COLLEGE OF ENGINEERING
UNIVERSITY of WASHINGTON

the Trend in engineering

Spring 2010: Volume 60, Issue 1

Engineering's Expanding World

pages 4–5

A Summit of Opportunity

UW Engineering is excited to host a National Academy of Engineering Grand Challenges Summit on May 2–3. One of a series of regional summits nationwide, it focuses on two of this century's fourteen "grand challenges" identified by NAE — engineering better medicines and engineering the tools of scientific discovery. We will explore how these challenges will impact our lives in the 21st century and how engineers can best address them. We invite you to join hundreds of other engineers, scientists, innovators, policymakers, and students at this forum (see page 3).

The NAE Summit is a great opportunity for the College of Engineering. It showcases our long-time strength in bioengineering, our emerging leadership in molecular engineering, and our innovation in advancing the tools of discovery through computer science and computational biology, nanotechnology, and "smart" materials and systems for diverse applications.

It also is a great opportunity for students to discover how these challenges will shape their careers. Day one of the summit features a design competition on the theme "Improving Human Wellbeing in the Developing World." The best projects will compete at the National Grand Challenges Summit in Los Angeles this October.

We have encouraged all students from across the Pacific Northwest to participate because their careers will focus on finding solutions to the 21st century's grand challenges in both developed and developing societies. How is the rise of e-science, reliant on mega databases and real-time analysis, changing how we do research and educate future engineers? Students must be prepared to collaborate on cross-disciplinary teams that are often geographically dispersed.

The summit also is a great opportunity for Puget Sound's biotechnology and IT industry sectors. Rich Newton, former dean of engineering at UC Berkeley, modified Thomas Friedman's flat world concept to incorporate industry and academic technology spires. Silicon Valley is the biggest spire in the U.S., but Puget Sound's spire is growing rapidly and should promote closer collaborations between industry, academia, and government to ensure our future as a world-class innovation center and regional economic engine.

The Trend center spread story echoes the grand challenge themes. It highlights four exceptional young faculty members, all NSF CAREER Award winners, who are collaborating on research that bridges several disciplines. For example, Charlotte Lee, who joined the faculty just a year ago, has NSF funding to launch important research into how scientists and engineers working with huge databases and cyber infrastructure develop the tools, systems, and teamwork needed to collaborate effectively.

Construction of the new Molecular Engineering Building (image below) is progressing on schedule and under budget toward its January 1, 2012 opening.

Congratulations to Professor Dennis Lettenmaier, our newest inductee into NAE membership (page 3). Kudos also to the faculty and students who received prestigious national-level awards noted on page 6 — further affirmation of the talent at UW Engineering.

Matthew O'Donnell
Frank and Julie Jungers Dean
of Engineering

Construction of the Molecular Engineering Building *proceeds on target. This March 22 photo shows a worker checking the rebar atop the subgrade-level vapor barrier. The ground floor slab pour was completed March 24 and ceiling formwork began the next day.*

College Leadership Transitions

In late 2009 several long-time faculty members and leaders assumed new administrative roles.

Dave Castner, now the college's associate dean of infrastructure, guides the development of new research and computational facilities. He is a professor of chemical engineering and bioengineering and a former director of the UW Center for Nanotechnology.

Greg Miller, professor of civil and environmental engineering, became chair of the department on December 1. He previously served for two years as associate dean of infrastructure.

Dan Schwartz, Boeing-Sutter Professor of Chemical Engineering and adjunct in materials science, assumed the chair of ChemE in September. He also served a term as associate dean for research.

