

TODAY ENGINEERING



STANFORD ENGINEERING NEWSZINE SUMMER 2006 STANFORD UNIVERSITY

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Don't miss the Alumni Job Fair.

RESEARCH PROGRAM INSPIRES UNDERGRADS

Introductory science and math classes provide undergraduates with important fundamentals, but they are not usually what inspire students to become engineers. A much richer introduction is one that includes the chance to become immersed in real research problems and to make original contributions in the lab. The School of Engineering now offers that opportunity to every student, through its Research Experience for Undergraduates (REU).

REU places undergraduates in research groups within the school where they can work side-by-side with professors, postdocs, and graduate students on some of the most advanced problems in engineering. Supported by a \$5,100 stipend, they can spend the summer experiencing the excitement and challenge of real-world engineering where the answers are not canned solutions in the back of the book, says Brad Osgood, the school's senior associate dean for student affairs and an electrical engineering professor.

and wondering whether they really want to be engineers.”



Students Paz Hilfinger-Pardo and Isabelle Kim with CS Assistant Professor Scott Klemmer

A SUMMER WELL SPENT

This year Isabelle Kim and Paz Hilfinger-Pardo are looking for inspiration in the lab of computer science Assistant Professor Scott Klemmer. Both students declared CS as a major as sophomores this winter, but they see exposure to real

research as an opportunity to answer key questions in their academic lives. Kim says her experience this summer will help her decide if she is interested enough in research to consider graduate school. Hilfinger-Pardo is trying to determine whether to stick with computer science at all in favor of the other half of her double major: drama.

The students had already started working with Klemmer in this context during a research-project class in the spring, CS 294. The class gave them a grounding in the basic concepts of Klemmer's

“In many cases, this has a huge impact on students,” says Osgood. Engineering becomes a calling and a career, which is important not only for students but also for the United States where there is deep concern that not enough students are considering engineering careers. Says Dean James D. Plummer: “REU helps us to retain students in engineering when they are still occupied taking math and physics and chemistry

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HIGH HONORS FLOW FOR PIONEER OF AERODYNAMICS

By the time aeronautics and astronautics Professor Antony Jameson was six years old in 1940, there was already ample evidence that the British boy growing up in wartime India would



become an aerodynamics expert. Ask him how he first became interested in airplanes, and he'll take you back there. Jameson, now 71, recalls going out for a stroll one day with his nanny. "We walked by a small airfield in the middle of Delhi," he recalls. "There was a big biplane on the ground there. I remember looking at the plane, and, it was interesting because I used to watch birds quite a bit. I looked at this plane and I saw it had these movable surfaces like the rudder. I didn't know what they were called but I could see straight away that if you put the elevator of the tail up, the air would push the tail down and it would push the nose of the plane up."

Equally evident in Jameson's childhood was a natural facility with numbers. As soon as his mother taught him 2 times 3 he worked out the rest of the multiplication tables for himself. Throughout his career, Jameson's success has derived at least in part from his ability to apply equal passion and mastery for both mathematics and airplane design. He is best known for developing

the "flo codes," computer algorithms written in FORTRAN that numerically solve the vexing differential equations that describe the flow of air around objects such as wings, noses and engines.

His achievements in the field of computational fluid dynamics (CFD) have earned him the 2006 Elmer Sperry Award, a unique award jointly conferred by six national engineering associations. Jameson will accept the honor next year in Reno, Nev.

Jameson began working on the first codes — using reams of mainframe

punch cards, the computer input of the day — as a staff engineer at the Grumman Aerospace Company on Long Island in 1970. Engineers back then were looking for models that could describe air flow around wings moving at supersonic speeds. Jameson took up the challenge and discovered how to generalize a particular solution worked out by other researchers. He also took advantage of the emerging computing power of the day to turn the solutions into design tools.

The rest is a history of ever more sophisticated and useful codes. Over the decades Jameson and collaborators have led the development of algorithms that handled ever more complex problems, such as flow around arbitrary shapes. By the mid 1980s he had worked out a code that could model flows around not just a wing, but an entire plane.

