UNIVERSITY OF MINNESOTA

SIGNALS

DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING

SPRING 2006

ECE Lends an Assist to Science Museum Exhibit

Kids of all ages flocked to one of the more enjoyable exhibits at the Science Museum of Minnesota this past winter, thanks in part to the work of ECE Assistant Professor Beth Stadler and a small army of volunteers from the University of Minnesota. The exhibit, called simply "Strange Matter" offered a practical look at materials science or, the study of "stuff," as it was billed by the Science Museum.

"One of the coolest parts of the whole experience were the 'camp-ins,'" says Stadler. "They brought school children—as many as 400 at once—to actually stay overnight in the museum."

Stadler first became involved with the exhibit through her participation in the Materials Research Society (MRS). She is a member of the MRS Board of Directors and, as chair of the MRS Academic Affairs Committee, was part of a group that proposed developing a full-scale museum exhibit on materials science. The MRS secured funding from the National Science Foundation (NSF), "hired" the Ontario Science Centre to build the traveling exhibit, and secured additional

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Industry-Sponsored Research Opens Different Doors

By Chuck Benda

While the vast majority of research projects are funded through various federal agencies, industry sponsors offer something the government can't: a direct link to what's happening in the real world.

In fiscal 2005, University of Minnesota researchers brought in a total of nearly $527 million in outside funding for research. Of that total, more than 70 percent, or about $370 million, came from various federal agencies. Another 22 percent ($117 million) came from state and local governments, associations, and private foundations. Only about 9 percent came in the form of direct support from business and industry.

The Department of Electrical and Computer Engineering (ECE) brought in about $7.2 million in outside research funding last year, roughly two million (a little more than 25 percent) of which came from business and industry. According to ECE faculty members who work with industry research sponsors, having a higher percentage of industry sponsors than the University average may bode well both for researchers and ECE students.

"Of course their funding helps us the same way that government funding does," says Professor Ned Mohan. "It enables us to put graduate students to work on important research and pay them. And it covers research project expenses. But it also helps us stay connected to what's going on in industry."

"My research is much more applied than theoretical," adds Professor Sachin Sapatnekar. "Interacting closely with industry helps me identify relevant problems—things that are useful in the real world. And I think it helps students round out their educational experience."

Professor Randall Victora couldn't agree more.

"Industry-sponsored research projects can be very beneficial to the students," explains Victora. "In addition to the research project itself, students are often able to secure an internship with the sponsoring company, which enables them to see what a career in that industry might be like. Plus, as researchers, when we work with businesses, we get more immediate feedback on the work that we're doing."

Below, *ECE Signals* takes a look at some of the current industry sponsored research projects currently being run by Mohan, Sapatnekar, and Victora.

NED MOHAN

New Applications for Old Technologies

It's sort of fitting that in the realm of electric power—a discipline that is itself considered "old"—an almost ancient technology is being widely explored as a means of providing cutting-edge energy storage methods. The flywheel—a technology illustrated in Leonardo da Vinci's drawings—is one of the

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INSIDE OUT

"To the fearful [change] is threatening because it means that things may get worse. To the hopeful it is encouraging because things may get better. To the confident it is inspiring because the challenge exists to make things better."

— KING WHITNEY JR.

In an effort to inspire and challenge us all, University of Minnesota President Bob Bruininks initiated a strategic planning process in 2005 with the goal of transforming the University into one of the top three public research universities in the world within the next ten years. With the strong support of the Board of Regents, dozens of groups of faculty and staff members, students, business leaders, and other interested participants have been working during the past year to figure out how to translate this bold vision into reality.

While we are just beginning to see some of the stimulating new ideas being proposed, it is clear that the Institute of Technology (IT), and the Department of Electrical and Computer Engineering in particular, will be major contributors to achieving this goal. There is a great deal of work ahead of us, but I have been tremendously impressed with the enthusiasm and dedication shown by the entire university community throughout this process. I believe the university will emerge from this planning process stronger and more competitive as we move further into the 21st century.

As I write this column on a chilly, rainy Friday afternoon in April, I have a few moments to reflect on what has been a whirlwind first year serving as head of this department. It has been a series of many new and often unexpected challenges. The job has been made much easier by Mos Kaveh, our previous head, as he left the department in excellent condition. Mos continued to serve the college during the past year in his position as IT associate dean for Research and Planning. I have been the fortunate recipient of his extensive experience and wisdom as I have transitioned into my new role.

One of the most enjoyable things for me about this new position has been the opportunity to learn more about the fascinating activities going on in the department. Although I have been a faculty member here for fifteen years, in my new role as head, I find that I learn something new every day about my colleagues, our students, and our alumni. In this issue of *Signals*, you will find articles highlighting some of these interesting activities, such as the extensive research interactions our faculty has with industry. I think these interactions clearly show that our faculty does not hide in an ivory tower out of touch with the real world around them, an action of which academics have sometimes been accused. Our faculty also continues to earn numerous international and university awards, which are summarized in the faculty news briefs section.

You will find articles highlighting some of the amazing contributions our alumni have made to their respective fields, many of the outreach activities in which our faculty are engaged, updates on some notable changes going on in the classroom, and changes we have recently made to streamline our graduate program. We also are pleased to report in these pages on the second-place finish of the university's entry in the North American Solar Car Challenge race.

This issue of *Signals* introduces you to two of our new faculty members: Marc Riedel, who joins us after completing his Ph.D. and postdoctoral work at Cal Tech, and Euisik Yoon, who comes to Minnesota after receiving his

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funds from Alcan, Dow, the Ford Motor Company Fund, Intel® Innovation in Education, and the 3M Foundation to support the tour.

The traveling exhibit opened at the Ontario Science Centre in June 2003, and traveled to New Jersey, Michigan, New Mexico, and several other locations before coming to St. Paul for its February 4 through April 2 run. Prior to the exhibit coming to Minnesota, Stadler organized a group of volunteers to help with the exhibit.

"When we first met with the Science Museum, they asked us to come up with enough volunteers to 'sponsor' Saturdays," says Stadler. "We put the word out through the ECE department, as well as Chemical Engineering and Materials Science and Mechanical Engineering. We had so many students and faculty members sign up—45 in all—that we had to sponsor both Saturdays and Sundays just so everyone could get to work a shift."

Among the more popular exhibits were:

Smash the Glass: visitors get to repeatedly smash a bowling ball into a piece of heat tempered glass to demonstrate its remarkable durability,

Amazing magnetic liquids: visitors were allowed to use magnets to manipulate pools of ferro-fluids and make them jump and dance (see photo), and

Memory metals: visitors use a robotic arm to bend and twist a Nitinol metal ribbon, and then see it return to its original shape when heated.

After leaving the Science Museum of Minnesota, the Strange Matter exhibit is scheduled for stints in Allentown, Pennsylvania, Edmonton, Alberta, Houston, Texas, and San Diego, California.