Seattle Grand Challenges Summit | May 2–3, 2010

Hosted by University of Washington College of Engineering

The National Academy of Engineering has identified 14 Grand Challenges that must be addressed to maintain our national security, quality of life, and sustainable future. The Seattle Summit, one of a series across the U.S., focuses on two of the Grand Challenges:

- **Engineer better medicines**
- **Engineer the tools of scientific discovery**

face the challenge

Sunday, May 2 — Meany Hall, UW campus

Summit kickoff
Student design competition and poster session

Monday, May 2 — Washington State Convention Center, downtown Seattle

NAE Members Breakfast
Panel presentations on Summit themes
Keynote speakers / presenters from academia and industry (partial list):

- Edward F. Crawley, PhD – Ford Professor of Engineering, MIT
- Bonnie J. Dunbar, PhD – President and CEO, The Museum of Flight; former astronaut
- Michael Griffin, PhD – Professor, University of Alabama; former administrator of NASA
- Nicholas Peppas, ScD – Chair of Biomedical Engineering, University of Texas, Austin
- Larry Smarr, PhD – Founding Director, California Institute of Telecommunications and Information Technology, University of California, San Diego

Join engineers, scientists, policy makers, economists, and educators to explore these important issues. Students across the Pacific Northwest are encouraged to attend.

Information Registration | **http://www.engr.washington.edu/naesummit**

Dennis Lettenmaier Elected NAE Member

Dennis Lettenmaier, professor of civil and environmental engineering, is among 68 new members and nine foreign associates elected to the National Academy of Engineering, joining seven other active members at the UW.

NAE cited his contributions to hydrologic modeling for stream-water quality and hydro-climate models for water management. His research in large-scale hydrology includes remote sensing and interactions related to climate.

A UW alumnus (BS '71, PhD '75) and a faculty member since 1976, he holds the Robert and Irene Sylvester Professorship of Civil and Environmental Engineering.

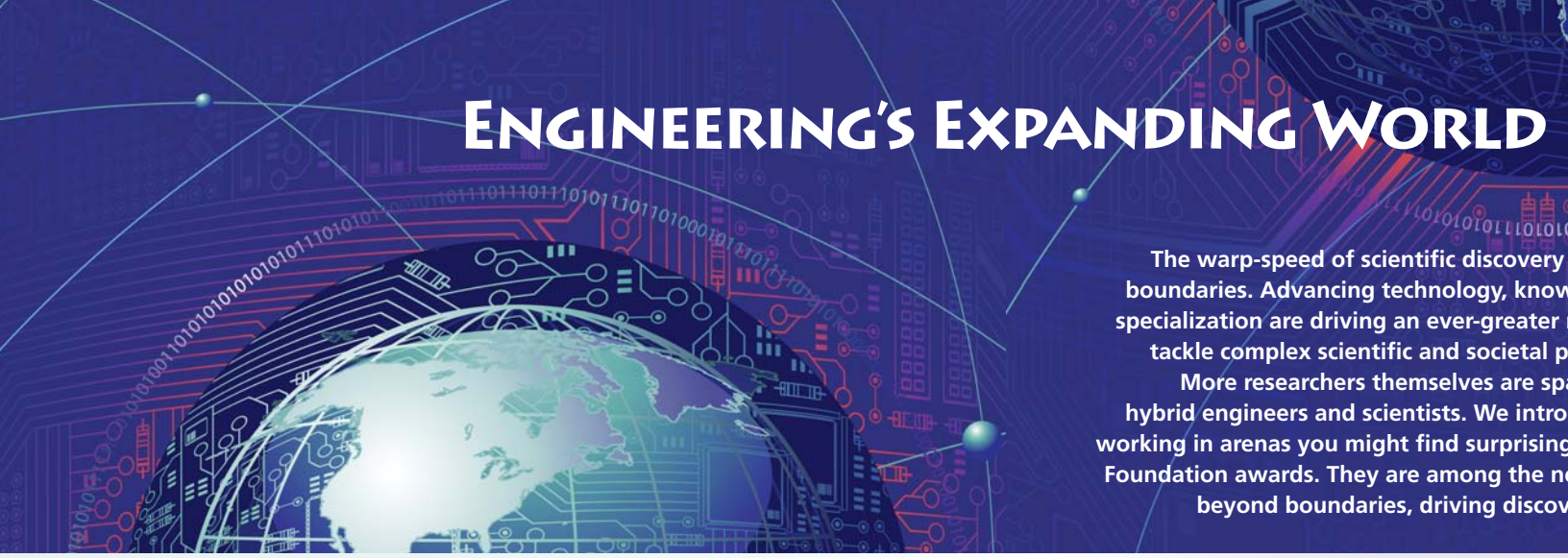
Among his professional associations, he is a Fellow of the American Association for the Advancement of Science and the American Geophysical Union, and is president-elect of AGU's hydrology section.

