COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON

the Trend in engineering

Autumn 2009: Volume 59, Issue 2

Progress on Key Fronts

We begin fall quarter with good news on two fronts. I'm especially excited that we break ground for the Molecular Engineering Building on October 9. A year ago we worried about having sufficient funds to build out all five levels in one phase. Now the timeline is looking good, as we are achieving excellent value on the construction costs, and we expect to open the doors in early 2012.

I'm also very happy with the caliber of the three candidates for director of the molecular engineering program, all UW faculty members. Each is first rate, and choosing among them will be difficult. We expect to announce the director by year end.

Progress on these two fronts ties closely to a third. This year we have hired 14 junior faculty members, all exceptional, in areas ranging from nanotechnology and molecular engineering to transportation systems, sustainable energy, and even a first joint appointment in computer science and genome sciences. You can learn more about these new faculty members at www.engr.washington.edu/facresearch/newfaculty2009.html.

These 14 plus the 13 faculty hired last year indicate continued growth, despite the economic downturn. We are sustaining our most important work and are well positioned to grow further when the economy rebounds. The faculty we have hired over the past five years are absolutely spectacular, confirmed by the research grants they are securing and national recognition through prestigious CAREER and PECASE awards. Our eight NSF CAREER award winners for 2009 rank us second among peer engineering schools (see page 7).

We must continue bringing in top young faculty, and the Molecular Engineering Building will help us do so. Many of these faculty members were drawn by this emerging program, and by the University's strengths in materials science and engineering, bioengineering, and the medical/genome sciences.

Yet another excellent piece of news is the appointment of Dan Schwartz to chair Chemical Engineering. He served the college for several years as associate dean for new initiatives and has been a key driver in developing the molecular engineering program. I'm most excited that he will leverage this expertise to partner with Bioengineering and Materials Science & Engineering on new programs. Eric Stuve has earned a big "thanks" for nearly ten years of service as department chair, for his fine leadership of students and faculty, and especially shepherding curriculum reform.

As fall quarter resumes, the college welcomes a record enrollment of undergraduate and grad students. It's energizing to see the campus once again in high gear.

Matthew O'Donnell
Frank and Julie Jungers Dean
of Engineering

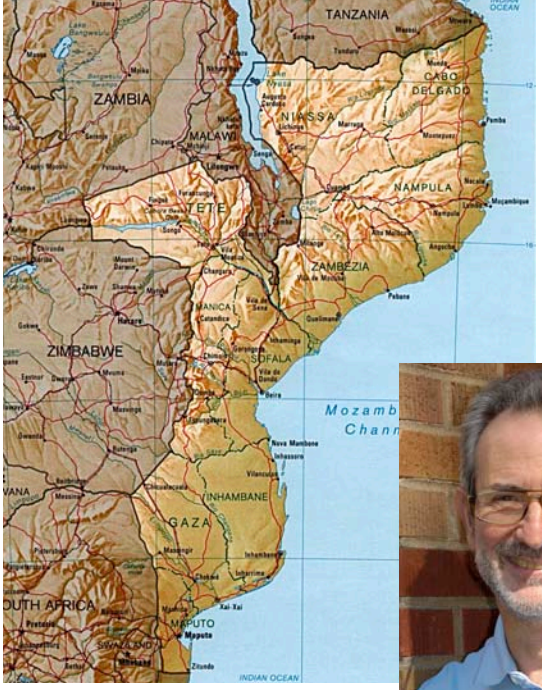
Molecular Engineering Groundbreaking

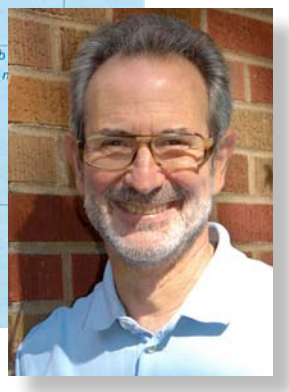
October 9 – 3:30 to 4 pm

Dean Matt O'Donnell and UW officials lead the ceremony at Grant Circle near Gerberding Hall, just north of the building site on Stevens Way. Join us to cheer the symbolic construction launch of the 160,000-square-foot facility. It will house interdisciplinary laboratories, faculty offices, meeting rooms, and space for graduate students.