Ph.D. from the University of Michigan and working for several years in industry and at the Korea Advanced Institute of Science and Technology. Professor Sang-Hyun Oh is joining the department at the end of spring semester after completing his Ph.D. at Stanford University and postdoctoral work at the University of California in Santa Barbara. Professor Tom Misa will join the university this summer as the new Director of the Charles Babbage Institute and a Professor in the History of Science and Technology program. We are pleased that ECE will be Misa's home department. More information about Oh and Misa will appear in the next issue of *Signals*.

In addition to these new faculty members joining the department, there have been a few other changes as well. We were fortunate in this past year to be able to hire Julia Sytina as our new research administrator. Julia's role in this new position is to assist the faculty with all of the administrative details associated with applying for and managing externally funded research grants and contracts. After more than a decade as our associate head, Professor Larry Kinney has decided to relinquish that role. Fortunately, he has agreed to continue serving as the director of undergraduate studies for both the Electrical Engineering and Computer Engineering programs. Effective July 1, Professor Doug Ernie will step into the associate head position while continuing his work as head of IT's UNITE distance-learning program.

It has been a privilege for me to have the opportunity to meet with so many of our alumni, friends, and supporters during the past year. It gives me a great sense of pride to see the interest and excitement all of you feel about the department. We very much appreciate your ongoing support and will continue to do our best to ensure that your trust in us is well placed. I would enjoy hearing from you as we continue on this exciting journey of change.

David J. Lilja
lilja@umn.edu

Research, continued from p. 1

earliest known energy storage devices developed by man. The potter's wheel—a flywheel in one of its simplest renditions—is an early example of flywheel technology at work. And, in some ways, it parallels what the modern day flywheels offer the electric power industry; the ability to take energy from an irregular, surging source, store it in the rotational motion of a massive wheel, and return it in a more even, measured flow.

"We're looking at using flywheel energy storage devices in conjunction with wind generation of electric energy for a project funded by Xcel Energy," says Mohan, who is the Oscar A. Schott Professor of Electrical Engineering. "Because of the variability of the wind, so called 'wind-farms' pose lots of challenges for electric utilities in terms of being able to maintain steady levels of power generation."

From the other end of the equation, the variability in demand also creates challenges for the utility companies. Anything that can be done to level out surges in supply and demand makes electric power generation more economical, reliable, and predictable. Generating stations operate more efficiently if they run at a constant output level—and customers are happier when they can get all the power they need when they need it.

"If there were inexpensive technologies available to handle the storage needs associated with electric power production and distribution, they would nearly double the capacity of the current power grids," says Mohan.

Toward that end, the industry has explored everything from hydro-storage (pumping water uphill during times of excess production and allowing it to run back downhill to 're-generate' electricity during times of peak demand), to pumping compressed air

Ned Mohan

into underground caverns (again, releasing the air to drive generator turbines when the energy is needed), to using banks of batteries to store the excess electricity. Flywheels offer advantages over the other technologies: they return a very high proportion of the original energy—up to 90 percent, they have a very small environmental footprint, and they last a long time. But there are a few stumbling blocks associated with flywheels that have yet to be resolved.

Flywheel storage systems rely on a "machine," if you will, that functions as a motor when it is converting electric energy into rotational energy and as a generator when it is turning the rotational energy back into electric energy. The flywheel spins on magnetic bearings, which are almost frictionless. To date, most attempts on developing flywheel storage devices have focused on systems that place the flywheel in a vacuum (which minimizes energy losses to wind resistance) and the machine outside the vacuum. According to Mohan, however, so doing creates another problem. The drive shaft that goes from the machine to the flywheel penetrates the vacuum chamber, and

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"If there were inexpensive technologies available to handle the storage needs associated with electric power production and distribution, they would nearly double the capacity of the current power grids" —NED MOHAN

Research, continued from p. 3

so a pump must be constantly operated to maintain the vacuum. Operating the pump increases the overall energy loss of that system. The approach that Mohan's group has taken is to develop a prototype of the machine so that the entire apparatus—machine and flywheel—will be in a common enclosure, thus eliminating the need for constant pumping. Doing so has introduced other challenges, however.

"The power losses in the rotating part of the machine turn into heat," Mohan explains, "and, in a vacuum, the heat doesn't dissipate very well. Our research suggests that it may not be feasible to operate in a complete vacuum, but rather in a closed system containing low-pressure hydrogen."

Mohan began this research project for Xcel three years ago. He's nearing the final stages of the project, and is excited about the progress they've made.

"The prototype had to be designed so that the flywheel could be ramped up to 15,000 RPM, which was pretty challenging in itself," Mohan says. "We also had to develop the controls and design a power electronics converter that can interface with a 60-hertz utility grid on one side and a flywheel on the other. You have to be able to start out very slowly, and ramp up to very high speeds."

The work they did on the power electronics converter was so promising that the University has decided to file a provisional patent application. Overall the project has been successful enough that they are encouraging a manufacturing company that is interested enough to want to build a full-scale prototype to further explore the possibilities.

"If this project works out, the end result could be a short-term energy storage device that has applications that go way beyond wind generation," says Mohan. "It could be useful anywhere you require frequency control in a power system, as well as damping [the ability to manage the frequency oscillations in a utility system that occur as the result of loads being switched on and off]."

Sachin Sapatnekar

SACHIN SAPATNEKAR

Optimizing Computer Performance

Professor Sachin Sapatnekar, holder of the Robert and Marjorie Henle Chair in Electrical and Computer Engineering, is a recognized leader in the area of computer-aided design (CAD) of Very Large Scale Integrated circuit (VLSI) systems. As silicon feature sizes continue to shrink, Sapatnekar is working to develop design automation techniques that can optimize and analyze circuit designs, primarily with respect to timing, power, and layout issues. Along with numerous federal grants that have supported his research through the years, Sapatnekar has secured several research grants from corporate sponsors as well.

I've worked with a number of different companies over the years," says Sapatnekar. "Some of that support has come from a consortium of semiconductor industry companies called Semiconductor Research Corporation. Currently, however, I'm working on three projects funded by Intel, IBM, and Freescale—a spin-off from Motorola."

For the Intel project, Sapatnekar has teamed up with David Lilja, ECE department head and professor. Together, they are working to bridge the gap that exists between the realms of computer architecture design and circuit design.

"People have recognized for some time the importance of considering both circuit design and architecture when seeking to optimize performance—but nobody's done much of anything about it," says Sapatnekar. "As a result, design decisions were pretty much based on guesses about architecture—and vice versa."

Sapatnekar and Lilja—who are in the second year of the three-year project—have come up with a method for measuring and analyzing performance that is based on the realization that it isn't necessary to perform simulations that are absolutely accurate. Instead, they focus on relative accuracy.

"If the objective is to arrange your blocks of circuits for optimal performance, all you really need to know is whether or not A is better than B," explains Sapatnekar. "As a result, we're able to design our simulations to focus on much smaller amounts of information and, instead of simulations that take weeks or even months, we can complete ours in a matter of minutes."

In his current project for SRC—which is partially funded by IBM—Sapatnekar is looking at using statistical circuit analysis as a means to better account for some of the anomalies that begin to appear as circuit designs become smaller and smaller.

