Chris Emery

After graduating from Princeton University last spring, Katie Hsih went looking for problems to solve. She found plenty in the Republic of Sierra Leone.

Since September, Hsih has lived in a war-torn region of Sierra Leone, working for a nonprofit organization that serves people with few options for health care and basic education.

"My experience is constantly reminding me about how much need there is in the world," Hsih said. "People in many countries and communities are living without running water or electricity, bathing in streams filled with tropical disease and losing their children to diseases that are easily treated in developed nations."

The medical clinic where Hsih works was established in 2006 in the country's war-ravaged Kono District, and is run by the U.S.-based Global Action Foundation and Sierra Leone-based National Organization for Welbody.

The nonprofit organizations were founded by 2003 Princeton graduate Dan Kelly, a physician, and Sierra Leone physician Bailor Barrie to support the clinic in providing medical services and health education to residents of Kono. This diamond-mining region was at the brutal epicenter of the country's decade-long civil war.

During the war, rebel soldiers severed the limbs of civilians as a form of intimidation, leaving many amputees in a region with few medical facilities to offer long-term care. Originally focused on treating amputees, the clinic has since expanded its role to serve the entire community.

Last summer, a nonprofit called Energy for Opportunity installed an array of solar panels to provide electricity for the clinic. Nizette Edwards, a Princeton chemical and biological engineering senior, helped install the panels as part of an internship arranged through Princeton's Keller Center and International Internship Program (IIP). She said the clinic and the solar energy system served as crucial resources for the impoverished community.

"The clinic and the solar array provide more than just health care and energy," Nizette said. "They also provide opportunities for jobs, improved livelihoods and enhanced security to people who truly need it."

Hsih first worked at the clinic during the summer between her junior and senior years at Princeton, as part of a 10-week internship arranged by IIP and the Program in Global Health and Health Policy. She returned in September under a yearlong ReachOut 56-81 International Fellowship, a partnership between the Princeton classes of 1956 and 1981 to fund public service projects by graduating seniors.

Fatu Conteh, a Sierra Leone native who graduated from Princeton in 2010, also received a ReachOut 56-81 fellowship and works for the same organization as Hsih, focusing on education programs to prevent teenage pregnancy in the Kono community.

Hsih, who majored in operations research and financial engineering, said the clinic and other programs run by the organization are growing rapidly, and that her engineering education has helped her manage the complex day-to-day operation of the various projects and conduct health studies in the community.

Her projects include training teenage girls to become peer educators in sexual health at local schools, organizing community health workers to provide HIV patients with home-based medical care and reorganizing the clinic's record-keeping system, including creating a computer database to store medical records electronically. She also is taking the lead in developing an internal communications strategy for the rapidly growing organization.

"My engineering background has shaped the way that I think, and shapes my decision-making skills, which is crucial regardless of the work being done," Hsih said.

She plans to eventually attend medical school, but hopes to continue helping the people of Sierra Leone as she pursues her career in medicine.

"I wanted to become involved in global health work to understand why so many countries around the world lack adequate basic health care and what can be done to improve the situation," she said. "It is a constant learning process and I still do not have these answers. But each day teaches me more about how I can contribute to that world."

Hsih is actively blogging about her experiences at **http://perambulating.wordpress.com**.

As part of her service in Sierra Leone, Katie Hsih worked with girls participating in an education program intended to reduce teen pregnancy and maternal mortality.

ENVISIONING A BETTER WORLD THROUGH ENGINEERING

Nine months in Africa convinced Cole Freeman to major in engineering.

He went to Ghana last year as one of 20 students who participated in the inaugural term of Princeton's Bridge Year Program, which allows students to delay their freshman year to engage in University-sponsored international service.

Freeman worked mostly in Ghana's capital city of Accra and surrounding areas. He taught science to middle-schoolers, helped people develop work skills such as typing and catering and launched a program to reduce the ill health effects of workers who dig through land fills to recover metals from discarded electronic devices.