Lamborghini Laboratory Dedication

Aeronautics & Astronautics will dedicate the Automobili Lamborghini Advanced Composite Structures Laboratory on October 6. Automobili Lamborghini S.p.A. provided generous support for the laboratory, established in late 2007 with the reopening of Guggenheim Hall. The ACSL, directed by Assistant Professor Paolo Feraboli, hosts research activities focused on the safety and certification of composite aircraft structures.





Professor Richard Storch, chair of ISE, will visit Mozambique in February.

ISE Charts New Mission with Global Reach

Industrial & Systems Engineering boasts more than an expanded name. Its mission also is expanding, geographically and across disciplines that might seem surprising at first glance. ISE's work now extends all the way to Mozambique, on Africa's southeast coast, thanks to a collaboration with the UW Global Health program in the School of Public Health and Health Alliance International (HAI), an affiliated nonprofit organization.

HAI received a seven-year $10 million grant from the Doris Duke Charitable Foundation to work with the Mozambican Ministry of Health to strengthen primary health care in a region hard hit by the AIDS epidemic, poverty, and other challenges. Project teams will work in Sofala Province in central Mozambique, where fewer than ten doctors serve more than 1.6 million people — most living without running water and electricity.

"ISE is contributing expertise in three main areas," said department chair Richard Storch. "We're looking at ways to help district health care managers improve the productivity of hospital clinics and health care centers, the logistics for delivering drugs and supplies, and the allocation of health care providers."

As the economy has shifted in recent decades, the field of industrial engineering has been moving away from a manufacturing focus to a service industry focus. Coincident with the rising concern over the efficiency, quality, equity, and cost of America's health care system, health systems engineering is becoming a major specialty area of research and teaching.

With grant funding, ISE is developing a Center for Health Systems Engineering Best Practices that will concentrate in three areas: (1) major urban hospitals starting with UW Medical Center and Children's Hospital, (2) the Mozambique project, and (3) U.S. inner city public health clinics and clinics serving remote rural areas.

In addition to Storch, participating ISE faculty include Zelda Zabinsky, Christina Mastrangelo, and Archis Ghate. Initially, the center will fund the work of two graduate research assistants, with a longer term plan to hire a center director and two new junior faculty who specialize in health systems engineering.

"We are probably one of the few industrial engineering programs working in the global arena," Storch said. "It's tremendously exciting because we are tapping into a growing strength in the Seattle area and at the UW. We are already attracting engineering students who want to pursue careers in global health."

There's a lot more UW Engineering news online! www.engr.washington.edu/news/news.html

- **Engineering Spinoff Wins $21 Million Federal Grant**

  EnerG2, a Seattle-based company spinning off from work in MSE professor Guozhong Cao's lab, is developing next-generation batteries based on nano-structured material. EnerG2 will receive $21 million in federal stimulus funds to build a manufacturing plant in Oregon. *Learn more on the News site.*

- **New Semiconductor to Allow Simpler Circuit Design**

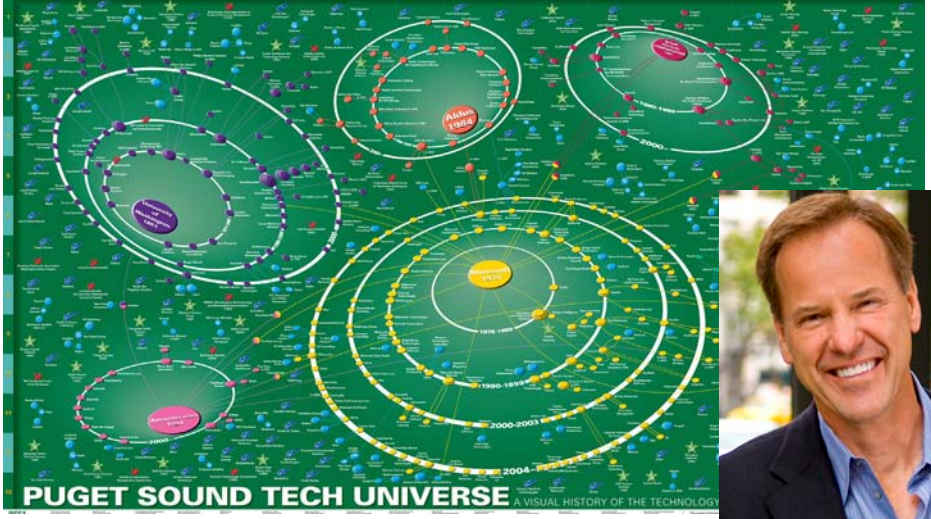
  An organic circuit developed by Chemical Engineering professor Sam Jenekhe offers promise for thinner and more flexible electronics. Jenekhe overcame a big problem with polymer semiconductors by creating one that transmits both positive and negative charges. *Learn more on the News site.*