Jameson spelled out the industrial significance of the flo codes in a 1974 paper when he wrote, "The results of these computations reinforce the view that the computer can eventually be

used as a 'numerical wind tunnel.'" Sure enough, when Boeing incorporated "flo 27" into its design software starting in 1978, a single wind tunnel model cost about \$750,000, Jameson says.

By comparison, testing a wing design by running flo 27 on a Control Data 6600 mainframe computer cost roughly \$5,000. The company therefore saved a bundle by trying out designs on the computer first and then wind-testing only the most promising ones. Boeing ultimately used flo 27 and flo 28 in designs of five of its 7X7 passenger jet models. In 1994, to celebrate his 60th birthday, Boeing awarded him a plaque with models of each of the planes his codes have helped the company build. In all, Jameson's codes have been used in more than 25 airplane designs by 10 different manufacturers.

Despite the success, in 1988 while a professor at Princeton, Jameson turned his research on its head. Instead of solving how air flows around wings, he began asking what the optimal wing shape should be to control the flow of air around it. The answers required a different approach and a new set of codes. This research focus is the one he brought with him to the Stanford aeronautics and astronautics faculty in 1997 and still pursues today as the Thomas V. Jones Professor in the School of Engineering.

These days by far the most prominent feature in his Durand building lab is a 15-foot long plot of the product of a recent research exercise: a proposed new wing shape for the next generation Boeing 747. To untrained eyes, there isn't much difference between the juxtaposed blue line of the proposed wing and the red line of the existing wing. But Jameson's optimization software and calculations yield a significantly improved lift to drag ratio, that would allow the

Continued next page

Continued from page 2, Jameson

new plane to fly 12 percent farther on the same amount of fuel.

Boeing has developed its own wing this time, but there is no shortage of recognition for Jameson's contributions. There is, of course, the Sperry award, but also this July the 7th World Congress on Computational Mechanics honored Jameson with a special symposium. Reads the abstract, "Jameson has had an enormous impact on the field of CFD for over three decades, opening up new avenues of research, and developing tools to solve problems thought impossible."



PROFESSOR BENT ON RESTORING SIGHT

Miraculous devices such as pacemakers for the heart and cochlear implants for the ear can help people overcome physiological shortcomings. A long hoped-for prosthetic is a retinal implant for victims of age-related macular degeneration (AMD) or retinitis pigmentosa (RP). New research in chemical engineering Professor Stacey Bent's group could bring such a technology significantly closer.

In diseases such as AMD and RP, the light-detecting cells of the retina have stopped working but the neurons they stimulate are still fine. Researchers have been trying to replace the failed light-detectors with electrodes that can properly stimulate the neurons. A major problem has been that the electrodes are too big, need too much power and, because they broadcast an electric field, stimulate too many cells at the same time.



Bent's team has overcome the last two problems by chemically encouraging individual neurons to form direct connections with the electrodes. On a small glass chip with an 8 X 8 array of electrodes, the researchers patterned a protein to encourage rat neurons to spread their root-like dendrites to the electrodes. This direct physical connection — which mimics how nature does it — uses less power and ensures high-resolution because one electrode stimulates only one neuron. Bent, graduate student Neville Mehenti, and collaborators announced their results in the June 2006 issue of the journal *Biomedical Devices*.

Researchers still face substantial obstacles to producing a working implant, but Bent says progress in her lab and in other groups is cause for optimism, "Wonderful advances have been made," she says. "We can begin to imagine a day when retinal implants can restore vision."

FACULTY NOTES

GLYNN, MURRAY LEAD ICME

Management Science and Engineering Professors Peter Glynn and Walter Murray have taken over the reins of the Institute for Computational and Mathematical Engineering.

"Peter and Walter bring an enthusiasm for ICME and a commitment to work closely with ICME's faculty and students in creating an interdisciplinary environment capable of fully leveraging the impact of mathematics and computation at Stanford," said Dean James D. Plummer. ICME's central mission is the development of sophisticated algorithmic and mathematical tools for many disciplines.

Glynn will be the director, succeeding founding director and mechanical engineering professor Parviz Moin, while Murray will direct student affairs.

STANLEY GOES TO THE SMITHSONIAN

After winning a grueling desert race of autonomous robotic cars last October, Stanley the robot car has hardly been put out to pasture. Instead "he" has been spending the summer on display at the Smithsonian Institution's National Museum of American History.



