Signals

INSTITUTE OF TECHNOLOGY
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Department of Electrical and Computer Engineering

Fall 2009

UNIVERSITY OF MINNESOTA
Driven to Discover℠

U of M Solar Car Team places first in 2009 Formula Sun Grand Prix

On June 5, the University of Minnesota Solar Vehicle Project team placed first among 11 solar car teams in the 2009 Formula Sun Grand Prix, a closed-track race at MotorSport Ranch in Cresson, Texas. With its latest solar-powered car—Centaurus—the team of engineering students from the University's Institute of Technology completed 487 laps on the 1.7-mile, road-style track (827.9 miles total) throughout the three-day race.

This is the second consecutive Formula Sun Grand Prix win for the team. The race was last held in 2005 at the Heartland Park Raceway in Topeka, Kan., where the University of Minnesota solar car—Borealis III—took first place.

"The team did a great job, helped others and pulled off a very clean race," says Adem Rudin, the University of Minnesota Solar Vehicle Project team student crew chief. The team achieved 94 more laps than second-place finishing University of Kentucky. Northwestern University placed third. The University of Minnesota team also achieved the fastest lap at two minutes and 20 seconds.

During the next year, the University of Minnesota team will focus its efforts on designing and building the team's next-generation, completely solar-powered car—Centaurus II—the ninth car in the team's 19-year history. The Solar Vehicle Project is funded by generous private donations from corporations and individuals, and managed through the Department of Electrical and Computer Engineering.

The University of Minnesota Solar Car team took home the gold at the 2009 Formula Sun Grand Prix, a three-day race held at MotorSport Ranch in Cresson, Texas.

Some of our Solar Car Vehicle Project's corporate support include: 3M, General Plastics Manufacturing Co., Northwest Airlines, Remmele Engineering, CAT, PAR Systems, Initiative for Renewable Energy and the Environment, Freescale Semiconductor, Advanced Circuits, Future Lighting Solutions, EMJ, AIRTECH Advanced Materials Group, VICOR, Digi-Key, University of Minnesota Institute on the Environment. Dr. Partrick J. Starr, Clifford I. Anderson, and Dean Chenoweth. For a complete list of our sponsors, go to www.svp.umn.edu/sponsors.html.

For more information, visit the University of Minnesota Solar Vehicle Project Web site at www.svp.umn.edu/index.php.

In This Issue

Defining moments end long search for career dream

Erik Peterson

Erik Peterson (EE'04) credits Rhonda Franklin, Ph.D., with planting the seed for his further study. He found his career passion after talking with a woman whose life was improved with a electrical neural prosthesis. Now Erik is working toward a Biomedical Engineering doctorate to improve people's lives.

Erik decided after receiving his University of Minnesota bachelor's degree in electrical engineering that he'd like to work for awhile before continuing his studies. By the end of the summer, he landed a job with Intel's CPV design unit and moved to Portland, Ore. But, in the back of his mind was a conversation he had earlier with Franklin, who had become his mentor while he was still at the University of Minnesota.

Rhonda Franklin, Ph.D.

"It was about this time of the summer, five years ago, that I was sitting in Professor Franklin's office and we were talking about my plans post-graduation. She had a hunch that a Ph.D. program was the track for me, and she was absolutely right," Erik says.

After a couple years of starts and stops applying to a number of universities, he took a campus tour at Case Western Reserve University.

"While touring the Case campus, I met a woman who had been paralyzed on the right side of her body for 12 years," says Erik. "She had participated in a procedure conducted by Case, performed at Metro Health Hospital, Cleveland, Ohio, where they implanted an electrical neural prosthesis that helped her to use muscles in her neck to control her hand. The movements were slow and imprecise but she squeezed my hand. The experience was so powerful I knew then I wanted to improve the lives of people with paralysis so they could play with their kids and have jobs. I wanted to work on neural interfaces to help make that happen."