- **CSE Student Creates Technology for Self-Destructing Digital Data**

  Doctoral student Roxana Geambasu, working with Professor Hank Levy, developed Vanish, software that will make messages and data disappear after a specified time. *Learn more on the News site.*

- **Student-Built Rocket Blasts More Than Two Miles High** *See video on the News site.* ▶▶▶▶▶▶

Help UW Engineering Go Green — Subscribe to *The Trend* online at www.engr.washington.edu
Click the signup for electronic communication link in the upper right corner of the home page.



The map is online at: http://uwnews.org/uweek/article.aspx?id=47426

A strong research university has a huge impact on the flow of ideas and people into industry. The UW is absolutely fundamental to the continuing economic vitality of the region. J. Jaech

Jeremy Jaech

A Supernova in Our High-Tech Economy

Aldus Corporation (orange on the map) is a high-profile early sun in the evolution of the Puget Sound technology universe. UW computer science alumnus (MS '80) and Aldus co-founder Jeremy Jaech led development of PageMaker, its revolutionary graphic software and a key driver of the desktop publishing revolution. Even 15 years after its merger with the San Jose-based Adobe, which established a satellite presence in Seattle, Aldus alumni feed the universe with talent and seed startups.

Jaech scored another spectacular success with Visio, paradigm-changing technical drawing and diagramming software that filled a big need in the business world. Microsoft recognized a good thing, purchased the company for $1.3 billion in 2000, and markets Visio worldwide as a stand-alone MS Office application.

Both Aldus and Visio were engines for job creation, hiring hundreds of talented UW grads and others, and providing the training and experience that propelled many into influential positions in the high-tech sector.

Late last year, Jaech took on a new challenge as CEO of Verdiem, a young IT company that develops power managment software for PC networks. IT accounts for about 4% of total energy usage around the world, and organizations and individuals waste $4 billion a year and exacerbate carbon emissions by leaving computer equipment on 24 hours a day. The City of Seattle has already reduced PC energy use by 35% after deploying Verdiem software on more than 8,000 computers.

"My mission is to scale up the company. We have enormous potential for growth as more businesses and institutions look for ways to go green and save money. We can have a big impact on the environment," Jaech said.

Jaech also has fueled the local economy over the years by securing more than $50 million in venture capital, mostly from California. He sees access to capital as one pillar of a thriving high-tech sector, the others being excellent education and research institutions that generate innovation and a skilled workforce.

As chair of the Technology Alliance, a statewide organization of technology leaders, Jaech believes that promoting an innovation economy is essential to Washington's ability to thrive in a competitive world.

▶ **Read more about Jeremy Jaech at: www.engr.washington.edu/alumcomm/jaech.html**

Jaech's Corporate Ventures ~ Innovation & Impact

ALDUS •

Co-founded:	1984 with four colleagues
Core Product:	PageMaker desktop publishing software
Impact:	Revolutionized publishing amd graphic design
Jaech Role:	VP engineering & software development till 1989
Employees:	1000 by 1989
Merger:	1994 with Adobe, Inc., $535 million stock exchange

VISIO •

Co-founded:	1990 with two colleagues
Core Product:	Visio technical drawing and diagramming software
Impact:	Groundbreaking business software; used by 3.5 million people worldwide by 1999
Jaech Role:	President & CEO, 1990–2000
Employees:	600 in Seattle, 100+ internationally in 1999
Acquired:	By Microsoft in 2000 for $1.3 billion

TRUMBA •

Co-founded:	2003 with two colleagues
Core Product:	Web-based calendar sharing software
Impact:	400 customers include Seattle Public Library, New York Times, Smithsonian Institution
Jaech Role:	CEO till January 2008; remains co-owner

VERDIEM •

Established:	2001 (Jaech was not involved)
Core Product:	Surveyor "green IT" power-management software for PC networks
Impact:	Reduces network power usage by >30%; Key clients include city of Seattle, King County, Washington and California state agencies, and Cox Communications
Jaech Role:	CEO since November 2008

Photos courtesy of NASA

Gregory C. Johnson

High-Flying Pilot to the Hubble Telescope

It's a stunner. One of the first images taken by the rejuvenated Hubble Space Telescope blazes with 100,000 stars residing in the crowded core of Omega Centauri, the biggest star cluster in the Milky Way.