While teaching in a rural area, he fixed a village chief's blender by filing down some of the gearing mechanisms that connected the pitcher to the base. "When I finished, it worked," he said. "We made mango smoothies."

It was a small triumph, but Freeman says it reminded him that he's always been good at building and repairing things. He realized that he could apply those talents at a larger scale.

"When I was in Ghana, I noticed a lot of problems that I thought engineering could solve," he said. "I'm very interested in sustainable development and international development. If I apply my strengths I can make the world a better place." –CE

ENGINEERS WITHOUT BORDERS: BUILDING COMMUNITY

Princeton's Engineers Without Borders team spent time with school children of Huamanzaña, Peru, during their final trip in August 2010. Princeton students are (in front, from left) Nicole Businelli, Allison Daminger and Courtney Crumper, and (in rear) Hank Song. Next to Song is Don Moris, a retired civil engineer who mentored the group.

When members of the Princeton chapter of Engineers Without Borders (EWB) returned to Huamanzaña, Peru, last summer for their final visit, the work was less about building physical things than building community.

It was the sixth year the undergraduate-led group had been working in Huamanzaña, a mountain town of about 130 people. The group had helped build a holding tank for the town's water line and installed water taps in most of the buildings. The students also designed and installed stoves and chimneys that allowed residents to cook more efficiently and vent smoke out of their living spaces to avoid respiratory illnesses.

On the final visit, the object was to help the community sustain these developments. The students found that some of the metal chimneys had corroded so they helped residents repair them with local materials. They also helped the town establish a committee consisting of residents who would take responsibility for maintaining the water system.

"It really brought home the importance of projects being taken on by the community," said project leader Barbara Hendrick, a junior. "We can bring in all this technology but if you don't have the community support, you'll never really get anything done."

Next year, the group plans to begin work in the nearby town of Samne to help with trash and sewer problems. On campus, EWB also has focused on building community: In November, the group ran a daylong conference called "Collective Motion" that was part of EWB's "campus initiative to generate meaningful, reflective dialogue on what sustainable international development truly means," said chapter president Jane Yang, a senior. –SS

INTERNSHIPS
ENCOURAGE SERVICE

These internships were supported by the Eugene Wong '55 Fund for Engineering and Policy, administered by Princeton's Keller Center.

STEPHEN TUOZZOLO '12
International Water Management Institute in Accra, Ghana

I worked on the Ghana Dams Dialogue, which promotes a more sustainable dam development process. This is done by bringing together stakeholders for meetings and discussions; for instance, a relocated village sends a representative to a meeting with representatives from the various power authorities, ministries and other decision-makers. Such meetings serve to improve relations between these groups and lead to a fair resettlement and compensation process. Working with the Ghana Dams Dialogue gave me the opportunity to view dam development through social, political, environmental and economic lenses. The opportunity to visit traditional communities that will be resettled in the near future was incredible.

ALTHOUGH TECHNOLOGY MAKES A DIFFERENCE, IT IS ONLY SUSTAINABLE WITH THE APPROPRIATE POLICY IN PLACE.
–EDEN FULL

EDEN FULL '13
Solar For All, a joint initiative of Ashoka and the Canopus Foundation

My primary responsibility was to assist in developing an understanding for how policy in developing countries has to change to improve the accessibility of solar technology. I focused on one particular research project involving the company Calisolar, which holds patents for a process for purifying metallurgical grade silicon into 15-percent-efficiency solar wafers. I conducted extensive background research on the technology, wrote reports and then prepared a final proposal for a collaboration with Calisolar. Following this internship, I conducted research with Professor Wole Soboyejo at Princeton, concluding with a trip to Mpala, Kenya, where I helped two villages install their first solar-powered battery charging stations. This summer helped me understand that although technology makes a difference, it is only sustainable with the appropriate policy in place.

HARLAN YU, graduate student
U.S. Department of Labor, Washington, D.C.