More UW Engineering news online! www.engr.washington.edu/news/news.html

- **UW Campus a Site for Smart Grid Demonstration Project**
  Smart meters will be installed on most buildings on campus to provide updates every 15 minutes on electricity usage during 2012–13. UW partners with Seattle City Light on this federally funded pilot project to test next-generation grids.
- **Undergrads Create Keypad System to Help Children Learn Math**
  Children in poor, rural communities usually have to take turns using computers. CSE undergrads developed a "one keypad per child" device that lets up to four students share a computer screen to work together to solve math problems.
- **OneBusAway Wins Technology Industry Award**
  If your bus is late, you can learn just where it is by using a mobile device to access www.onebusaway.org. CSE and CEE doctoral students developed the tool, which won a 2010 Washington Technology Industry Association Achievement Award.
- **CEE Structural Engineer Assessed Earthquake Damage in Haiti**
  Professor Marc Eberhard (photo) led a five-person team sent to evaluate damage from the devastating earthquake that struck Haiti on January 12. They installed instruments to measure aftershocks and helped pinpoint the epicenter.

Earthquake Aftermath: Professor Mark Eberhard looks over damage in Haiti's main port of Port-au-Prince. Soil liquified and caused the pavement to collapse.

Engineering's Expanding World



The warp-speed of scientific discovery
boundaries. Advancing technology, know
specialization are driving an ever-greater
tackle complex scientific and societal p
More researchers themselves are sp
hybrid engineers and scientists. We intro
working in arenas you might find surprising
Foundation awards. They are among the n
beyond boundaries, driving discov

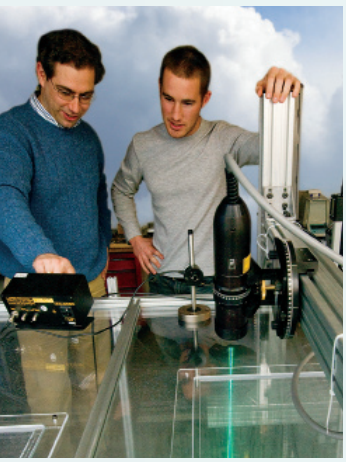
Alberto Aliseda The realms of microbubbles

In his native Spain, Alberto Aliseda studied aeronautical engineering, then earned a PhD in fluid mechanics at the University of California San Diego. Aliseda still has his sights set skyward, but at clouds, not airplanes. His other medium of interest is human blood circulation, rather unexpected for an assistant professor of mechanical engineering. Bubbles are the bridge.

Aliseda's doctoral research focused on a fundamental and challenging problem in fluid mechanics, the integration of turbulent flows with droplets.

"When I gave talks at conferences, atmospheric scientists would tell me my work my might help explain how raindrops form in turbulent clouds. Medical specialists would talk about the action of microbubbles in blood. The commonalities are in the physics of fluids," Aliseda said. He decided to delve into cardiovascular circulation during his postdoctoral work, sitting in on relevant medical school classes to learn the language of physicians.

Since joining the ME faculty in 2008 he has collaborated with vascular surgeons and radiologists on research to improve diagnostic tests. Injecting microbubbles in saline solution into the bloodstream improves the contrast between the heart wall and blood during ultrasound tests, but physicians can't control how many microbubbles reach the heart or when they arrive, so tests are a matter of trial and error.