"It looks like lots of Christmas lights with red giants, young yellow stars, and cooling blue stars," said Gregory Johnson (AA '77), pilot on the Atlantis crew that flew the last service mission to Hubble. "I'm just ecstatic to see the new images. They are ten times better than previous ones. Astronomers are besides themselves, and the public is excited too."

The new images are the reward for accomplishing all goals on an extremely difficult and risky mission. The seven astronauts spent 12 plus days orbiting 350 miles above the earth in a zone with more space debris than at the 220-mile altitude of the International Space Station.

Five space walks enabled the astronauts to equip Hubble with a powerful $132-million camera, a new spectrograph, six gyroscopes, batteries, and other equipment. Hubble should be "good to go" for at least another five years, peering into the depths of the universe and beaming back images and data.

Johnson first heard about Hubble in 1998, on his second day working at NASA, the very day after the telescope launched into orbit. He could hardly have imagined that his first space flight would be a seat on the last Hubble mission, a highly coveted assignment.

His thoughts when the auxiliary power units turned on a few minutes before liftoff on May 11? "This is not a simulation. We're going!"

No doubt about that when the engines lit up and Johnson felt "a whole lot more shaking than in the simulator — 7.5 million pounds of thrust and high-energy physics at its best." An alarm sounding one second after launch and another 30 seconds later diverted his attention from shaking to troubleshooting, but he and mission commander Scott Altman found no major problems.

Johnson explains the pilot's role as the mission jack-of-all-trades, schedule tracker for daunting 17-hour work days, and backup to the commander. "It's co-pilot duty, but astronaut pilots don't like that title," Johnson admitted with a laugh. He handled many of the thruster burns to position Atlantis so Altman could fly it in close to Hubble, and had a brief stint at the controls after reentering the earth's atmosphere on the flight home. He's still amazed at "having my hands on a $2 billion space ship — big, complicated, and 250,000 pounds, but very responsive."

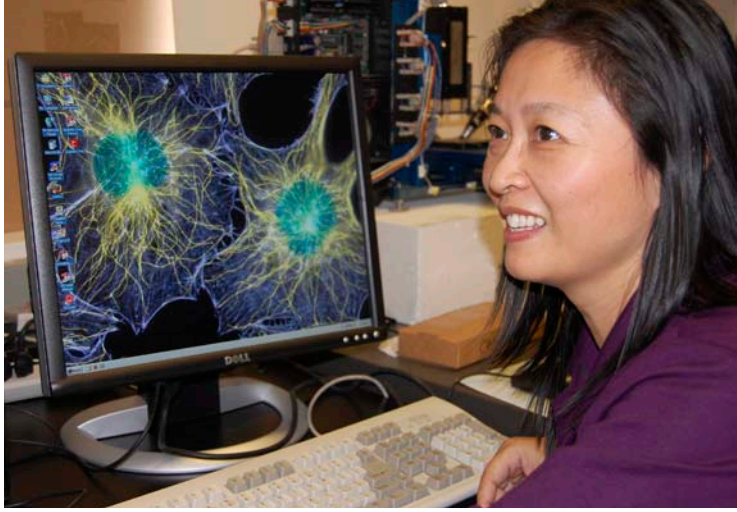
It's a long way from the seaplanes Johnson flew for Kenmore Air to pay his way through the UW, also helped along by a Boeing scholarship. AA chair Adam Bruckner remembers him as a smart, attentive student who sat in the front row during lab classes.

"My AA studies taught me the value of critical thinking and making decisions based on data," Johnson said. Even at NASA, stocked with engineers and scientists, he stands out as a "show me the data" guy.