I spent the spring and summer working on open government issues. The White House last December instructed each agency to establish a plan to increase its efforts in transparency, participation and collaboration. I helped to develop and write the labor department's plan—which was due at the end of my first week—and spent the remainder of my time implementing it. I focused on our transparency initiative, and in particular, on identifying high-value documents and datasets that could be published online in the most useful way possible. I also worked collaboratively with the White House Office of Science and Technology Policy to increase public participation across the entire executive branch, among other projects. This was my first experience working in the federal government and it was a very positive one.

PRINCETON NAMED CYBERSECURITY HUB BY NATIONAL SECURITY AGENCIES

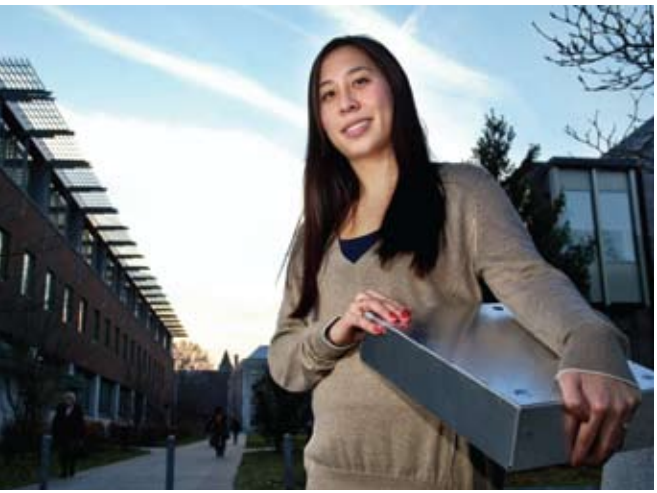


Photo by Frank Wojciechowski

For her graduate research, electrical engineering student Maddie Lu is developing a device (seen here) to prevent wireless signals from interfering with each other. Princeton's recent designation as a national cybersecurity center is intended to encourage such information assurance research and attract talented scientists to national security service.

by Chris Emery

Maddie Lu returned to Princeton University as a graduate engineering student this fall to finish what she started as an undergraduate: building a communications device to help safeguard U.S. soldiers in the battlefield.

Her goal is for the device to prevent wireless communications systems used by the military, police and other first-responders from interfering with one another when they are most needed.

"I learned about this project as an undergraduate, and after we got the principles of the device worked out, I thought it was fascinating," said Lu, who graduated in 2009 with a degree in electrical engineering.

The federal government announced last summer that Princeton will have special status as a hub for cybersecurity research, opening the door to more research such as Lu's, which uses engineering expertise to solve national security problems. Universities with this status are designated a National Center of Academic Excellence in Information Assurance Research. The program is administered by the National Security Agency (NSA) and the Department of Homeland Security.

The program allows Princeton faculty and students to apply to federal agencies for special fellowships, scholarships, internships and research funding related to information assurance, the practice of protecting sensitive national security data.

The Princeton program will be administered by the University's Center for Networks Science and Applications.

Princeton is one of seven U.S. universities accepted into the research program for the 2010-15 term, bringing the total number of centers to 47. The other newly accepted universities are Kansas State University, Purdue University, the University of Memphis, the University of Connecticut, Virginia Tech and West Virginia University.

"The National Security Agency and the Department of Homeland Security are looking for smart American citizens to help address the technical challenges of national security," said Paul Prucnal, a professor of electrical engineering who spearheaded Princeton's involvement in the program. "This gives faculty and students here an opportunity to pursue funding from NSA and DHS and will open doors for students who want to pursue careers in national security."

In addition to research funding and fellowships, the designation allows Princeton students to apply for the Department of Defense Information Assurance Scholarship Program and the Federal Cyber Service Scholarship for Service Program.

The programs provide scholarships to rising juniors and seniors and graduate students. Those selected for the program receive funding for tuition, books and other education costs and a stipend to cover room and board.