Stanley assumed his esteemed position in Washington DC on June 28 and will remain there until the museum closes for renovations September 4. Meanwhile the Stanford Racing Team, headed by computer science and electrical engineering Associate Professor Sebastian

Thrun, is working on a new robot for the next "Grand Challenge" race in November 2007.

PROFESSORS WIN SLOAN FELLOWSHIPS

The Alfred P. Sloan Foundation chose two Stanford Engineering professors (and five Stanford scientists overall) to receive prestigious Sloan research fellowships for 2006. Zhenan Bao, associate professor of chemical engineering and Tim Roughgarden, assistant professor of computer science will each receive \$45,000 in unrestricted research grants over the next two years.

They are among the 116 outstanding young researchers in the United States and Canada to receive the prizes, which are designed to help promising young faculty members freely pursue their research interests.

LOYALTY DRIVES ALUMNI PALS TO HELP BOYHOOD REGION

The roots that Teo Tijerina and Leo Ramirez, Jr. share are long — they run from their hometown of McAllen, Texas, to Stanford and back again. Those roots also run deep. Both men, successful



Leo Ramirez, Jr. and Teo Tijerina

technology professionals in Austin, are putting their hearts and souls into a quest to bring some Silicon Valley- and Austin-style tech success to the impoverished border region where they grew up.

“Our mission is to work on facilitating and participating in the startup of high value-added enterprises in the U.S.-Mexico Border region,” says Tijerina (BS ‘96 ChemE). To do this, Tijerina recently founded the not-for-profit Economic Development Catalyst Organization (EDCO) and invited Ramirez, his buddy since junior high school and a fellow former Stanford engineering student, to join the board of directors. The venture is still quite young but this May it received a huge jump start: a three-year, \$384,000 grant from the U.S. Department of Commerce.

These guys know the meaning of loyalty, both to each other and to their neighbors. Tijerina and Ramirez’s home county, Hidalgo County, is among the poorest in Texas. Median household income averaged \$25,894 in 2003 compared with \$39,967 across all Texas. Almost a third (31 percent) of the population lives

below the poverty line, compared to 16.2 percent of Texans overall, according to the U.S. Census Bureau. It’s not that there aren’t jobs, Tijerina says. There just aren’t good ones. Retail, wholesale, and agricultural businesses just don’t earn enough of a profit for decent returns to trickle down to rank and file workers. EDCO’s focus will be on identifying high-tech business opportunities that can use novel intellectual property to create high-margin businesses. Those are the type of enterprises that create the living-wage jobs the area is missing.

These businesses are something that Tijerina and Ramirez know about. Tijerina works at a major consumer electronics company, where he is a manager responsible for ensuring the quality of the liquid crystal displays the company buys. Tijerina is also an investor (and former executive) at an electronics repair company he helped found in El Paso. Ramirez, meanwhile, works at Sun Microsystems where he leads the Latin American consulting branch of the company’s Identity Management Practice (he’s also helping produce an independent film).

At Tijerina’s invitation, a couple of other Stanford alumni, investment bankers Angel Fierro (BS ‘96 IE) and Steven Chang (BS ‘94, MS ‘95 Biology, BS ‘94 Economics), have joined EDCO’s Directive Board and Group of Advisors, as well.

EDCO is too nascent to have brokered any blockbuster deals yet, but the group has an emerging strategy that seems well-tailored to the region it hopes to serve. The trick for EDCO will be to assemble three key components: money, talent, and ideas. “The area has all three,” says Tijerina, “but what is missing is the sophisticated entrepreneur that knows

how to bring these three resources together into a successful enterprise. EDCO plans to facilitate and participate in this process; hence, its catalyst role in economic development for the region.” Amid the poverty, for example, there are pockets of wealthy angel investors who have been waiting for good ideas and teams to invest in, he says.

Certainly there is talent, too. Hidalgo County has sent some great students to Stanford Engineering. This year, in fact, a McAllen-area student, Daniel Salinas, won a Terman Scholastic Award for finishing in the top five percent of the undergraduate class. And, of course, there were many of Tijerina and Ramirez’s high school science and math teammates, who went on to top schools such as Stanford, MIT, and the University of Texas at Austin. Many studied with Ramirez’s father, an award-winning local math teacher and many still keep in touch with each other. “We maintain an informal network,” Tijerina says. EDCO plans to tap into much of this human capital scattered across the country to become leaders in their enterprises.