Alberto Aliseda (L) and doctoral student Colin Bateson fill their laboratory's wind tunnel with fog and introduce turbulence to study how micro droplets coalesce into water droplets.

Aliseda's National Science Foundation CAREER award supports five years of basic research on complex interactions involved in the physics of blood flow, the physics of the ultrasound force field, and the dynamics of microbubbles. The ultimate goal is to incorporate the bubbles into "smart" drug delivery systems for targeted drug delivery with fewer systemic side effects.

Aliseda has received NSF and Department of Energy grants to study how micro droplets suspended in clouds coalesce into raindrops. "The growing need to model the weather and track climate change makes predicting cloud cover and rainfall increasingly important," he said.

Simulating clouds and turbulent air flow in his lab's small wind tunnel could lead to mathematical models that add to the complex puzzle of weather prediction. In this work he collaborates with faculty in atmospheric sciences, oceanography, and civil engineering. And yes, Aliseda now regards himself as a true hybrid researcher, comfortable working across several distinct disciplines.

▶ **http://fluids.me.washington.edu/**

Georg Seelig On the frontie

In a laboratory in the Electrical Engineering building, interdisciplinary teams of EE and Computer Science & Engineering faculty and graduate students are working in the new field of synthetic biology. One is assistant professor Georg Seelig, who came to the UW in 2008 with joint appointments in both departments. He also holds an adjunct appointment in Bioengineering.

Seelig trained in physics, not engineering, and it would be hard to find a better example of a "hybrid" researcher who is at home in an environment integrating a half-dozen science and engineering disciplines. He earned his doctorate in theoretical condensed matter physics at the University of Geneva. While a visiting scientist at Bell Labs in New Jersey, he became intrigued with new biological systems and DNA technology and began postdoctoral research in this arena in 2003 at the California Institute of Technology.

"Biology is the new frontier in science," Seelig said. "Biological systems are so complex and there is still so much to learn. On the downside, this also makes it hard to engineer novel molecular systems that can operate in a biological environment."

Seelig describes himself as a molecular programmer. "We use nucleic acids as nanoscale building material for molecular circuitry. We can take advantage of design ideas from computer science and electrical engineering to build new programmable biological circuitry. The goal is to build complex control circuits

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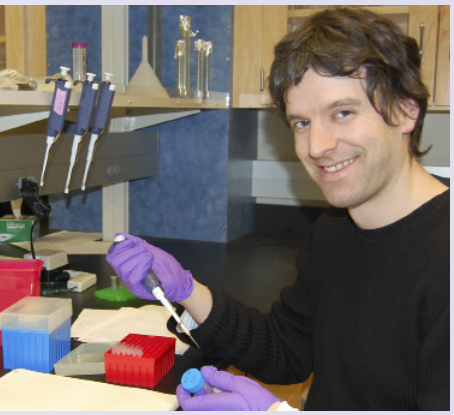
rs of synthetic biology

that can behave similarly to existing biological circuits such as gene regulatory networks," Seelig said.

His team has built nucleic-acid logic circuits that function reliably in an aqueous, cell-free environment. Now the challenge is to create molecules that will detect mRNA and microRNA in a cellular environment



and regulate target genes. Ultimately such circuits could lead to "smart" drug delivery systems to treat disease. He recently received a 2010 NSF CAREER award to further his work to design nucleic acid circuitry.

Seelig also is helping train the next generation of cross-disciplinary engineers and scientists in collaboration with EE professor Eric Klavins, who spearheaded a series of undergraduate courses in synthetic biology that are drawings students from across campus.

▶ http://www.cs.washington.edu/homes/seelig

Brian Otis

Tiny chips, big potential in the field

Song sparrows don't immediately flit to mind as a research focus for an engineer, but they have found their way into Brian Otis's portfolio through a cross-campus collaboration with a Department of Psychology research team that studies how young sparrows acquire their song repertoire. This model for the neurobiology of learning has surprising parallels to language learning by humans. The next step is field research to study the social factors among sparrows that may be key to song learning.