After UW, Johnson entered the Navy, becoming a top aircraft carrier pilot, with more than 500 landings and 9000 flight hours in 50 aircraft types. He then joined NASA as a test pilot for the KC-135 microgravity plane and high-altitude WB-57.

"There was only one other flying job in the universe I wanted," he said. That provided a spectacular view, dramatic sunrises and sunsets, and a role in keeping Hubble alive to expand our knowledge of the universe. He filmed the mission for an IMAX documentary to be released in 2010. "You'll feel like you're there," he said. Don't miss it — and do register for his November 4 UW talk at UWalum.com.

▶ **Johnson speaks at UW on November 4,** see pg 8.



Scorpion venom, crustacean shell, and nanoparticles are the stuff of scientific breakthrough for Miqin Zhang. Her work with these substances has produced stunning advances that one day could revolutionize treatment for intractable medical problems such as brain cancer and nerve injury.

Tiny but Mighty: A Nanoprobe Conquers the Blood-Brain Barrier

The blood-brain barrier, long considered virtually impenetrable, has given way to the invasive prowess of a specially designed nanoparticle. This achievement is turning scientific heads, but more important, holds promise for vastly improving diagnosis and treatment of brain tumors, among the most deadly cancers.

Leading the interdisciplinary team of UW engineering and medical scientists is Miqin Zhang, professor of materials science and engineering and adjunct in radiology, neurological surgery, and orthopaedics/sports medicine.

In the team's landmark study, fluorescent nanoprobes injected into the bloodstream of mice crossed the blood-brain barrier and attached to tumors, lighting them up. "We call it brain tumor illumination or brain tumor painting," Zhang said.

In the brain, cancer invades the surrounding tissue, without a clear boundary between normal tissue and the tumor, which makes diagnosis and treatment more difficult. The nanoparticles increase the contrast between cancerous and normal tissue in MRI scans and in optical imaging used during surgery (sidebar). They could improve imaging resolution by a factor of ten, to detect smaller tumors and enable earlier treatment.

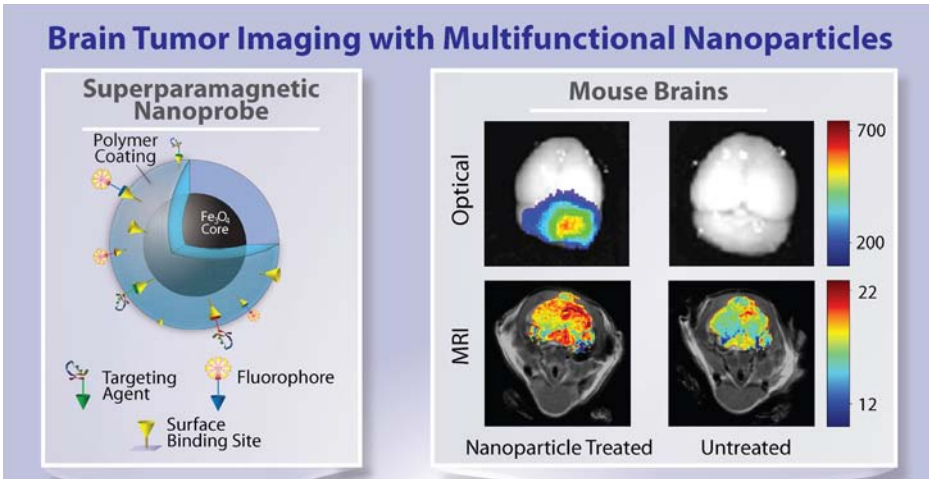
"Precise imaging of brain tumors is phenomenally important. Patient survival is directly related to the amount of tumor that you can resect," said Richard Ellenbogen, professor and chair of neurological surgery and research team member. "This is next-generation imaging."

The team's nanoprobe (sidebar) is an iron oxide nanoparticle coated with a biocompatible co-polymer and coupled with a tumor-targeting agent and an infrared fluorescent dye. It is a third the size of nanoparticles used elsewhere in the body.

The probe's tumor-targeting agent is chlorotoxin, derived from scorpion venom. It binds to a surface protein produced in excess by many types of tumors. For more than a decade, researchers have been studying chlorotoxin's ability to disrupt the spread of invasive tumors, and some centers are now conducting trials in cancer patients.