The bonds Tijerina and Ramirez retain with each other and their hometown are so strong, that when Tijerina asked Ramirez earlier this year to join him on the EDCO board, Ramirez didn’t think twice. “What really excited me about EDCO was its social impact,” he says. “The legacy that I hope to leave in my life is how I touch and help people. That coupled with my friendship with Teo and my confidence in his leadership hooked and continues driving me.”

EDCO’s Web site is www.developcat.com.





For five years the Stanford Engineering Alumni Job Fair has been a great place to come if you're looking for a job, planning your next professional move, or just keeping your career-building skills sharp. This year, however, there are a couple of firsts: The fair will offer one-on-one career coaching with Steve Piazzale, PhD, and it will take place in the inspiring setting of the Computer History Museum in Mountain View, Calif.

Piazzale will field "any nagging career question" you've got in 10-minute personal sessions at the fair. You can also soak in some advice by attending two career seminars led by Piazzale during the evening.

Of course, the core of the fair remains the opportunity to meet hiring managers and recruiters from more than 70 employers, ranging from major technology corporations, Stanford start-ups, governmental agencies, and other organizations. Unlike most job fairs, the jobs available are not just entry-level. Attending companies are also looking for experienced, well-educated candidates for middle and senior-level positions.

Survey comments from alumni who attended last year demonstrate that the fair is a place where experienced, Stanford-trained engineers and scientists can find great jobs.

"I received a job offer from a company I met at the last job fair," wrote one attendee. "The company is Medallia, and they are an industry leader in customer feedback management."

Another told us, "I found out about an opportunity at the last career fair and am currently completing my second week at the new job. Thanks!"

After you've had a chance to visit with prospective employers, you can take a break and explore the past by taking advantage of free docent-led tours of the museum's wealth of computer artifacts and exhibits. Refreshments will also be available during the fair.

Like last year, the fair will be held in the evening, from 4 p.m. – 8 p.m., to accommodate alumni who are working.

Advance registration is requested. For more information about the fair, including directions to the site and links to registration, visit the Web site soe.stanford.edu/ajf. Alumni can also contact Marge Kastner at 650.736.2240 or marge.kastner@stanford.edu. Attendance remains free, and this job fair is limited to Stanford alumni only.

Job Fair Facts

Date: Tuesday, Sept. 19, 2006

Time: 4 p.m. – 8 p.m.

Where: Computer History Museum
1401 N. Shoreline Boulevard
Mountain View, CA

ALUMNI NOTES

INDUCTEES IN THE SPACE HALL OF FAME

Four alumni were inducted April 6 into the Space Technology Hall of Fame for their work on using the Global Positioning System to enable applications such as automated airplane landing. They are Clark Cohen, Michael O'Connor, David Lawrence and Tom Bell, four principal members of Novariant Corp.

Cohen (MS 1989, PhD 1993), O'Connor (MS 1993, PhD 1998) and Bell (MS 1997, PhD 1999) were advisees of aeronautics and astronautics Professor Emeritus Bradford Parkinson, and Lawrence (MS 1992, PhD 1997) was a student of AA and mechanical engineering Professor David Powell.

FAMILIES ENJOY 'CAMP EDAY'

Nearly 500 people, mostly alumni and their children, packed the Arrillaga Alumni Center on July 15 for Camp EDAY, the seventh annual engineering



day. Families came to glimpse the frontiers of research on topics ranging from global warming to wireless phones.

Keynote speaker Carl Rosendahl (BS 1979 EE), founder of Pacific Data Images (now part of Dreamworks), gave attendees an inside look at modern movie

making. Faculty and students gave talks and demonstrations focusing on four themes: environment, technology, life sciences, and college and careers.

FOUR GENERATIONS OF ENGINEERS

When David Narver, Jr. attended the commencement of his granddaughter Katie Narver in June, it must have seemed like déjà vu a few times over. She and brother Andrew (BS 2003 CS) represent a fourth generation of Narvers to earn Stanford Engineering degrees.