"Traditionally, when you try to establish performance metrics for a given circuit design, you try to arrive at an absolute number," he explains. "If you're trying to determine the overall delay for the chip, for example, you would measure the delay at each gate, add them together, and come up with the total delay for the chip. As chips get smaller and smaller, however, controlling the design parameters gets harder and harder. A higher level of uncertainty is introduced. The delays—or whatever else you might be measuring—aren't always what they're 'supposed' to be."

At these chip densities, Sapatnekar has determined that statistical analysis is more useful in predicting or analyzing performance. Instead of basing his simulations on absolute numbers (which aren't very accurate at current design densities), Sapatnekar works with ranges or statistical distributions.

In the project funded by Freescale, Sapatnekar is once again determining new methods to perform optimization and analysis simulations that will function better at today's—and

tomorrow's—extremely high chip densities. In this case, the subject matter is power distribution.

"The power grid in these chips has to be designed very carefully so that you don't get a voltage drop in certain areas," says Sapatnekar. "If the gates don't get the right voltage, they don't function."

In the past, chip designers have attempted to design a grid that delivered uniform voltages across the entire circuit. Once again, at the higher densities that exist on state-of-the-art chips, the old methods of designing power grids aren't working as well. Sapatnekar has developed an approach that focuses on the overall reliability of the design. That reliability is achieved by designing power grids that are very regular within regions on the chip—but somewhat variable from region to region.

"This approach allows us to make the grid denser in some areas than in others," he explains. "That enables us to control the overall reliability of the grid."

> "The work that we do is primarily the development of some theory and then simulations of prototype designs. When we get some good ideas, then we talk it over with Seagate's people and see what they think." —RANDALL VICTORA

Randall Victora

RANDALL VICTORA

Next-Generation Magnetic Recording Heads

The challenges of designing the next generation of magnetic recording heads can be a bit daunting, according to ECE Professor Randall Victora. The problems start with the tiny dimensions of future recording heads: a mere 50 nanometers wide by 150 nanometers long. Then, when actually incorporated into a hard drive, these tiny heads are expected to "fly" a mere five nanometers above the magnetic recording media, at speeds of up to 40 meters per second. (High-end hard drives spin at up to 20,000 rpm.)

"It's kind of like trying to fly a 747 a few inches off the ground," says Victora, who has served as director of the University's Center for Micromagnetics and Information Technologies (MINT) since January 2003. "Everything's fine as long as the earth doesn't shake and the wind doesn't blow."

Or, in the case of Victora's flying magnetic heads, as long as people don't drop their laptops. To add to the challenges, Victora is working on design problems for heads that will be expected to read and write data at densities of up to one terabyte per square inch. (Current commercial magnetic media store data at densities of about 100 gigabytes per square inch.)

Victora has an impressive track record of research work in the theory and modeling of magnetic materials, primarily for information storage. Typically, his research involves developing two- and three-dimensional computer models of ultra-thin film magnetic recording media and heads to address issues around writing, overwriting, reading processes, transition noise, and ultra-narrow-track-edge noise. He has worked with companies such as Western Digital and Samsung, and has recently been working on a series of projects funded by Seagate.

In these projects, Victora has worked on: developing very high-magnetization materials, designing a magnetic head with vertically aligned magnetization, and solving the problem of adjacent track erasure in conventional media. Although his research is aimed about five years ahead of current commercial applications, he thinks the solution they developed for neighbor induced transition shift—a triangular-shaped shield that goes on the side of the head and absorbs the magnetic field before the field from adjacent tracks can reach the track being written—may one day make it's way into commercial products.

In his latest project for Seagate, Victora is focused on developing heads for exchange-coupled composite (ECC) media. One of the approaches researchers have taken as they have attempted to achieve greater recording densities is to work with perpendicular recording media. Most perpendicular recording media are hard to switch, but Victora and his group recently discovered a new type of media (ECC) that is much easier to switch. In fact, ECC media often behave just the opposite of other perpendicular recording media.

"We're trying to come up with head designs that will exploit the behaviors of ECC media as much as possible," says Victora. "The work that we do is primarily the development of some theory and then simulations of prototype designs. When we get some good ideas, then we talk it over with Seagate's people and see what they think."

So far, Seagate has identified some challenges to implementing the "good ideas" for ECC heads that Victora and his research team have developed. And so, it's back to the drawing board: more theorizing and more simulations—this time, to see if they can come up with ways to make their ideas more "implement-able."

"When your research work is at a highly theoretical level, such as this, you can never know for sure what, if anything will come of it in terms of applications," says Victora. "But I think this kind of interaction with industry is absolutely essential for us as researchers, for our students, and for the department in general."

Bruce J. Bergman (EE '64)

Engineering a Business Career

Throughout his life, Bruce J. Bergman (EE 1964) has demonstrated a knack for finding and hitching his wagon to the right star. In the panic that followed the Russian's launching of Sputnik in 1957, there arose in the U.S. a call for more young Americans to get educations in science and engineering. Bergman answered that call.

As computers came into vogue, Bergman steered his career in that direction, working first for General Dynamics Corporation (1964-65) and then Honeywell, Inc. (1965-71), where he developed avionics controls and specialized computer systems for aerospace applications. Bergman began to realize the importance of the business side of all engineering successes at about this time and he began pursuing his master's degree in business administration—first at the University of Minnesota, and then, at the University of Southern California (USC). He earned his MBA from USC in 1971. When he began working at Control Data Corporation that same year, Bergman "engineered" a shift in his career path, veering towards management and away from the engineering side of things. He started as a product manager, moved to Original Equipment Manufacturer (OEM) Sales Manager, rose to Director of Operations (as which he led a start-up operation to provide peripheral systems for computers), and finally became General Manager of both the Mini-peripheral Systems and the Large Peripheral Systems divisions. By the time he left Control Data in 1983, he had learned what was to become one of the driving tenets of the rest of his professional life.

"In the high tech business, if you don't change, you're going to die," says Bergman. "I saw it happen with the changeover from mainframes to minicomputers, and from minicomputers to PCs. My time at Control Data was an exciting time, with lots of fast growth—but, unfortunately, we held onto some old ideas too long. Since then, I've held fast to the belief that, if new technology is available—and that new technology can do the old job faster and cheaper—you'd better embrace the new technology, and do it sooner rather than later."

Embracing new technology became a hallmark of Bergman's burgeoning business career.

His work at Control Data—and his newfound understanding of the way changing technologies drive business success—gave Bergman the drive to "run something." He accepted a job in 1983 as president of a privately held OEM supplier of precision parts and sub-assemblies, but soon realized that he belonged in the computer and computer peripherals industry. From 1983 to 1993 he served as president and CEO of Xylogics, Inc., a Burlington, Massachusetts provider of computer network access, remote access, networking, and input/output hardware and software products. Xylogics was struggling at the time, and in need of a turnaround. Bergman got the job done, and quickly. In just a little more than a year's time, he achieved profitability by repositioning the company in the marketplace. Under his command, Xylogics increased both revenues and profitability for five straight years. He raised two rounds of venture capital and completed the initial public offering for Xylogics in just four years.