Leveraging his EE degree and work experience, Erik applied to and was accepted at Case in the Biomedical Engineering program. "I had some apprehension about jumping in with a very light biology background, but I ended up really enjoying my physiology classes and getting stretched in new directions."

Erik recently completed the first year of his Ph.D. program studying neural engineering in the hope of helping bridge gaps in the nervous system left by injury.

Looking back, Erik believes his choice to work for awhile was right for him. "I think I needed the time at Intel to get some perspective on working in industry and to better hone what I wanted to pursue, but I am so much happier where I am today," he says. "I want to thank Dr. Franklin for her encouragement and for taking the time to help me along the way."

During his first year at Case he's enjoyed working with the other graduate students. "Many of them went straight from undergraduate studies into graduate studies rather than taking time off to work as I had," he says. "Although there are only five years difference between our ages, I am aware of a "generation gap" especially when we talk about cultural references. Imagine… I spoke with a student who had never seen the movies "Back to the Future" or "Princess Bride."

"If I had to give a word of advice to current undergraduate students, I would stress the importance of finding what makes you happy and following that path," Erik says. "I am where I want to be and it's great. Now I need to figure out my next steps."

ECE Offers Integrated Five-Year BEE/MSEE and BCompE/MSEE Degree Programs

The Department of Electrical and Computer Engineering offers five-year integrated undergraduate/graduate completion degrees—BEE/MSEE and BCompE/MSEE—that save time and money for students. The five-year programs allow qualifying juniors to take undergraduate and graduate classes simultaneously. The students enrolled in this program also are eligible for research or teaching assistantships and fellowships (some of which provide a stipend, tuition and health insurance benefits), earn graduate credit at undergraduate tuition rates (16 graduate credits at undergraduate rates), and complete a Master's degree in five years.

"A Master's degree is necessary for students interested in design and development, or research and development careers," says Keshab Parhi, ECE Director of Graduates Studies. "Our five-year programs provide students with additional coursework and project experience for advanced job competencies."

Qualifying GPA: 3.4 and above are eligible to apply.
Qualifying completed coursework: 79 credits; or during the semester of completion of at least 79 credits.
Department application deadlines: Fall Semester – May 15; Spring Semester – September 15
Graduate school application deadlines: Fall Semester – June 15; Spring Semester – October 15

For additional information, please contact Linda Jagerson, Assistant to the Director of Graduate Studies, at 612-625-3564, or by e-mail to jager001@umn.edu.

To read more, go to our Web site at www.ece.umn.edu/graduate/ECEBSEEMSEEDEGREE.html.

Wearable Sensor System for Autism Assessment and Therapy

According to the Centers for Disease Control and Prevention in a 2007 report, the prevalence of autism in the United States was one in every 150 children—and nearly one in every 94 boys.

An interdisciplinary team of researchers at the University of Minnesota hope to develop effective tools to help physicians and parents improve the lives of children with autism. This research is funded by a grant from the University of Minnesota's Institute for Engineering in Medicine, and the Medical Devices Center.

Anne Kelly, MD, MPH, a member of the team and a pediatrician who treats children with complex medical problems, says children with autism spectrum disorders (ASD) are particularly challenging because they have varied abilities to communicate their physical symptoms. "Understanding these children's irritability and other behaviors often is baffling to physicians and parents," Kelly says. "Physicians often recommend treatments for specific symptoms and behaviors based upon parental observations. What parents and physicians need are quantitative tools to assess children's behavior patterns in order to develop effective treatments."

Ahmed Tewfik, Ph.D.

Ahmed Tewfik, Ph.D., Principal Investigator of the research project and professor in the Department of Electrical and Computer Engineering, saw an opportunity when Kelly convinced him that a device similar to one he created to measure brain activity for stroke victims had the potential to benefit children with autism who cannot communicate their symptoms.

Repetitive hand-flapping, common in a significant number of children with autism, was identified as a behavior that could be measured. Tewfik, his Ph.D. student Cheol-Hong Min, and their engineering team began working to develop a device that would measure and track hand-flapping movements, and possibly help predict and track treatments that could affect this behavior.