Zhang's team decided to try using nanoparticles as the delivery system for chlorotoxin. They grew mouse-brain cancer cells in the lab and found that the chlorotoxin attached to nanoparticles decreased tumor spread by 98 percent, more than twice the decrease for chlorotoxin alone. The combined particle may inhibit the tumor cell's ability to elongate and thus more easily invade other tissue.

"This finding was quite a surprise to us," Zhang said. "We think this approach also might be useful in slowing the spread of cancers of the breast, colon, skin, lung, prostate, and ovaries."



The nanoprobe (left) has an iron oxide core coated with a co-polymer of polyethylene glycol and chitosan. The tumor-targeting agent (chlorotoxin) and fluorescent dye (fluorophore) bind to the probe. The nanoprobes attach to tumors in mouse brains (left column above) and "light them up" to reveal the tumors more distinctly than in the untreated brains (right column).

Zhang received funding from the National Institutes of Health, the National Cancer Institute, and the National Institute of Biomedical Imaging and Engineering.

Rejoining Severed Nerves

Zhang and her team also have taken on a big problem impeding regeneration of severed peripheral nerves. At each nerve end surgeons graft on tiny tubes, called nerve guides, to channel the severed nerve fibers to grow toward each other. Commercial nerve guides made from collagen (a protein) can trigger an immune response and are prone to collapse in wet environments.

"A nerve guide needs to be biocompatible, stable in solution, resistant to collapse, and also pliable, so that surgeons can suture it to the nerve," Zhang said.

Chitosan, found in the shells of crab and shrimp, is biodegradable and biocompatible and is FDA approved for many applications, but like collagen, it also weakens in the wet environment inside the body.

Zhang and colleagues created a new hybrid fiber of chitosan and a strong, flexible, biodegradable polyester commonly used in sutures. The nanoscale-size woven fibers combine the biological advantages of the natural material with the mechanical strength of the synthetic polymer.

"The new material would work well for wound dressings, heart grafts, tendons, ligament, cartilage, muscle repair, and other biomedical applications," Zhang said.

The team has filed a patent and early next year will establish a spinoff company to make three-dimensional scaffolding and other materials for varied applications and for the next stages of testing and research by diverse institutions.

"We are the only group with the technology to make these hybrid materials, and they should have wide commercial applications in medical care," Zhang said.

This research is funded by the National Science Foundation, the National Institutes of Health, and other sources.

▶ **Read more and find links at: www.engr.washington.edu/news/**

New NSF CAREER Awards Bring 2009 Total to Eight

UW Engineering's eight National Science Foundation CAREER awards to young faculty ranked us among the top in the nation among our peer engineering programs. Magda Balazinska (CSE), Luis Ceze (CSE), Tadayoshi Kohno (CSE), and Maryam Fazel (EE) received their awards earlier this year. In the last three years UW faculty have won 15 NSF Career Awards and three PECASE Awards. Congratulations to all for this prestigious recognition.


Hochberg


Chung


Otis


Sniadecki


Wang

Michael Hochberg, assistant professor of electrical engineering, has won a coveted Presidential Early Career Award for Scientists and Engineers (PECASE) for his work in nanophotonics. Hochberg directs the UW's Nanophotonics Laboratory and is installing a multimillion-dollar electron beam lithography tool that will be used to create prototypes for nanotechnology designs. He was nominated by the Department of Defense and receives $1 million over five years.

Jae-Hyun Chung, assistant professor of mechanical engineering, received a National Science Foundation CAREER award for faculty early career development. The award of $400,000 over five years will support his research on using a nanostructured tip for detecting circulating DNA without amplification. This work has applications for disease diagnostics and environmental monitoring.

Brian Otis, assistant professor of electrical engineering, has received a CAREER award from the National Science Foundation for research using an ultra-low power, flexible 2-D electrode array to record signals on the surface of the brain. This new approach holds promise for future neuroprosthetic devices. The five-year award provides $400,000 for his research.

Nathan Sniadecki, assistant professor of mechanical engineering, received a CAREER award for his research in the mechanics of vascular and smooth muscle contraction using nano-mechanical testing and computational modeling. The five-year award provides $400,000. He also studies the cellular mechanics of the cardiovascular system in relation to biomedical devices and diagnostic systems.