His success at Xylogics led to additional opportunities for turnaround and start-up types of situations. From 1993 to 1994, he served as president and CEO of Proteon, Inc., a Westborough, Massachusetts' supplier of internetworking hardware and software products. During that time, he restructured the company, reorganized the management team, and soon had the company on track for a return to profitability. From 1995-96, Bergman completed a similar restructuring effort for ATG Cygnet, Inc. a San Jose, California supplier of multiple-media, robotic mass storage libraries.

Bergman's most noteworthy turnaround/start-up effort came as president and CEO of a Silicon-Valley startup called Brocade Communications Systems, Inc. From 1996 to 1998, Bergman led the privately held provider of gigabit switching hardware and software products based on the Fibre Channel standard from a startup to a market leader. Bergman raised more than $30 million in venture capital and oversaw the launch of a number of new products. Under his leadership, Brocade's staff grew from around a dozen to more than 100—and, annual sales grew from zero to more than $25 million. Today, Brocade is a publicly traded company. At its highest valuation, Brocade was worth more than $20 billion.

"Although Brocade had a dozen engineers and a bookkeeper when I came on board, that job was essentially a raw startup," says Bergman. "I really enjoy working in the early stages of emerging companies—and Brocade was about as fun as it gets. We didn't produce the absolute first fiber channel switch—but we produced the first one with the right architecture. As it turned out, we were absolutely in the right place, at the right time, with the right technology."

Having lived through the stock market crash of 1987, Bergman had seen how quickly "paper" wealth could disappear. With Brocade, he had the good sense to reap some of the fruits of his labors before the high tech bubble burst in 2000 and secure his financial future.

Not bad, for a working-class boy from Virginia, Minnesota. It's probably a safe bet to assume that the struggles of his early years made the rewards that came later in his career all that much sweeter. Money was tight in the 60s and Bergman began his college education at Virginia Junior College (now Mesabi Community College). He came to the University of Minnesota to finish his degree work—and he can still remember what a challenging time that was.

"In those days, a degree in electrical engineering took five years and you needed 250 credits," says Bergman. "I was already married—and I had a child before I graduated—so, I pretty much kept my nose to the grindstone. But I was very impressed by almost all of my instructors."

As an engineering student, he was able to work for Honeywell. Typically, he worked 20 hours a week, plus quarter breaks and summer vacations. He started out as an engineering aide, but by the time he finished was doing pretty much the same work as many of the fulltime engineers.

The strong work ethic he developed served Bergman well throughout his career. For most of his professional life, he worked 50 to 60 hours a week—and sometimes more. When he left Brocade in 1998, Bergman started his own consulting firm, Bergman & Associates. Working out of his Silicon Valley home and then later out of his current hometown of Naples, Florida, Bergman created what he called a high-tech consulting and investing practice, providing his clients with business, market, strategic, technical, and management analysis and recommendations. Initially, he continued with the long workweeks, but has gradually pulled back.

Nowadays, his consulting work is very limited, often informal, and typically restricted to trusted friends and colleagues. He has continued to serve on the boards of three companies—iVivity, DataCore Software, and Acopia Networks—but he's also making time for activities that he finds more important these days: his son and daughter, his five grandchildren, and some charity work. His son-in-law and one granddaughter have diabetes. Bergman has become a strong supporter of the Juvenile Diabetes Research Foundation, sponsoring a research laboratory at Washington University.

He enjoys saltwater fishing and, when he returns to Minnesota each summer, walleye fishing. He also likes to golf and swim. As for the work life, well, you might say he's decided it's time to put that on the back burner.

"These days, I am blessed to be about as busy as I choose to be," he says.

KUDOS

Trio of Alums Receive OAA Awards

Three alumni of the Electrical Engineering Department were awarded the University of Minnesota Outstanding Achievement Award (OAA) during the past year. The OAA, which is the highest honor the University bestows upon its alumni, was presented to Richard A. Hackborn (1960), F. Robert Naka (M.S. 1947), and Darell D. Rinerson (Physics 1969 and Electrical M.S. 1977). The citation for each recipient reads as follows.

Richard A. Hackborn

- Distinguished graduate of the University of Minnesota
- Former executive vice president, Computer Products Organization, and chair of the board of Hewlett-Packard Company
- Skilled engineer and business visionary, who pioneered Hewlett-Packard's highly successful printer business, whose talent and effective mentoring have been instrumental to the field of information technology
- Esteemed technology leader and first-rate strategist, who served on the board of directors of Microsoft Corporation and the William and Flora Hewlett Foundation
- Dedicated philanthropist, who along with his wife, established the Hackborn Foundation to support the arts, higher education, and human service organizations

F. Robert Naka

- Distinguished graduate of the University of Minnesota
- President and CEO of CERA, Inc.
- Brilliant scientist and engineer, whose expertise in science and technology for national defense and security is revered by both government and industry
- Innovative pioneer and former chief scientist of the Air Force, whose technical input has had a major impact on aircraft reconnaissance and communications
- Esteemed member of the National Academy of Engineering and three-time recipient of the U.S. Air Force Exceptional Service Medal, who has made invaluable contributions to the country's national security

Darell D. Rinerson

- Distinguished graduate of the University of Minnesota
- CEO and founder of Unity Semiconductor Corporation
- Innovative engineer, who has demonstrated outstanding technical leadership throughout his career
- Visionary inventor, whose design of circuits for computers and digital memory systems resulted in more than 36 patents and patent applications
- Successful entrepreneur, whose two companies developed early high performance flash memory technologies and disruptive high performance non-volatile universal memory technology

Reintroducing Microcontrollers

In 1981, Charles Rennolet was a visiting assistant professor in the Electrical Engineering Department. His office-neighbor at the time, Assistant Professor In Huang, was given the task of developing a course that would serve as an introduction to microcomputers. Rennolet helped develop the labs, and from time to time, offered informal assistance to Huang as he developed the course. Now, 25 years later, Rennolet, who returned to the Department part time as an adjunct professor in 1990, has come full circle. He just completed updating the labs for the current version of that course—ECE 2361: Introduction to Microcontrollers. If the early reviews are any indication, the update has been a resounding success.

"Traditionally students liked the course but detested the lab," says Rennolet. "Now, they seem to like the labs so much more, that they sometimes act as if they dread the course."

Through the years, the course has gone through repeated revisions. ("No chip remains up-to-date for more than two to three years," explains Rennolet.) During that time, the labs worked with a variety of different hardware, starting with Motorola, going through a couple of incarnations of Intel hardware, and returning to Motorola hardware prior to the current updates. The course was last revised about 7 years ago. Rennolet got the go-ahead to revise the labs about two years ago and the revisions were completed in time for the Fall 2005 semester. At the suggestion of Adjunct Professor Tom Posbergh, who teaches related courses and informally collaborated on the lab updates, Rennolet switched to the PIC family of microcontrollers. (The related courses will also switch to the PIC family in the next year to allow students to build on their familiarity with the architecture.)