Cheol-Hong Min

To help him understand how best to design a measurement tool, Min, who up to this point spent most of his time in the research lab, was introduced to children with autism in Kelly's clinic. Min observed these children in a variety of settings. "This was a stunning experience for me," Min, a father of two young boys, says. "I couldn't help but think of my own children while observing these children. You can't help but get emotionally attached. I found myself asking, 'How can I help as an engineer?' "

A major challenge the team faced was that children with autism often are averse to change, and unwilling to keep any device on their skin or clothing because of their heightened sensory issues.

The project's wearable sensor (above) benefits children with autism who cannot communicate their symptoms.

To overcome these obstacles Tewfik's team developed a special device—a wireless sensor that can be hidden in a cloth wristband.

The device contains an accelerometer, Bluetooth technology, and a microcontroller that can record real time movements. The movements translate into signals that are interpreted through a specifically developed computer program. Through pattern detection, this device can detect when an increase in behavior is about to occur.

Tewfik's team also installed an audio alert. A beep, a buzz or sometimes a non-audible vibration alerts the child (or personal care attendant) when the behavior occurs.

John Hock, a post doctorate fellow at the Center for Neurobehavioral Development whose research focuses on applied intervention, says, "This device not only saves time in data collection, but also teaches us different ways of looking at the behavior and the cause. If we know what triggers the emotional overload for these patients, we could teach their providers how to avoid those situations."

Melissa, a mother who agreed to allow her son, Steven, 16, to be part of the research study, says, "Steven had been diagnosed with autism at age 3. Not being able to communicate is beyond heartbreaking because somewhere inside is this awesome, smart, amazing young man. He is locked in there."

"This research has been a gift for our family," Melissa says. Like many parents of children with autism, she welcomes tools and techniques that could help. She hopes to see this device help parents and caregivers understand what triggers some behaviors and sensory overload. "Every moment lost from sensory overload could be a moment spent socializing," she says. "And socializing is invaluable for Steven's development."

by Tonya M. Femal, Institute for Engineering in Medicine

Spring 2009 Senior Design Show Highlights

The Minnesota/Taiwan Multi-mode Security System with Automic Pattern Detection and Sensor Fusion team spent a week together on the University of Minnesota campus in April discussing and testing their theories as well as their project equipment. The National Cheng Kung University team received certificates of completion for their joint project work and returned to Taiwan. The Minnesota team completed the combined project details and presented the project at the Spring 2009 Senior Design Show.

Both fall and spring semesters, the Department of Electrical and Computer Engineering (ECE) and the Department of Mechanical Engineering (ME) host a Senior Design Show to highlight semester-long capstone design projects undertaken by our graduating seniors.

The Spring 2009 show featured 13 ECE exhibits with work by 62 senior ECE students. More than 15 business and industry volunteer judges viewed the projects, asked questions and quizzed the students' knowledge of their work.

Industry sponsors who provided real-world challenges for the ECE students to solve included: BAE Systems; Environmental Sentry Protection, LLC; ICD Corporation; For the Edge, Inc; "TRENCH'N edge" Trencher; Diagnostic Biosensors, LLC; and Xcel Energy.

Global Design: Minnesota/Taiwan Multi-mode Security System with Automatic Pattern Detection and Sensor Fusion team provided a presentation about their joint project for a security system that uses data from cameras and microphones to automatically detect intruders.

National Cheng Kung University of Taiwan **Team:** Wei-Hsin Sam Wang, Cheng-Hung Kevin Chung, Che-Jung Jim Hung, Shu Ting Chris Wang, Kuo-Hao Howard Lee. **Minnesota Team:** David P. Crayton, Gavin M.Werner, Halit S. Silahyurekli, Piyush Kumar, Aaron T. Van De Bogart.