"My father received his degree around 1917, myself in 1941, and my son, Robert Narver, in 1974," says David Narver Jr. Katie studied mechanical engineering. David and Robert both studied civil engineering.

THE PLEASURE OF PUTTING SCIENCE, ART TOGETHER

Engineers often see systems that are greater than the sum of their parts. Optimistic engineers recognize their opportunity to

create such systems. Computer science doctoral student Rachel Weinstein, in so many aspects of her life, employs and radiates this kind of optimism.

For starters, take her research in the com-

puter graphics lab of Assistant Professor Ron Fedkiw. There she works on an algorithm that models the motion of articulated joints like knees, tank treads, or the slats in a rope bridge. It's all about producing the most realistic possible animation of systems made up of distinct parts. The obvious application is computer generated images for the movies but an equally interesting outcome will be

simulations of human motion that help surgeons treat motor disorders.

One of Weinstein's earliest computer graphics inspirations was also an early example of her penchant for achievement through assembly: desktop publishing. Winter Park High School had no newspaper for 9th graders until she started one, reveling in the craft of assembling stories and pictures into eye-catching and communicative pages. "I love the idea of taking a number of parts and putting them together to create something else," she says. "Graphics is just this ideal blend of my scientific side and my artistic side."

Weinstein's budding interest in computer graphics led her to Brown University. In the male dominated computer science department, she says, the few, older female students served as mentors and provided an environment where her confidence in the science could develop. She ultimately

became a mentor herself and, since coming to Stanford in 2002 for her graduate studies, has been an officer in Stanford's Women in Computer Science chapter. A core service of the group is bringing the small minority of women in the field together so that they don't feel alone. As a leader in the group, Weinstein is characteristically acting as the glue that helps form those bonds.

One of Weinstein's newest hobbies is perhaps the most overt example of her desire to make something greater than its components. She is now trying her hand at making furniture. You can bet that every joint fits perfectly together, as if the parts were always meant to be in a greater whole.



Cubes fall on virtual bridge.



STUDENT NOTES

CONGRATS, CLASS OF 2006

The School of Engineering awarded a total of 1,644 degrees in the 2005-06 academic year. This includes 383 undergraduate degrees, 998 master's degrees, 17 ENG degrees and 246 PhDs.

Electrical engineers earned the most degrees, 368 in all. This year mechanical engineering surged into the number two spot with 277 degrees, edging ahead of computer science, which awarded 264. This year was only the second in which the new bioengineering department awarded degrees, swelling its alumni ranks from five last year, to a total of 22 now.



A total of 393 women earned degrees in the school this past year, representing 23.9 percent of the total.

STUDENT WINS "AMERICAN DREAM"

This spring Yuriy Teslyar, a senior majoring in electrical engineering, became one of 15 seniors nationwide to win a Merage American Dream Fellowship.

The fellows, each of whom will receive \$20,000 over two years to "pursue their American Dream," are immigrant citizens or permanent residents with stellar academic records who demonstrate leadership, are ethically responsible, and have the potential to make significant contributions to American society.

The scholarship was created by Paul and Lilly Merage, U.S. immigrants who established the Merage Foundation for the American Dream to recognize and reward academically outstanding immigrant students. Teslyar was born in Russia.

CHINA EXCHANGE UNDERWAY

In June, four Stanford graduate students headed to China as part of a pilot academic and industrial exchange program between Tsinghua University and the School of Engineering.

The master's students, Xuan Wu (EE), Sye Min Chan and Jason Herbst (CS), and Mike Rothenberg (MS&E) are studying in Beijing alongside four Tsinghua students who in turn will come to Stanford next spring. Exchange programs are common at universities but this one stands out because it takes place at the graduate level of engineering, where research, technology transfer, and entrepreneurship converge.

The Stanford students are also interning with technology companies in Beijing this summer to gain exposure to Chinese business culture.

SCHOOL MUST INNOVATE TO STAY ON TOP

Amid increasing global parity, the school must offer compelling research and teaching to remain a pre-eminent destination for the world's best faculty and students, says Dean James D. Plummer.