Lu participates in a similar NSA program, which supports her research in exchange for her serving as an intern at the security agency for two summers.

"It frees me from having to work as a teaching or research assistant, so I can focus on building this device," she said. "I have to spend summers working for NSA, but that seems pretty interesting."

PRINCETON ENGINEERS BRING

TECHNICAL EXPERTISE

TO GOVERNMENT SERVICE

by Chris Emery

In his first year out of Princeton, Michael Konialian helped the U.S. State Department advance international cooperation to address climate change and reduce the risk of dangerous materials from nuclear reactors falling into the hands of terrorists.

"It has opened my eyes to the sheer amount of meaningful work done by the government," said Konialian, who graduated from Princeton with a degree in mechanical and aerospace engineering in 2009. "It also helped me understand how all the pieces fit together, whether it's mitigating climate change or enhancing nuclear security."

Konialian is the second Princeton engineering graduate to participate in the Scholars in the Nation's Service Initiative, a program that combines government service with graduate studies at Princeton's Woodrow Wilson School of Public and International Affairs.

Participants in the program complete a government internship between their junior and senior years at Princeton. After graduation they serve in the U.S. government for two years before returning to Princeton to complete a two-year master in public affairs program in the Wilson School.

Ishani Sud, the first engineering graduate to participate in the program, has returned for her graduate studies after two years of working as a technology analyst in Washington, D.C. She found that her training as an engineer put her in demand during her stint in government service.

"They really needed me to get to work right away," she said. "There are so many problems that are going to need to be tackled. The government needs people who understand technology to develop many of the solutions."

Konialian started his two years of service working for the U.S. State Department in the United Kingdom where he worked to enhance cooperation between the United States and the United Kingdom on alternative energy development and analyzed the U.K. government's climate change policies.

He worked closely with British scientists and government officials to develop connections between U.S. universities and government agencies and their counterparts in the United Kingdom. He focused on efforts to develop technologies that capture carbon emissions from burning fossil fuels and store that excess carbon underground, thus preventing it from entering the atmosphere.

His second post is with the State Department Office of Nuclear Energy, Safety and Security in Washington, D.C., where he focuses on policies intended to prevent terrorists from obtaining highly enriched uranium and radioactive sources used in civilian nuclear plants.

"Basically, the office works to prevent the bad guys from getting access to nuclear materials," he said. "We are able to produce civil power and medical isotopes using low-enriched uranium now, which greatly reduces the proliferation risk of highly enriched uranium. We know what economic and policy mechanisms are needed and have the technological platform, but we have to get everyone working together to make it all work."

When he returns to Princeton, Konialian plans to focus his graduate studies on issues at the intersection of science and international relations. "The program has enabled me to focus on the topics that interested me most," he said, "and given me great latitude to pick the type of work I want to be doing." E

Michael Konialian, seen above in the U.S. State Department diplomatic lobby in Washington, D.C., has worked for the State Department as part of his participation in Princeton's Scholars in the Nation's Service Initiative.

As part of the Scholars in the Nation's Service Initiative, Ishani Sud conducted research on an American military base in Okinawa, Japan, during a summer internship prior to her senior year at Princeton. Below, she is seen on the deck of the USS Kitty Hawk off the coast of Australia.

FTC APPOINTS PRINCETON COMPUTER SCIENTIST FELTEN AS CHIEF TECHNOLOGIST

Photo by Jamie Rose

The U.S. Federal Trade Commission (FTC) has named Edward Felten, a Princeton professor of computer science and public affairs, as the agency's first chief technologist to help guide government policy in an era when technology has a growing influence on businesses and consumers.

Felten is the founding director of the Center for Information Technology Policy (CITP), a Princeton research center that explores the connection between technology, government policy and the social sciences. He will take a leave of absence from the University for his one-year appointment to the trade commission position, which will begin in January.