Mark your calendars

Fall Semester
2009 Senior Design Show
December 15
McNamara Alumni Center

Patent Awarded to 2007 Senior Design Team; 2009 Senior Design Teams Work on Refining Advancements

2009 Spring Senior Design GPS-Controlled Sod Edging Machine Team (from left) William C. Reynolds, Brandon T. Duncan, Chad A. Knotz, Hanz P. Lillevold, and Nicholas S. Taylor.

In September, a 2007 Fall Senior Design ECE and ME team and Patrick Dean, President of "TRENCH'N edge" Rotary Trencher, received good news—their patent for the Automatically Steerable Trencher had been accepted. Former students Seongtae Kim, Paramanand Jagnandan, Christopher Singh, Peter Jans Gillespie, Nick A. Schottler, Katrina Alexis Faucett, and Christopher Thomas Weyandt helped design the machine and write the patent application. The machine digs subsurface drip irrigation trenches which help save up to 60 percent of irrigation water use.

"As demand for water increases thoughout the world, the "TRENCH'N edge" installation method will enhance water-saving and water-recyling systems," said Dean. "Working with the University of Minnesota Institute of Technology's electrical engineering and mechanical engineering design students is a win-win opportunity. They help create, build, and test new ideas at a fraction of the cost for industry and they gain immeasurable professional experience that will help them find jobs when they graduate."

The 2009 Spring Senior Design Team, pictured at right, worked on advancements that enable the trencher to download computer-aided designs (CAD) and then cut those designs into the ground surface. The upcoming Fall 2009 Senior Design Team is enhancing functionality for the CAD system download with more a powerful computer processing board.

ECE student Jon Harms invited to State Capitol to present poster

ECE student Jon Harms (EE'09) and Minnesota Senator Michelle Fischbach discussed Jon's work on his senior honor's project.

I had the opportunity of doing a **Senior Honors Project** (see article below) with **Professor Jian-Ping Wang**. It was a great experience, and I hope to continue building upon my work as I pursue a Ph.D. at the University of Minnesota. To me, successful research doesn't necessarily mean finding the answers or solving the problems. Some of the problems we face are much too large to solve today. Instead, successful research means that you productively contribute to the discussion and provide some insight that guides us towards those final solutions.

In my research, the ultimate problem we are facing is the limits of Moore's law*. It can't continue forever, so someday we need to shift from making electronics smaller to making electronics smarter. I believe that magnetic devices will play a key role in making these smarter designs.

I contributed to the discussion by making an important contribution to the solution we are working towards. For decades, models have been readily available for simulating transistor-based circuit designs in Simulation Program with Integrated Circuit Emphasis (SPICE) simulations. The ability to simulate circuits is important because engineers need to be confident of their designs before committing large amounts of money to building physical devices.

Working with my classmate, **Farbod Ebrahimi**, our project goal was to provide a model of a magnetic-tunnel-junction so that engineers can simulate smarter circuit designs that incorporate these new magnetic devices. Prior to the development of this model, researchers at the University of Minnesota were not able to test their ideas using a SPICE simulation. I was able to provide them with the tools to do this.

I shared my research with my Minnesota Senator Michelle Fischbach. I was excited to represent my University and help spread the word about what we are doing here. I know that times are tough, and budget cuts are the reality of the day. The University isn't going to be immune; it's just a question of how much. Our lawmakers have some hard decisions to make. I wanted personally to thank Senator Fischbach for the financial support that I have received from the state and to share with her the positive experience I had at the University. We have an admirable goal, to be one of the top public research universities in the nation, but we can't do this without the support of our politicians. It's critical that we invest in our future, and the University of Minnesota is an awesome place to invest! I wanted to share this with her, and I hope that in the coming months as decisions are made that my experience will help her understand the value of investing in University of Minnesota.

I'm honored to be able to contribute something to the University from which I have received so much.

by Jon Harms (EE'09)

* "Moore's Law describes a long-term trend in the history of computing hardware, in which the number of transistors that can be placed inexpensively on an integrated circuit has doubled approximately every two years." (source: Wikipedia)

ECE Enhanced learning through Senior Honors Projects help students achieve success

Each year, a group of ECE juniors find themselves able to take a departure from the regular senior year Senior Design project curriculum.