Providing the tools is Brian Otis, assistant professor of electrical engineering. He collaborated with Dr. John Burt to design wireless transceiver devices they call Encounternet tags that weigh only a gram and are a hundred times smaller than any similar devices. Tags placed on song sparrows can track social interactions and transmit signals to nearby receivers. The system had a successful field test in February and Otis and team will continue to refine the hardware with National Science Foundation grant funding.

"The song sparrow research is exciting," Otis said, "and I'm even more excited about our next-generation sensor, called the Bumblebee for its yellow platform." This ultra lightweight (0.3 g) low-power sensor with 100,000 transistors in each microcircuit can continuously transmit data over 10 meters for about three days on one 0.17-g battery. *(cont. on page 6)*

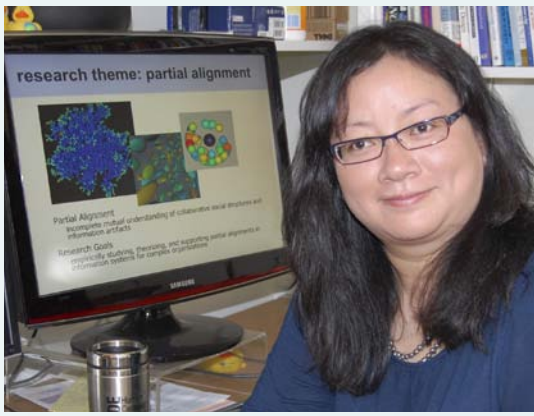
Charlotte Lee

Studying researchers in a booming cyberworld

It's unusual for an engineering school to recruit a sociologist to its faculty, but UW Engineering did so in early 2009 when it hired Charlotte Lee as an assistant professor in the Department of Human Centered Design & Engineering. She arrived with a BS (UC–Berkeley) and MS (San Jose State) in sociology and a PhD in information studies from UCLA.

"As a student I was entranced with social science research methods," Lee said, "but all my friends were engineers, and I finally realized that engineering problems fascinated me the most."

She is taking on an important new area of research by studying how engineers and scientists work across disciplinary boundaries on huge, complex problems requiring analysis of large-scale data sets and development of cyber infrastructures. These initiatives are often geographically diverse and reliant on supercomputers.



One driver is the continuous monitoring of environments and systems made possible by inexpensive sensors. The data collected are relevant for many disciplines, but how do *(cont. on page 6)*

Otis *(from page 5)*

With further advances these tags could have applications for monitoring endangered species.

"The Bumblebee can be taped to a person's skin to record extracellular neural or muscular signals," Otis said. "Future uses might include health monitoring and a wireless human-computer interface powered by neuromuscular signals."

Otis has been integrating engineering and biological disciplines since he was a UWEE undergraduate. He returned to the UW in 2005 after completing his PhD in EE and computer science at UC Berkeley. Last year he won an NSF CAREER Award to research integrated circuitry for recording signals on the surface of the brain, with potential applications for neuroprosthetics.

"We've had to learn a lot about biology, psychology, and neuroscience," Otis said. "This other expertise sneaks up on you, but we need to stay humble about what we don't know. EE is my first love, and I'm still primarily a circuit designer."

▶ **https://www.ee.washington.edu/people/faculty/otis_brian/**

Lee *(from page 5)*

scientists collaborate to manage it all and decide what research questions are the most important?

"Science is changing so rapidly. The Internet has transformed the way we work, but it's only the beginning. Cloud computing and e-science are the future," Lee said. "It's a new world and everyone is struggling to surf the technology wave. I'll look at where this new world is headed with a goal to help improve information systems that support innovation. Also fascinating is how researchers working across disciplines develop hybrid identities."