Felten will advise the agency on evolving technology-related issues of consumer protection, such as online privacy and cybersecurity, and antitrust matters, including tech-industry mergers and anticompetitive behavior.

"The trade commission is heavily involved with issues that touch on technology," Felten said. "Much of my research and the work of CITP focuses on issues of consumer protection and competitiveness. This is a chance for me to apply what I've been studying and see the policy-making process from the inside."

During Felten's leave of absence, Margaret Martonosi, also a professor of computer science in Princeton's School of Engineering and Applied Science, will serve as the acting director of CITP. The center is a joint venture of the engineering school and the Woodrow Wilson School of Public and International Affairs, where Felten also holds a faculty appointment.

Felten is the lead contributor to Freedom to Tinker, an influential technology blog hosted by CITP. In announcing Felten's appointment, the trade commission noted his expertise in computer security and privacy relating to consumer products, technology law and policy, Internet software, intellectual property policy and the use of technology to improve government.

"Ed is extraordinarily respected in the technology community, and his background and knowledge make him an outstanding choice to serve as the agency's first chief technologist," said FTC Chairman Jon Leibowitz.

"He's going to add unparalleled expertise on high-technology markets and computer security," Leibowitz added. "And he also will provide invaluable input into the recommendations we'll be making soon for online privacy, as well as the enforcement actions we'll soon bring to protect consumer privacy. We're thrilled to have him on board."

Felten has advised the trade commission on Internet privacy and safety issues related to children and on the recent proposal to create a "Do-Not-Track" registry that would allow consumers to opt out of having their Internet activities collected by businesses. He has served as a policy consultant for the agency since August.

–CE

GAST SERVES AS U.S. SCIENCE ENVOY

The Obama administration has appointed Princeton engineering alumna Alice Gast as one of three State Department envoys charged with promoting U.S. global engagement in science and technology.

According to the State Department, she will use this role to "deepen existing ties and foster new relationships with foreign counterparts and gain insights from other nations about potential areas of collaboration."

Gast, who has been president of Lehigh University since 2006, earned her Ph.D. in chemical engineering from Princeton in 1984.

"I have always felt that science diplomacy is an extremely fruitful way to build relationships between countries and people," Gast said. "It is exciting to see our government taking a leading role in such an approach and I am pleased to be a part of it."

The Science Envoy program, announced by President Obama in Cairo in June 2009, has the goal of creating global collaboration on developing new sources of energy, creating green jobs, digitizing records, providing clean water and growing new crops.

Photo courtesy of Alice Gast

Storm chaser: Augustine keeps up pressure on competitiveness

"Rising Above the Gathering Storm," the 2005 report issued by a National Academy of Sciences committee led by alumnus **Norman Augustine**, made a powerful impression with its stark analysis of science and technology education and funding in the United States.

The report inspired the America Competes Act, federal legislation that included a range of provisions, such as increased funding targets for research. It also provided some of the basis for stimulus package spending aimed at science and technology. However, in a five-year follow-up, the committee, again led by Augustine, found that the ability of the U.S. to compete for quality jobs has continued to deteriorate.

The committee's new report, issued in September, has a new subtitle that reflects Augustine's wry manner: "Rising Above the Gathering Storm, Revisited: Rapidly Approaching a Category 5." In interviews, Augustine called for more sustained investments with long-term horizons. "By focusing so much on short–term bursts of spending, we're not paying enough attention to core problems like quality of teaching and the need for scientific research investments that could pay huge dividends in the long term," Augustine told *The New York Times*. "We're in a marathon, not a sprint."