"In the past, the course was taught using the development board approach," explains Rennolet. "If the students made mistakes, they could easily 'fry' their development boards—which proved both costly and difficult to remedy."

> "We start from the assumption that our students know absolutely nothing about microprocessors and, through the labs, build them up to the point where they can solve fairly complex problems related to microprocessors."

This new approach is based around a prototype board methodology. Students buy their own chip and build the microcontrollers with which they will work throughout the lab. In addition to new hardware, Rennolet adopted a new learning approach for these labs as well.

"We've applied an evolutionary approach to teaching the students about microcontrollers," says Rennolet. "The basic idea is to take the students through the same sort of process that most microprocessor experts followed as they developed their understanding of this discipline. We start from the assumption that our students know absolutely nothing about microprocessors and, through the labs, build them up to the point where they can solve fairly complex problems related to microprocessors."

The course includes approximately 10 labs. The difficulty of the labs varies quite a bit, and they have been intentionally sequenced so that difficult labs are followed by substantially easier labs.

The labs can be very realistic in that students are asked to measure real world values. For one lab, students are asked to build a human-reaction-time measurement device. So far, it has proven to be the early favorite.

The device, according to Rennolet, typically consists of a button, some LED displays, and a processor. When the button is pushed initially, the processor randomly waits from one to 10 seconds before turning on one of the LEDs. When the LED lights up, the operator must then hit the button again as quickly as possible. A multiplexed, seven-segment LED display then reveals the individual's reaction time in hundredths of a second.

"It's very easy to understand what this device does," Rennolet notes, "but the level of sophistication required to actually build the device is comparable to some of the projects students may one day encounter in the real world."

One reason the labs have been so successful is that, after initially writing them, Rennolet had a group of students and teaching assistants actually work them before they were adopted for use in the course. This allowed Rennolet to tweak and refine each of the labs as needed.

In addition to an enthusiastic reception from the students, the new course methodology has enabled the faculty to cover as much as 20 to 25 percent more material in the class. Part of the reason is the RISC-based PIC architecture, which enables professors to cover the basic instruction set more quickly, and then switch to "C" programming language early in the semester.

"These changes make the students work a little harder, but we can cover some pretty advanced topics because we're not totally tied to the assembly language," says Rennolet.

Have there been any downsides to the new labs to date?

"Well, I've noticed that when we get about half way through the course, students begin to get so comfortable that the labs start to get a little raucous," Rennolet says (with his tongue planted firmly in his cheek). "I think a certain level of suffering enhances learning—and these students are having way too much fun in our labs."

E = MA(mass appeal)^2

When Professor Paul Imbertson first tackled the job of developing a course about the technology of energy five years ago, he had no way of knowing how popular it would become—or how timely. In fact, he wasn't even sure how to go about developing a course that would be useful to the broad range of students he hoped to attract.

"We wanted to develop a course that could reach across all majors, " Imbertson explains. "One of the goals was to enable students to understand and talk intelligently about many of the issues surrounding energy and our society."

The problem was, that meant developing a course that could appeal to a broad range of academic backgrounds. It needed to be sophisticated enough from a technical standpoint that it didn't put Institute of Technology students to sleep—yet accessible enough from a math and science standpoint so that it didn't scare liberal arts students right out the door.

Toward that end, Imbertson developed a lecture-based course that is an amalgam of the history of energy (starting from campfires), basic science and technology, and environmental and political issues surrounding the production and consumption of energy. The course (ECE 1701: Energy, Environment, and Society) requires students to prepare a report on an energy-related topic, and to give a presentation to the rest of the class prior to the end of the course. The reports and presentations—the subject matter of which has run the gamut from nuclear energy and its impact on the environment, to cold fusion, to third world energy issues, to zero point energy—are part of what makes the course so dynamic according to Imbertson; that, and the diverse range of students.

"We've had everything from students who want to start new political movements, to students who want to intern for power companies, to students who want to protest the power companies," says Imbertson.

Two-thirds of the students taking the course come from outside the Institute of Technology. Only a handful each year are actually electrical and computer engineering majors—and yet, a number of those students have changed the focus of their studies to power after taking the course.

"Our students go away with a newfound appreciation of the complexity of energy and the issues surrounding it," says Imbertson. "Many students have come back two or three years after the course and talked with me about hot issues related to energy or told me about interesting articles on energy."

Given the challenges energy seems to be depositing on our doorstep these days, the increased awareness and interest these students have shown somehow makes the future a wee bit less disconcerting.

Graduate Degree Program Changes

The faculty of the Electrical Engineering Graduate Program made a number of changes to its master's degree programs. The changes, which went into affect Fall semester 2005, are as follows:

- The Electrical Engineering MSEE Plan A (Thesis) Degree will remain as is without any changes,
- The Plan B (Project) option for completing the Master of Science in Electrical Engineering (MSEE) Degree will be discontinued,
- The Master of Electrical Engineering (MEE) (Professional) Degree will be discontinued,
- Students who are presently doing an MSEE Plan B or MEE and are in good standing can complete their degree as planned, and
- A new MSEE Plan C coursework only option for completing the MSEE Degree with project, written report, and oral presentation course experience requirement will be created.

For more information see http://www.ece.umn.edu/academics/grad-studies/ee/

ECE Students Help Power Solar Car to 2nd Place Finish

A team of 46 undergraduate students from the University of Minnesota, designed, built, and drove their solar-powered car, Borealis III, to a second place finish in the most recent running of the North American Solar Challenge. A group of Electrical and Computer Engineering students, led by Mike Couch, Steve Faulhber, Chris Olson, Martin Sturm, and Josh Wibben, participated in the project, which consumed an estimated 43,000 man-hours and culminated in last summer's 2,500-mile, Austin, Texas to Calgary, Alberta, Canada race.

University students—including electrical engineering students—have been building and racing solar cars since 1990. Typically, they design and build a new car every two years. This year's version required corporate and university support from 60 different sponsors. Borealis III weighs 370 pounds and has reached speeds in excess of 75 miles per hour. The University of Minnesota team completed the race in just a little more than 54 hours, averaging more than 45 miles per hour and finishing just 11 minutes behind the first place team from the University of Michigan.

ALUMNI NEWS

Gary Harold Glover (B.S. '64, M.S. '65, Ph.D. '69) was named to the National Academy of Engineering in February. Glover is professor of radiology and director, Radiological Sciences Laboratory, Stanford University, Stanford, Calif. Glover was elected for his research and engineering in the development of computed tomography and magnetic resonance imaging. Glover was profiled in the 2005 edition of *Signals*.

Yunqian Ma (Ph.D. '03) has received the International Neural Network Society (INNS) Young Investigator Award for 2006. This award is presented by the INNS Board of Governors to recognize individuals who have made outstanding contributions in the field of neural networks. Ma, who was advised during his Ph.D. research by Professor Vladimir Cherkassky, is currently with Honeywell Labs where he works on video surveillance and security applications.

News By Email!