In the spring, ECE faculty compile a list of top-ranked juniors and Department Head David Lilja selects on average 15-20 students and invites them to participate in the **Senior Honors Program**.

Senior Honors students must select a professor with whom to work for the entire following year (two semesters). The Senior Honors program allows the student more one-to-one time working with a professor on research. The project work is funded through the faculty labs.

"This program provides an exceptional opportunity for students who excel," says Lilja. "A greater percentage of these students continue on in their education, achieving master's and doctorate degrees. A number of them stay on for our 5-year program."

A Conversation with Dean Klein (EE ’80, MEE ’04)

Dean Klein, Vice President Micron Technology, Inc. Memory System Development

Engineering is a career rich in collaborations, business concepts and economic realities according to alumnus Dean Klein (EE ’80, MEE ’04). Currently serving as Micron Technology, Inc. Memory System Development Vice President, Klein works on memory technologies and capabilities, primarily Solid State Drives (SSDs). He was the co-founder of PC Tech, Inc., from its inception in 1984 until it was acquired by Micron Electronics in 1995.

Klein has developed more than 200 patents in computer architecture and electrical engineering and contributed to several books. He describes his specialties as computer architecture, engineering management and “herding cats.”

In his home community of Eagle, Idaho, he is a mentor to the Mountain View High School Robotics Club, a 20-member student team who learn the real world of problem solving; the joys and agonies of teamwork; scheduling and budgeting; and procuring sponsorships. With his wife, Theresa, Klein promotes science in elementary schools and has been nicknamed “Mr. Science.”

Describe your view of engineering as a career.
Engineering is very rewarding. For me it’s been exciting working with really smart people on really interesting projects. Today I have 141 engineers in my organization—all with remarkably creative ideas; they never stop thinking. It’s extremely rewarding working with them.

And it is lots of fun putting the pieces together. I am not a master, but a jack of all trades, and I enjoy putting the pieces together with these bright people.

Engineering has been enjoyable, rewarding and fruitful. I haven’t changed jobs in 25 years but my job has changed around me.

What are the most surprising aspects of your career?
The most surprising to me was the nature of interdisciplinary engineering. I’m an electrical engineer with some mechanical engineering and medical background. It is exciting to me to combine these backgrounds for an engineering solution… surprising and entertaining.

We don’t engineer in silos. The products we develop are components for bigger systems. We can’t engineer a solution without considering the whole system, and looking beyond.

What is the biggest challenge you face in your business?
The biggest challenge in our business is economics. The overall semiconductor business and the memory subset: we’ve been hard hit by the economy and foreign competition. Part of the problem is caused by subsidies provided by foreign governments to our foreign competition which led to oversupply and low selling prices for components.

The memory industry is an industry of ups and downs—over supply to under supply. A current challenge of my job is to keep my team motivated during the difficult times in this industry. When we see foreign governments subsidizing our overseas competitors, we see it as unfair. So keeping teams motivated through issues like that is important.

Which do you prefer in your career: research or business aspects?
You can’t separate them. Business drives our research. We economically evaluate our solutions. We don’t engineer in a vacuum, but rather we consider our solutions through all the life cycles and business aspects. In the end, there must be a market for the solution.

I take a practical view of technology because of the sub-segment of the electronics industry we operate in. There is little room for error and while there is a lot of experimentation we do on the process-development part of our design, there is little room for system-level experimentation. There has to be a plan for commercialization before dedicating resources.

We evaluate a lot of memory technology relays. The evaluation is not solely of technological merits but also the economics of the technology. We ask ourselves, ‘Will it be less expensive to produce?’ We can always find ways to increase the performance but we can’t produce high performance at high cost.

Of what patent inventions are you most proud?
The patents of which I am most proud are the ones my company is using. Others I have looked back on and chuckled because I wondered what I was thinking at the time.