Augustine earned his bachelor's and master's degrees in aeronautical engineering from Princeton in 1957 and 1959 and went on to become chief executive officer and chairman of Lockheed Martin Corp. –SS

Photo by Frank Wojciechowski

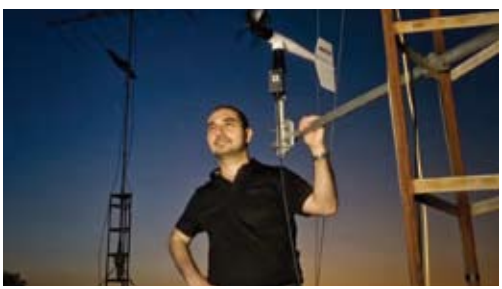


Photo of Elie Bou-Zeid (top) by Volker Stieger; photo of Edgar Choueiri (left) by Frank Wojciechowski, and photo of Ed Weng (right) is courtesy of Ed Weng.

Videos feature Princeton engineers

Elie Bou-Zeid, an assistant professor of civil and environmental engineering, is creating a wireless sensor network across campus to map the microclimate of Princeton. Bou-Zeid aims to better understand how local built environments can influence climate on a global scale.

Edgar Choueiri *91, professor of mechanical and aerospace engineering, is a leading expert in deep space propulsion but has a burgeoning interest in acoustics and how the brain locates the sources of sounds in space. He invented a technique for creating true 3D sound, which is demonstrated in the video.

Ed Weng '10 and fellow students shot footage as they field-tested Weng's "unplugged water pump"—powered by a bamboo bicycle—in Kenya. Weng developed the pump, which was part of his senior thesis work, to provide clean drinking water to remote areas. (At left, Weng worked with Princeton engineering graduate student **Ismaiel Yakub** while in Kenya.)

Watch these videos and many others at **www.princeton.edu/engineering/video**.

Engineering ethics courses emphasize responsibility

Photo of Claire Gmachl by Frank Wojciechowski

No longer just the province of the humanities, the study of ethics is taking on a greater role in engineering. In the fall 2010 semester, two courses—one graduate, one undergraduate—introduced students to the complex professional and societal implications of conducting research and bringing new technologies to market.

Claire Gmachl, professor of electrical engineering, taught "Responsible Conduct in Research: A Course on Ethics in Engineering," a new half-semester course required of all engineering graduate students. In addition to providing a brief background in moral philosophy, the course covers topics such as research misconduct, credit and authorship in publications, student-adviser relationships, collaborations, and the wider societal implications of engineering decisions.

Responding to both Princeton University and federal agency requirements, Gmachl volunteered to teach the course for engineers and worked with the Keller Center to plan and develop the content.

"It's not just for their time as graduate students; it's training for a profession," said Gmachl, noting that the University and society put a lot of resources into graduate education. "What we ask in return is their honest work and their good judgment to solve societal problems. It's a big responsibility and it's important to live up to it."

Jay Benziger, professor of chemical and biological engineering, taught "Ethics and Technology: Engineering in the Real World," which drew 29 undergraduates, including a number from outside the engineering school. The course focuses less on research misconduct and more on the decisions and tradeoffs engineers face in developing technologies for market.

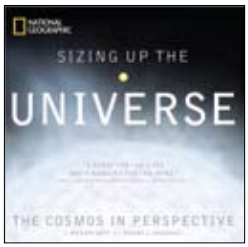
Case studies in the course range from safety failures in the auto industry to the unintended consequences of innovations such as freon, the ozone-depleting refrigerant.

"Technology shapes our society and political institutions in ways we don't get to vote on," Benziger said. He cited the invention of ever-larger farm equipment that increased yields and helped drive a shift toward corporate mega-farms.

"I'm trying to raise these issues for students. I don't have all the answers," Benziger said. "But as an engineer you really do have an ethical responsibility because your work really impacts society, whether you know it or not." –SS

Putting the universe in perspective

Robert Vanderbei, professor and chair of operations research and financial engineering, has taken on a big topic: the universe. Working with Richard Gott, professor of astrophysical sciences, Vanderbei has co-written *Sizing Up the Universe*, a 240-page, picture-packed book published by National Geographic.



Tying together an image of an astronaut's footprint on the moon with the last echoes of the big bang itself, the book takes an engaging approach to helping readers comprehend the vast range of sizes that exist in the universe.