A 2010 National Science Foundation CAREER Award enables her to dive into these questions during a five-year study to begin this fall.

▶ **http://faculty.washington.edu/cplee/**

Accolades

2010 NSF CAREER Awards

The first round of 2010 National Science Foundation CAREER awards has recognized three young faculty members with support for their outstanding research projects. The awards are typically about $500,000 over five years.

Julie Kientz, assistant professor of human centered design and engineering, received a CAREER Award for her research on "Healthy Families: Technology to Support the Health and Wellness of Young Children."

Charlotte Lee, assistant professor of human centered design and engineering, received a CAREER award for her research on "Interacting with Cyberinfrastructure in the Face of Changing Science." (also see page 5)

Georg Seelig, assistant professor of computer science and engineering and electrical engineering, received a CAREER award for his research on "Nucleic Acid Circuitry for Programming Gene Expression." (also see page 4)

New Sloan Research Fellows

Two faculty are among 118 early career scientists in the U.S. and Canada to receive prestigious Sloan Research Fellowships given by the Alfred P. Sloan Foundation. The grants provide $50,000 over two years.

Luis Ceze, assistant professor of computer science and engineering, focuses his research on making it easier to write reliable programs for parallel computer systems, now common in laptops, data-center nodes, and even cell phones.

Christine Luscombe, assistant professor of materials science and engineering, is developing better methods to make a special class of polymers that absorb light and electricity. They could lead to cheaper and more flexible electronic devices.

Bioengineering Student Wins Luce Scholarship

Senior honors student **Jesse Burk-Rafel** is one of 18 students nationwide and the first at UW since 1977 to receive a coveted Luce Scholarship to spend the 2010–11 academic year in Asia, where he will study health care challenges. He then plans to enter an MD/PhD program to become a physician-scientist.

Honors Abound ▶ **Visit www.engr.washington.edu/News and department websites to read about other recent honors to faculty and students.**

Sharing Fellowship: Runstads Meet Their Students

UW alumni Jon ('65) and Judy ('74) Runstad met their Chemical Engineering fellowship students and visited labs in Benson Hall in November. At far right is current fellowship recipient Michael Robinson. With him are previous recipients Kjersta Larson Smith and Andrew White. Jon Runstad is a great-grandson of Professor Henry Benson. The UW Foundation honored the Runstads with the 2009 Gates Volunteer Service Award for outstanding contributions to the UW.

Entrepreneurial Star

Peter Janicki Soars As World Enters the Age of Composites

Photos courtesy of Boeing (above) and Gilles Martin-Raget / BMW ORACLE Racing.

Imagine the *USA*, resounding winner of the 33rd America's Cup sailboat race, sitting in the middle of Safeco Field. This trimaran would cover the infield. Its 223-foot wing sail would rise eight feet above Safeco's roof, making it impossible to close. The sail has aerodynamic properties similar to an aircraft wing, but is more than twice as long as a Boeing 747 wing, and its composite carbon fiber–Kevlar frame is covered with a shrinkable aeronautical film. Lightweight but stiff, it enables the boat to sail up to three times faster than wind speed.

BMW Oracle Racing's boat was built in Anacortes in collaboration with Janicki Industries, which provided the high-tech tooling, or molds, used to create the wing sail. Construction took five weeks and 20,000 person-hours.

It is just one example of the high-profile innovation that marks Janicki Industries as a global leader in design and manufacture of composite tooling. Mechanical Engineering alumnus Peter Janicki (MS '89) founded the company in 1993 because he realized he could use his engineering skills to vastly improve the slow, labor-intensive process for machining molds for yacht hulls. Boat builders worldwide use his custom-designed molds to build composite hulls for craft ranging from high-performance kayaks to luxury mega-yachts.