"We cannot presume that we can just rest on our laurels," Plummer said in a packed Clark Center auditorium at his State of the School address May 11. In the talk, titled "Innovation in Engineering Education," he outlined a strategy to ensure Stanford's leading position even as India and China develop strong graduate engineering programs.

The increasing stature of overseas programs is not an immediate crisis for Stanford or the United States, Plummer said. But a plan to remain ahead of the pack is crucial nonetheless, he said.

Plummer's three-pronged approach focuses on developing innovative teaching

models, attacking globally important research problems, and lowering some barriers for students to attend Stanford.

The school has been developing several teaching programs to begin providing this extra layer of preparation on top of the fundamentals of specific disciplines. One example is the Stanford Technology Ventures Program, which teaches students principles of entrepreneurship. Additionally, at the Hasso Plattner Institute of Design, students collaborate in multidisciplinary teams to design products, experiences or services to meet human needs ranging from clean water to financial planning. REU (see page 1) is another example.

Plummer is emphasizing four major research initiatives that address the most compelling global issues where engineering has a key role: human health, environment and energy, information

technology, and nanotechnology.

"People want to work on things that are going to make a difference," Plummer said.



Dean James D. Plummer

The final element of Plummer's vision is to lower hurdles that can prevent the best students from attending Stanford.

As the school faces stiffer competition for international students, Plummer said, it will be especially crucial for the school to attract the brightest minds in the United States. By recruiting more top female students, for example, the school could engage more of a population that remains grossly underrepresented.

Continued from page 1, REU Program

specialty, computer-human interaction, and an initial taste of the open-ended, no-easy-answer environment Osgood described. This summer, however, they are participating in Klemmer's research group, focused exclusively on a project with substantial scope and visibility.

So far, both students say they like what they're seeing in the real research world. "We have to decide how things are going to work," Kim says. "I think it is a lot more interesting because you're not just doing something that someone has already done anyway."

Hilfinger-Pardo says she is enjoying the creative aspects of designing truly new software. "On the one hand it's creative because we are literally generating ideas," she says. "It is also creative in a coding sense. We can actually discuss how to structure the code."

For his part, Klemmer, who also hosted five REU students last summer, says undergraduates make substantial contributions to his group's research. In fact, REU students from last summer were co-authors on three papers he's presented at recent conferences. Similarly Hilfinger-Pardo and Kim will likely be co-authors on a paper he expects to submit to a conference this summer.

In addition to contributions to research, Klemmer points to another benefit to his group from participating in REU. By working with undergraduates, PhD students gain valuable early experience in mentoring, something they may well do a lot of in their careers.

SUPPORTING UNDERGRADUATE RESEARCH

Some portion of undergraduate students have always become involved each year in research in the school, but the university's sweeping re-examination

of undergraduate education during the 1990s inspired the school to expand undergraduate research opportunities by providing better organized and funded support. Often professors would have to spend their own funds to bring undergraduates into their groups.

REU began five years ago in the departments of computer science, electrical engineering, and mechanical engineering. More recently it has been spreading to the school's other departments. Overall, the program has grown quickly. This summer about 170 students are participating, compared to 150 last year and 105 in 2001.

The program is transforming the learning experiences of hundreds of Stanford engineering undergraduates, says Osgood. "They'll have their horizons broadened about what engineering is, and they can take much more active control of their own learning."



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PHONE (OPTIONAL) _____ EMPLOYER (OPTIONAL) _____

CALENDAR

ALUMNI JOB FAIR

*Tuesday, September 19, 2006
4:00 – 8:00 p.m.
Computer History Museum
Mountain View*

Stop by this Job Fair unlike any other, featuring companies eager to hire experienced professionals as well as career workshops and 1:1 coaching. Visit soe.stanford.edu/ajf.

ALUMNI WINE TASTING

*Saturday, September 30, 2006
11:00 a.m. – 2:00 p.m.
Charles Krug Winery
St. Helena*

Enjoy a private tasting, lunch on the lawn, and more, hosted by alumnus Peter Mondavi Jr. Watch E-News for registration details.

REUNION HOMECOMING

*Thursday, October 12 –
Sunday, October 15, 2006
Stanford campus*

All alumni are invited to return to the Farm for classes without quizzes, an undergraduate research symposium, and more. Visit www.stanfordalumni.org/erc/reunions.

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