ECE Signals can now take "News About You!" via email. If you recently got a promotion, a new job, or have any other news to share with your classmates, send it to ecea@umn.edu and we'll make sure it gets into the next issue of your newsletter.

Tech Tune-up Zeroes in on Latest Nanoscale VLSI Design

The Department of Electrical and Computer Engineering (ECE) is hosting the Tech Tune-up: Nano VLSI Design course sequence at the University of Minnesota on June 26-28, 2006. Tech Tune-up will focus on applications and problem areas associated with the very near future nano VLSI generation.

Topics that will be covered during the 3-day course include:

- Advanced digital CMOS circuit design
- Advanced CAD for analog, RF and mixed-signal systems
- Digital design, verification and applications
- Architectural design issues for reliable computing
- Current FPGA architectures and computer-aided design (CAD)
- Tolerating process variations through design and CAD in sub-100nm circuits
- Nanoscale CMOS (<100nm) analog interface design
- Process issues for nanoscale CMOS

Instructors from both academia and industry will lead this three-day course sequence. For further details please see course website: http://www.umn.edu/~harjani/techtuneup/

2004-2005

SCHOLARSHIPS

Boeing
Agyeman-Budu, David Nana
Severson, Eric

Hartig Fund Scholarship
Jindal, Ankit
Prahladka, Manish

Hamilton Scholarship
Abichandani, Ankur
Asgar, Zain
Wu, Youyou
Zou, Jia

K.S.P. & Usha Kumar Undergraduate Scholarship
Prahladka, Manish

Roger M. Nordby Scholarship Fund
Persaud, Devin
Quan, Xing
Shaukat, Faraz

Northern MN Community College Transfer Scholarships
Eichmueller, Richard (Hackborn)
Haag, William (Hackborn & Greene)
Porter, Cameron (Hackborn)
Thomson, Kent (Hartig)

Oscar A. Schott Scholarship Fund
Lee, Brian
Reinke, John
Walden, Ryan

FELLOWSHIPS

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Gabriel, Nicholas

Department Fellowship
Ballard, John
Hua, Ling
Liu, Renfei
Olson, Christopher

DTC Fellowship
Hajiaghayi, Mahdi
Huang, Yao

Graduate School Fellowship
Bai, Xue
Gawarikar, Anand Sudhir

IBM Fellowship
Qian, Haifeng

IGERT Fellowship
Hernandez, Stephanie

Norton Fellowship
Khajavikhan, Mercedeh

Ph.D. Dissertation Fellowship
Zheng, Wei

Schnell Fellowship
Ratnanjali, Ratnanjali

SRC Fellowship
Goplen, Brent

RECENT GIFTS

We would like to recognize the following organizations for making substantial financial contributions to the Department of Electrical and Computer Engineering during the past year.

Agilent Technologies, Inc.
Alliant Energy Corporation
Ayco Charitable Foundation
Boeing Company
Dairyland Power Cooperative
Exxon Mobile Corporation
E. I. DuPont DeNemours & Company
General Dynamics Corporation
Grandis, Inc.
Great River Energy
Honeywell International, Inc.
IBM
IEEE
Information Storage Industry Consortium
Intel Corporation
Minnesota Power
Otter Tail Power Company
Semiconductor Research Corporation
Southern Minnesota Power Agency
St. Paul Foundation

The Hartig Fund

Dr. Henry Hartig was a faculty member in the Department of Electrical and Computer Engineering from 1928 until his retirement in 1960. His leadership as department head during the booming post-war period stimulated the department's transition to national prominence. After his retirement, his former students and colleagues created the Hartig Fund as a tribute to his dedicated service to the department and the university.

Today, the earnings from the Hartig Fund allow the department to develop excellence in areas where direct University support is not available, and during times when State support is insufficient. For example, earnings from the Hartig Fund have been used to support the Borealis III solar car, the University's entry in the 2005 North American Solar Challenge, to purchase special equipment for our teaching laboratories, and to provide scholarships for students with unique circumstances. Without this fund, we would not be able to provide the richness and depth in our educational offerings that are so important to a well-rounded education.

We would like to thank all of you who have contributed so generously over the years to the Hartig Fund.

If you would like to contribute to the Fund in the future, you can send a check to: University of Minnesota Foundation CM-3854 PO Box 70870 Saint Paul, MN 55170-3854 Please indicate that your gift is for the "ECE Hartig Fund." Additional information about giving to the University is available online at: http://www.giving.umn.edu/ or contact Anastacia Quinn at quinn@it.umn.edu or David Lilja at lilja@umn.edu

Riedel Finds Start-up Challenging, Invigorating

Like many a new faculty member at a major research institution, Assistant Professor Marc Riedel is finding the process of launching a career in academia somewhat daunting. There are the matters of securing research funding, supervising freshman design projects and recruiting graduate students, to name a few. Although he's had just a few months to get his feet wet since joining the Electrical and Computer Engineering (ECE) department in January, Riedel is encouraged by the progress to date.

"I've been very impressed by the quality of the department's grad students and grad school applicants," says Riedel, "as well as by the quality and diversity of the research going on here. I'm glad I picked Minnesota." Riedel's satisfaction is shared by many in his new department.

In his years as a grad student and post doc, Riedel compiled an impressive track record—so much so that he received offers of tenure-track faculty positions at 11 different institutions. "The U came out as a clear winner—based on the faculty, as well as the interactions I had with everyone here from the time of my first interview until the time I made my decision," he says. "The attitudes were very positive overall and I was struck by what a supportive environment there is here for junior faculty. Some other institutions of comparable stature have exactly the opposite reputation; that of a fierce, brutal environment."

A native of Montreal, Riedel may have inherited his affection for academia. His father is a professor of mathematics at the University of Montreal—and his older sister is a neurobiologist. Riedel earned his bachelor's degree in electrical engineering with a minor in mathematics from McGill University in Montreal and his master's and Ph.D. degrees in electrical engineering from the California Institute of Technology.

"The attitudes were very positive overall and I was struck by what a supportive environment there is here for junior faculty."

While a student at Caltech, Riedel received recognition for both his Ph.D. dissertation and publications. Riedel's dissertation—"Cyclic Combinational Circuits"—was awarded the Charles H. Wilts Prize for the best dissertation in Electrical Engineering in 2004. A paper based on his doctoral research, "The Synthesis of Cyclic Combinational Circuits," received the Best Paper Award at the 2003 Design Automation Conference.

Riedel's research also led to two patents: the first on novel architectures for distributed computing as part of a project for the National Aeronautics and Space Administration's Jet Propulsion Laboratory; the second related to the subject of his Ph.D. work. "In my dissertation, I proposed a completely new way of designing digital circuits," says Riedel. "By introducing loops or feedback paths, I demonstrated that circuits could be implemented with significantly fewer gates, resulting in lower cost and lower power consumption." Riedel is continuing his research along these lines, investigating novel circuit constructs for nanotechnology.