What are the new challenges in memory reliability?
Memory reliability has been on an improving curve, getting to the point where we can take the reliability of a DRAM cell largely for granted. Failure rates for DRAM are extremely low, with FIT (failure-in-time) rates in the single digits. However, when one looks at reliability of memory from the system side the picture might be somewhat different. As the interface speeds have increased and voltages have come down we are seeing increasing challenges for system makers around the memory interface. Today, the designer needs to pay very careful attention to the memory channel design.

NAND Flash memory is the new challenge. NAND Flash is a nonvolatile memory replacing magnetic memory and challenging the rotating memory hard drives today. There are system level problems to be solved in this realm.

Tell us about your work with the 2007-2008 Defense Advanced Research Projects Agency (DARPA) study.
I was a participant in the DARPA Exa-Scale Computing Study with the goal to identify main challenges in the scaling of super-computing in the exa-scale era. That's a billion-billion operations per second. Today, the industry is working on peta-scale super-computers and is laying the groundwork for talking exa-scale. This is really important for solving really big problems accurately, problems such as climate modeling and other complex system modeling.

The findings from our study could fill a book. We identified the challenges of surrounding processor, memory and storage, highlighting the need for new solutions to scaling performance while keeping power consumption in check. The issues we addressed impact at all levels of computer architecture. The report can be found at: users.ece.gatech.edu/mrichard/ExascaleComputing-StudyReports/ECS_reports.htm

Tell us about being Mr. Science in your community.
I've been a strong advocate for science education. Getting kids interested in science is a first step towards raising young scientists who will tackle the tough challenges we face globally. I am a believer that this country must demonstrate leadership in applying science to problems such as climate change and world hunger. This is going to occupy future generations of scientists and engineers, so I feel it's appropriate to start at the youngest levels.

Mr. Science is my way of getting kids excited in science. It began when I was a Cub Scout leader. My wife and I began to see the need to promote science in elementary schools.

We created a science fair curriculum for several schools. At first, we tried it with fifth graders, but then we expanded it for first through fifth grades. As Mr. Science, I get to help kick off the science fairs with strange experiments. It's great watching the kids get excited about projects related to gravity, energy, and chemicals. The kids never fail to surprise me and some had real insights in their projects. Parental involvement is not a bad thing either, because if the parents are excited about science, the kids will be too.

What were some of the highlights when you were studying at ECE?
It was an opportunity to be surrounded by smart, inspiring people. It was fun working in student teams—we had a lot of fun and rewarding experiences. Some of my teammates during my senior year were a bit older and had been working in "the real world." I learned a lot from them and enjoyed hearing their stories of life in industry.

And there were those "Aha!" moments—when students would take a test and everyone would get the same question wrong. The professor would patiently explain the theories, putting the pieces together. We'd all put our palms to our foreheads and say, 'Why didn't we get that?'

One time we had a test question about a very simple circuit in the Analog Computing Lab exam. The question was "What does it do?" There were integrators and differentiators. Of course we all knew calculus and we knew what the circuit elements did, but not one of us put our knowledge of sines and cosines together with the circuit we saw in front of us to realized it was an oscillator. Of course when the professor wrote out the equation we could all visualize it. Aha!

What advice would you give to ECE students?

- Be multi-disciplined.
- Be conscious of the business aspects of engineering.
- Be aware of how other engineering fields relate to your own.
- Never stop thinking and have fun.
- Become an expert in an area but don't become pigeon-holed.

What would you like to say to faculty?
Keep on opening eyes and giving us those "Aha!" moments.

Eleanor Hale Wilson Lecture Series Begins

This year, the Department of Electrical and Computer Engineering is hosting the first annual Wilson Lecture series thanks to a generous gift from Eleanor Hale Wilson. The series support helps bring leaders in the engineering fields together to share their expertise and discoveries with University of Minnesota students, faculty, and alumni. Wilson Lecture attendees are invited to enjoy refreshments a half hour prior to the presentations. These lectures are open to the public. Go to our Web site's home page for calendar details: www.ece.umn.edu.