Vanderbei, whose background is in applied mathematics, transitioned his research about 10 years ago into helping develop space-based systems that could directly capture images of planets circling stars other than our own. He also pursues a hobby of astrophotography, and many of his images are featured in the book.

Photo by Frank Wojciechowski

Photo courtesy of Lynn Loo

Lynn Loo, an expert in flexible plastic electronics, received considerable media attention as a featured presenter at the summer meeting of the World Economic Forum in Tianjin, China.

Loo is featured presenter at world economic meeting

Princeton engineer **Lynn Loo *01**, who researches plastic electronics, was one of five early-career scientists who spoke in September at the World Economic Forum's "Annual Meeting of the New Champions" in China, otherwise known as Summer Davos.

Plastic electronics is a young and growing field that can potentially change the quality of human life in many ways, from greener sources of energy to better health monitoring, according to Loo, an associate professor of chemical and biological engineering.

"Imagine electronic wallpaper that changes patterns from green stripes to pink polka dots at a click of a switch," said Loo. "Imagine tinted windows that can also generate power during the day. Imagine disposable sensors that would change color if the water source is contaminated, or yet, think of smart plastic patches that can monitor your health and deliver medication when you're sick. The possibilities are endless."

Loo explains her work in more detail in a video that also features beautiful images of her materials and lab: **www.princeton.edu/engineering/video**.

Undergrads win hydrogen production contest

True to its name, the homemaker's hydrogen generator featured a reactor vessel from Walmart and a whole lot of caulk.

The student-made device also produced enough clean-burning hydrogen fuel to win first place in an international competition sponsored by the International Association for Hydrogen Energy (IAHE). The all-undergraduate team put about $600 worth of materials into its device, which used a solar panel to produce electricity that split water into hydrogen and oxygen.

"We realized we couldn't compete with the scientific literature in terms of time, resources and knowledge," said **Katherine Song**, a senior majoring in electrical engineering, and co-captain of the 10-student team. "We took a low-level approach that anyone could understand."

The project started in the fall of 2009 when seniors **Jane Yang** and **Yin Liang**, both chemical and biological engineering majors, started a Princeton student chapter of the IAHE with Professor **Jay Benziger** as the club's adviser. With the contest as the club's first venture, the students worked through the winter, hitting numerous roadblocks, including an inexplicable lack of hydrogen.

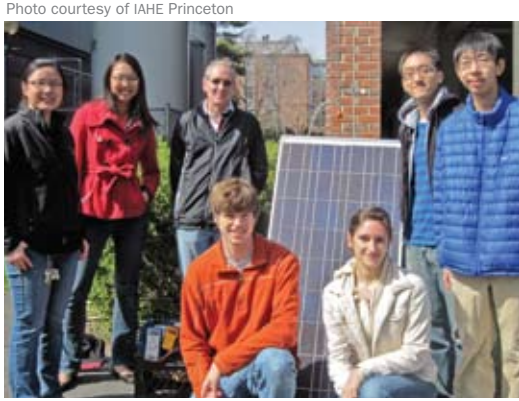
"One day I just went nuts with the caulk," said Song. The problem, which turned out to be many tiny leaks, was solved.

The students' write-up of their results, titled "A portable hydrogen generator for the homemaker," is due to be published in the International Journal of Hydrogen Energy. Their win also allows them to send five students to the World Hydrogen Energy Conference in Toronto in June 2012.

The project received support from the Kurtz Fund for Innovation in Engineering Education.

For more details on the group and to see a video explaining its submission, visit **www.princeton.edu/~iahe**. –SS

Photo courtesy of IAHE Princeton



Professor Jay Benziger (rear center) served as adviser to an undergraduate team that won an international hydrogen energy competition. Members of the 10-student team posing with their device are, from left: Yin Liang, Jane Yang, Alex Tait, Nicole Businelli, Leo Shaw and Michael Zhu.

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