As he begins his career in academia, a broad thrust of Riedel's research is the application of expertise from digital circuit design to problems in biology. "Breakthroughs nearly always stem from the infusion of new ideas and techniques, sometimes from quite unrelated areas," says Riedel. "Although designed by evolution, biological systems—from single cells to higher organisms—have remarkable parallels to computing systems engineered by humans. For instance, they exhibit modular designs and contain sophisticated signaling pathways with error-correction mechanisms. Clearly, the knowledge accumulated over the decades in computer engineering can inform us about the workings of biology."

Venturing into a new field is challenging. "But this is why I chose a career in academia and why I chose to come to Minnesota," says Riedel. "With its breadth and depth of research programs, the U is the perfect environment for such interdisciplinary work."

Yoon Uses Private Sector Experience to Bolster Research Efforts

When Associate Professor Euisik Yoon completed his doctoral studies, by design, he reported to work in the "real world."

"I wanted to get out there and see what industry was up to," he explains, "but I always planned to come back to academia."

And so, after Yoon completed his formal education (earning a bachelor's and master's degrees in electronics engineering from Seoul National University in 1982 and 1984, respectively, and a Ph.D. degree from the University of Michigan in 1990), he went to work in Silicon Valley. From 1990-94, he worked at National Semiconductor Corporation's Fairchild Research Center in Santa Clara, California, researching deep sub-micron CMOS integration and advanced gate dielectrics. In 1994, he moved on to Silicon Graphics in

"One of my goals is to produce some intellectual property that has commercial applications."

Mountain View, California where he spent two years as part of their technical staff, working in chip design.

His work in the private sector bolstered Yoon's confidence in his research goals and abilities, and by 1996, he was ready to return to an academic environment. Yoon joined the Department of Electrical Engineering at the Korea Advanced Institute of Science and Technology in Daejon, Korea, where he founded a research program focused on integrating micro-electrical-mechanical systems, or MEMS, with very-large-scale integrated (VLSI) circuit design. Yoon's research led to a dozen patents and scores of published papers, but it fell short in one respect.

"We developed many interesting technologies, but so far none of that work has materialized into a commercial products," Yoon says. "One of my goals is to produce some intellectual property that has commercial applications."

Which is part of the reason he joined the Department of Electrical Computer Engineering (ECE) at the University of Minnesota last fall. Yoon believes the ECE Department, with its proximity to "Medical Alley" and a long history of collaboration both with medical school faculty members and with private industry, presents a great opportunity for him to further his research program.

"I'm working on a couple of very interesting projects right now that combine MEMS and VLSI," Yoon explains. "The first is the development of a micro-fluidic biochip that can be used to perform single-cell assays."

In this project, Yoon is attempting to develop a chip that could be used to assay stem cells and cancer cells. Single cells could be placed directly on the chip and manipulated (injected with drugs or other chemical reagents) and then have their response/reaction monitored, measured, and recorded. Yoon is also working on an exciting project with the neurology department at the University of Minnesota Medical School.

"We're trying to develop a MEMS-based VLSI chip that would help disabled people regain some sensory function," Yoon says.

Judging from the promise these projects hold, it may not be long before Yoon realizes his goals.

ECE Research Administrator Brings Experience, Enthusiasm to the Job

When the Electrical and Computer Engineering Department hired Julia Sytina to become its new research administrator last August, faculty members gained an experienced ally in their quest to secure and administer research grants. Sytina has 11 years of experience in grants and contracts administration—all of it at the University of Minnesota. Perhaps even more importantly, she has the academic background to help her better understand the challenges faculty members face in the competitive world of research funding. Sytina was on track to earn her Ph.D. degree in chemistry from Moscow State University when "life" interfered, as she and her husband moved to the U.S.

"When you change countries, languages, and cultures, you have to make some choices," Sytina explains.

As a result, when she moved to the U.S., instead of resuming her pursuit of a Ph.D., Sytina gravitated towards the administrative side of academic research, first with the University's Laboratory for Computational Science and Engineering (from 1995-2003) and then with the University's Digital Technology Center (2003-2005).

In her current position, Sytina tries to help faculty members to the point where the only thing they have to do is to write up the "technical piece" of their research proposals. That means she regularly reviews the gamut of solicitations for research proposals and sees that they get to the right people, advises faculty members on the format and requirements of various proposals, and generally assists them in securing funding for their research projects.

"I do the basics—budget planning and administration, payroll, purchasing, and so on—but I also do whatever else I can to help faculty members submit more proposals and do so more efficiently and effectively," says Sytina. "My job is a service job."

It also is a job she likes very much.

"There is such an incredible variety of research projects underway in the department," she explains. "I have an unbelievable palette to work from on a daily basis. It never gets boring."

Editor's note: *Sytina is working with Associate Professor Doug Ernie to organize an open house at the ECE building for October 20th to showcase the multitude of research projects underway within the department.*

IN BRIEF

■ Self-healing infrastructure—a research area pioneered by Professor **Massoud Amin** during the past eight years—was recommended by the White House Office of Science and Technology Policy and the U.S. Department of Homeland Security to be included as one of three thrust areas for the National Plan for research and development in support of Critical Infrastructure Protection (CIP). The recently released 2004 National CIP R&D Plan is available at: http://www.dhs.gov/interweb/ assetlibrary/ST_2004_NCIP_RD_PlanFINALApr05.pdf

■ Professor **Steve Campbell** has been awarded an Institute of Technology (IT) Distinguished Professorship. This award is given to a select group of IT faculty to recognize their contributions to research, teaching, and service in both their professions and to IT. Campbell's research is in the area of fabrication of micro and nanosystems. Some of his most significant research contributions over the years include:

- His work on nanoparticle fabrication (e.g., single crystal silicon nanoparticles),
- His pioneering research in the development of the low-leakage high-K dielectric materials that are essential for next-generation low-power circuit designs, and
- His work on the modeling of flow dynamics during the rapid thermal processing stage of wafer fabrication.

Some of his major educational contributions include writing a widely used textbook on microelectronic fabrication and the development of a novel NSF-sponsored program for technical education in collaboration with local technical colleges. In addition to his role as a professor in the Department of Electrical and Computer Engineering, he serves as director of the NanoFabrication Center and has run the Nanocoordination Office for the past three years.

■ Professor **Rhonda Franklin Drayton** has been appointed to the Advisory Board of the Ceramic Interconnect and Ceramic Micro Systems Technology Conference. This group is co-sponsored by the American Ceramics Society and the International Microelectronics and Packaging Society organizations. These groups are dedicated to improving the industry's knowledge of ceramic technology for electronics and microsystems.

■ Associate Professor **Doug Ernie** received the Institute of Technology Taylor Service Award for his pioneering service to the continued development of the UNITE distributed learning program, growing it from a live 4-channel analog broadcast TV system to today's wider network, employing delivery techniques that use streaming video. In addition, he has made major contributions to the use of technology-enhanced learning throughout the university, served as interim director of the Center for Development of Technological Leadership, and been active in the UROP and REU undergraduate research programs.