Janicki's work took to the air when Boeing decided to build its next-generation commercial airliner with composites. Janicki Industries, based in Sedro-Woolley, won the contract to design and make the molds for the fuselage sections of the 787 Dreamliner. Boeing's production partners wrap carbon-fiber fabric around the drum-shaped molds and harden/cure it to create the sections. Now Janicki is one of the world's largest toolers for the aerospace industry, with customers such as Lockheed Martin, Northrop Grumman, and Pratt and Whitney.

Even outer space isn't beyond the company's reach. In a recent collaboration with NASA and a consortium of industry partners, Janicki participated in the construction of a prototype all-composite space capsule that could carry astronauts to the International Space Station during the next-generation Orion program.

CEO Peter Janicki directs research and development and runs the family-owned company with his brother John, who is president and head of business operations. In addition to its core ventures in the marine and aviation sectors, Janicki creates molds for light-weight experimental vehicles and has moved strongly into the energy sector in supplying molds for fabricating the huge blades driving wind turbines.

"The design and manufacture of large wind blades will evolve tremendously over the next 15 years. We intend to be at the leading edge of that evolution," Janicki said. "Much of our work is highly confidential and protecting our customers' intellectual property requires an extremely disciplined design and production system, whether it's for a wind blade or an airplane fuselage. If a customer hires us to design new technology, they own it."

He credits the quality of their products and efficiency of operations to talented staff capable of solving complex technical challenges and to exceptionally high-precision manufacturing systems, with many components designed and built in-house. A sophisticated software system continually tracks all materials, labor, tasks, and costs, and can accurately project revenues and "what will happen in the shop at 2 pm three months from now on every project." The result is total quality control.

Janicki Industries employs more than 350 people, including 70 engineers. For a relatively small company, Janicki's economic impact extends far beyond Skagit County. The company outsources about 25 percent of its work to other Puget Sound region businesses. With many global customers, its products are everywhere, and Peter Janicki is too, traveling regularly throughout North America and Europe to seek new opportunities for composite materials.

"In most cases, manufacturing with metal doesn't make sense anymore," Janicki said. "Whenever the human race enters a new age of materials — stone, bronze, iron, plastics — society advances. We are now in the age of composites, but still at an early stage. People all over the world are learning how to use these materials and the opportunities are huge. As composite technology advances, it will flow down to all kinds of products."

And Janicki Industries will be at the leading edge of the revolution. For more information and photos:

▶ **www.engr.washington.edu/alumcom/janicki.html**

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DIAMOND AWARDS 2010

Fifth Annual Diamond Awards Dinner

Friday, May 7, 2010, 6–9 PM
Don James Center

Please join Dean Matt O'Donnell, college faculty, and community friends as we honor these exceptional engineers. For details, contact Nancy Anderson, na3@uw.edu or 206-685-2422.


Citta


Williams


Carpenter


Bolton


Parikh

The College of Engineering is honoring five eminent engineers for their outstanding professional and community achievements.

Richard W. Citta '71 MS EE ***Distinguished Achievement in Industry***
At Zenith Electronics Citta played a key role in pioneering digital HDTV and the technology that brought an end to analog transmission in June 2009.

James C. Williams '68 PhD MSE ***Distinguished Achievement in Academia***
The world's leading expert on titanium alloy, Williams held key research positions in the aviation sector and academia. He is now at Ohio State University.

Loren C. Carpenter '76 MS CSE ***Entrepreneurial Excellence***
A computer graphics visionary and chief scientist at Pixar since 1986, Carpenter won a 2001 Oscar for his game-changing impact on the film industry.

Susan Bolton PhD CEE ***Distinguished Service***
A professor in forest resources and adjunct in CEE, Bolton is advisor to the UW Student Chapter of Engineers Without Borders and its project in Bolivia.

Tapan S. Parikh '07 PhD CSE ***Early Career***
Parikh helps people in poor rural regions improve business practices through cell phone technology. His innovative and humanitarian work has won plaudits.

▶ Learn more about the honorees at: **www.engr.washington.edu/**