Junlan Wang, associate professor of mechanical engineering, received a five-year, $320,000 CAREER award for work to develop novel experimental techniques complemented by numerical and analytical approaches to study the mechanics and physics of materials and structures at small spatial and temporal scales. Interests include nanoporous materials and mechanics of biomaterials.

Shwetak Patel Earns TR35 Innovator Status

Shwetak Patel, an assistant professor of electrical engineering and computer science and engineering, is one of 35 outstanding innovators under the age of 35 being honored in 2009 by *Technology Review* magazine. Patel creates devices that sense how people move through their homes and how they use electricity, gas, and water. He will be featured in the September/October issue and honored at a conference held at the Massachusetts Institute of Technology. He also is a featured speaker in the UW Engineering Lecture Series (back page).

Also on this year's list of TR35 winners are recent Computer Science & Engineering graduates, who were honored for research begun at the UW. **Jeff Bigham** (PhD '09) is recognized for creating a free service that helps blind people navigate the Web, and **Adrien Treuille** (PhD '08) is recognized for making complex simulations, such as airflow over racecars, run on personal computers.

COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON

371 Loew Hall, Box 352180
Seattle, Washington 98195-2180

The Trend in Engineering

Matthew O'Donnell, PhD
Dean

Judy Mahoney
Assistant Dean for Advancement

Heather Hoeksema
Director of Communications

Sandy Marvinney
Editor

Hannah Hickey
Contributing Writer

Cover Design
Mary Macenka

Send address comments or corrections to:
Editor, The Trend
trend@engr.washington.edu

http://www.engr.washington.edu • Tel: 206.543.0340 • Fax: 206.685.0666

2009 ENGINEERING LECTURE SERIES

Engineering Xtreme Challenges Outer Space to Cyberspace

Presented by the College of Engineering in partnership with UW Alumni Association

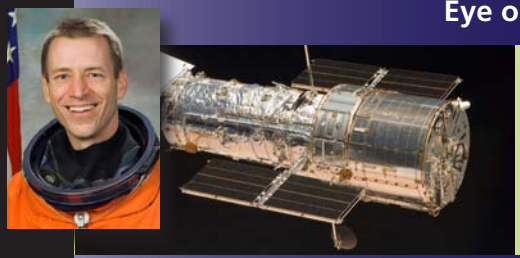
All lectures are at: 7 pm, Kane Hall 130, UW Campus — FREE!
Registration required, online to UWalum.com or call 206-543-0450

The Cyberspace Data Explosion: Boon or Black Hole Wednesday, October 21

Magdalena Balazinska, Assistant Professor, Computer Science & Engineering
Tadayoshi Kohno, Assistant Professor, Computer Science & Engineering

We are entering a cyber world where millions of sensors continuously collect data. From the ocean bottom to deep space, scientists are monitoring environments at unprecedented scales. On a more personal level, implanted medical devices can monitor our well-being, and "smart chips" embedded in passports, ID and transit cards can track our comings and goings. How do we manage this data onslaught wisely? How do we guard our privacy and ensure our safety?

Eye on the Universe: Final Mission to Hubble Wednesday, November 4



Gregory Johnson, '77 NASA Astronaut

The 19-year-old Hubble Space Telescope has yielded stunning images and a remarkable scientific legacy—revealing new insight into the origin and evolution of the universe. In May, UW alumnus Gregory Johnson piloted the space shuttle Atlantis into orbit for the final service mission to Hubble. Imagine the extreme challenges of making tricky repairs during five spacewalks. Johnson takes us on a thrilling journey into space and the final mission to the world's most famous telescope.

Energy Crisis, Smart Solutions Tuesday, November 17

Carl Imhoff, Manager, Electricity Infrastructure Market Sector, Pacific Northwest National Laboratory
Shwetak Patel, Assistant Professor, Computer Science & Engineering and Electrical Engineering

Our nation's electric grid must transform into an integrated digital system to meet expanding 21st century power demands. PNNL is a leading contributor in the nation's multibillion-dollar push to develop "smart grids" and the technologies that will boost energy efficiency, incorporate renewable energy, and produce a smaller carbon footprint. Meanwhile, UW scientists are inventing sensors to monitor resource use in real time in the home—smarter energy from source to user.