■ Professor **Georgios Giannakis** recently received the Technical Achievement Award for 2005 from The European Association for Signal, Speech and Image Processing (EURASIP). This is the highest award given to an individual by EURASIP. It is awarded in recognition of a person's fundamental contributions to the advancement of science. In addition, two of Giannakis' students, R. Wang and W. Zhao, won the best student paper award at the Institute of Electrical and Electronics Engineers Radio Wireless Symposium in San Diego, CA, Jan. 17-19, 2006. The award was for their paper, 'Distributed Trellis Coded Modulation for Multi-Source Cooperative Networks.' Giannakis was a co-author of the paper.

■ Associate Professor **Ramesh Harjani** has been elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) "for contributions to the design and computer aided design (CAD) of analog and radio frequency circuits." The grade of Fellow is awarded by the IEEE Board of Directors to recognize extraordinary accomplishment in one of the fields of interest of IEEE. The total number of Fellows selected in any one year is limited to no more than one-tenth of one percent of the total IEEE membership. Harjani also recently appeared on an episode of the University of Minnesota's "Tech Talk" television program. The show, which airs on Twin Cities Public Television Channel 17, illustrates various technical concepts for a lay audience. Harjani explained for viewers what wireless networks are and how they work. He covered personal area networks, metro area networks, and wide area networks.

■ Graduate student Chad Barry received a student travel award and a research gold award from the Materials Research Society (MRS) for his work with Professor **Heiko Jacobs** on, "Directed Assembly of Nanomaterials on Topographically Patterned Substrates." The travel award was one of 24 selected from more than 400 applicants to present their research at the conference. Just six of those 24 were selected for the gold award after their presentations. The award consists of recognition and presentation of a plaque at the MRS awards ceremony, a year's free MRS membership, and travel cost reimbursement.

■ Professor **Heiko Jacobs** has received a third 3M Nontenured Faculty Award in support of his research. The award is designed to support new faculty members and is funded by the 3M Contributions Program. This

award (in the amount of $15,000) is to be used for the performance of basic research in the physical and/or biological sciences.

■ The Institute of Electrical and Electronics Engineers (IEEE) Joint Information Theory/Communications Society Best Paper Award for 2005 was presented to Professor **Nihar Jindal**, Professor Siram Vishwanath (University of Texas, Austin), and Professor Andrea Goldsmith (Stanford University) for their paper titled "On the Duality of Gaussian Multiple-Access and Broadcast Channels." The award, which was presented at the 2005 IEEE International Symposium on Information Theory in Adelaide, Australia, recognizes an outstanding paper that addresses both communications and information theory and that has appeared in either a Communications Society or Information Theory Society publication. Their paper was published in the IEEE Transactions on Information Theory, May 2004.

■ A paper written by Professor **Chris Kim,** Jae-Joon Kim, and Kaushik Roy (titled "A Low-Power Embedded SRAM Cache with PVT-Aware Leakage Reduction and Improved Read Stability") won the low power design contest at the International Symposium on Low Power Electronics and Design. The award was presented at the symposium in San Diego on August 8-10, 2005.

■ Professor **Jim Leger** has been selected as the top Electrical and Computer Engineering Professor for 2006. The award was presented by the Institute of Technology Student Board, which surveys the entire Institute of Technology student body to determine winners of their Best Instructor Awards. Leger has also been honored with the Horace T. Morse—University of Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education. As part of the award, Professor Leger will be inducted into the University's Academy of Distinguished Teachers.

■ Professor and Department Head **David Lilja** was elected a Fellow of the Institute of Electrical and Electronics Engineers (IEEE) "for contributions to statistical methodologies for performance assessment of computing systems." The grade of Fellow is awarded by the IEEE Board of Directors to recognize extraordinary accomplishment in one of the fields of interest of IEEE. The total number of Fellows selected in any one year is limited to no more than one-tenth of one percent of the total IEEE membership.

■ A Workshop on Renewable Energy to discuss renewable energy prospects in Minnesota was organized by Professor **Ned Mohan** at the University of Minnesota on Dec 9, 2005. It was highly successful with a broad range of speakers and nearly 300 participants. The workshop details and many of the presentations can be found at http://www.ece.umn.edu/groups/wind/ Mohan also recently offered two internet-based short courses to more than 1200 registrants, "Electric Drives: From Basic Understanding to Advanced Vector Control and Encoderless Direct-Torque-Control (DTC) Operation" and "Teaching Power Electronics to Undergraduates: Double the Breadth AND the Understanding." On-demand videos and additional information are available at: http://www.ece.umn.edu/groups/power/. DVDs of these courses are available at cost from http://www.bookstores.umn.edu/viewCategory.cgi?categoryID=110;curr_ page=2 This work was sponsored by NSF grant no. DUE-0231119.

■ **Thomas Misa**, associate professor of history at the Illinois Institute of Technology (IIT), has been selected as the new director of the Charles Babbage Institute, effective July 1, 2006. Misa will hold concurrent appointments as Engineering Research Associates (ERA) Chair in the History of Technology, as a faculty member in the Program in the History of Science and Technology, and as professor of history of science and technology within the Department of Electrical and Computer Engineering. For more information, see http://it.umn.edu/news/misa.html

■ Professor **Guillermo Sapiro** received the Institute of Technology Taylor Research Award for his contributions to the area of image processing and computer vision. For example, his research has gone beyond Planet Earth (his loss-less image compression technique is used by the Mars rover to transmit images from the surface of the red planet), and his image inpainting work has been incorporated into Adobe Photoshop. Other research contributions include the application of mathematical analysis to imaging the HIV virus, and compression and analysis of digital elevation maps. Also, one of Sapiro's postdoctoral research associates, **Michael Hofer**, has received the best Ph.D. dissertation award from the Austrian Mathematical Society (OeMG). The award will be presented at the Joint Mathematics Meeting of the Austrian and German Mathematical Societies in September in Klagenfurt, Austria.

■ Professor **Ahmed Tewfik** has been elected to the Board of Governors of the Institute of Electrical and Electronics Engineers Signal Processing Society. His term will run from January 1, 2006, through December 31, 2008.

EXPERIENCE ECE:

Building Partnerships in Research and Education

OCTOBER 20, 2006

The Department of Electrical and Computer Engineering invites you to join us for a day of activities highlighting the research and education mission of our department. This year's event will include demonstrations/tours highlighting cutting-edge research being carried out in our department and exhibits by industry emphasizing electrical and computer engineering in the corporate setting. In addition, keynote presentations and a panel discussion on Forming Partnerships—Exemplars and Opportunities will explore the critical role partnerships at all levels increasingly play in the research and education environment and ways in which successful partnerships are established and maintained. This event provides people from government, industry, and educational institutions an exceptional opportunity to meet and exchange ideas with the faculty and students in the Electrical and Computer Engineering Department.

For further information and to register, please visit www.ece.umn.edu or call 612-625-2855.

SIGNALS

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Department Head

L. L. Kinney
Associate Head & Director of Undergraduate Studies

B. Wollenberg
Director of EE Graduate Studies

G. Sobelman
Director of CompE Graduate Studies

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