For Working Adults:

Did you know....you can work on your Master's in Electrical Engineering during hours convenient to you? ECE offers some upper division and graduate level coursework through the UNITE program (unite.umn.edu). For an extra fee, all the lectures are available online. You need only make time for exams and labs, usually available in late afternoon. For more information, go to www.ece.umn.edu/ProspectiveStudentsGraduate/index.htm.

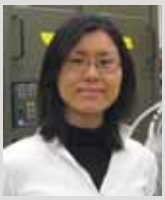
ECE Students

Graduate student Juyul Lee was named a recipient of the KUSCO-KSEA Scholarship which recognizes outstanding graduate students who have excelled in the field of science and engineering as well as in extracurricular activities including community services, and who have demonstrated a potential for becoming leaders in the scientific community for closer cooperation between the U.S. and Korea. (Nihar Jindal, Ph.D., advisor)

Ph.D. candidate Nathan Lindquist has been awarded the Doctoral Dissertation Fellowship from the University of Minnesota Graduate School. The purpose of the Doctoral Dissertation Fellowship program is to give outstanding final-year Ph.D. candidates who are making timely progress toward the degree an opportunity to complete their thesis research in the final year. Recipients of the fellowship, in 2009-2010, will receive a stipend of $22,500 for the academic year, plus full tuition for thesis credits. Eligible recipients also are covered by comprehensive health insurance, including subsidized dependent coverage and dental care. (Sang-Hyun Oh, Ph.D., advisor)

Ph.D. student Yun Sang Park has been awarded an Interdisciplinary Fellowship from the University of Minnesota Graduate School. Park's research is housed in the Institute of Translational Neuroscience (ITN), one of the interdisciplinary centers and institutes at the University. This fellowship is intended to provide a unique study opportunity for the top doctoral students whose research and scholarly interests best complement those of the University-wide, interdisciplinary research centers or institutes. (Keshab Parhi, Ph.D., Electrical and Computer Engineering, and Tay Netoff, Ph.D., Biomedical Engineering, co-advisors)

Graduate student Niranjay Ravindran and **Nihar Jindal, Ph.D.,** received the 2009 Leonard G. Abraham Prize 2009 Best Paper award for the IEEE Journal on Selected Areas in Communications. The award honors the best paper that appeared in the journal during the previous year. (Nihar Jindal, Ph.D., advisor)



Graduate student Xiaofeng Yao was selected as one of five finalists for the Best Student Presentation Award at IEEE International Magnetic Conference (Intermag) 2009 for her paper "Unique spin torque transfer switching in magnetic tunnel junctions with composite free layer." (Jian-Ping Wang, Ph.D., advisor)

ECE Faculty

Massoud Amin, Ph.D., presented an hour-long Webinar titled "Making the Electric Grid Smarter, Stronger and More Secure" on Tuesday, June 23 via Go ToWebinar, Web Events Made Easy. To see his presentation slides, go to www.smartgridlearninginstitute.com. Amin continues to be interviewed on this subject by a variety of media including Minnesota Public Radio, and others. He also presented "Toward a Stronger, More Secure and Smarter Grid" to the Minnesota Rural Electric Association (MREA) Energy Issues Summit in St. Cloud on August 12. MREA is comprise of 44 member-owned electric cooperatives and generation and transmission cooperatives, and serves more than 1.6 million Minnesotans, largely rural residents.

Anand Gopinath, Ph.D., is a co-author of the newly published book "High-Speed Electronics and Optoelectronics: Devices and Circuits," together with Sheila Prasad, Professor Emeritus of the Electrical and Computer Engineering Department at Northeastern University, and Hermann Schumacher, Professor and Director of the Competence Center on Integrated Circuits in Communications, Institute of Electron Devices and Circuits, University of Ulm.

Chris Kim, Ph.D., has been promoted to Associate Professor. Kim also was selected as one of the 66 recipients for the 2009 IBM Faculty Award.

Ned Mohan, Ph.D., received the IEEE's 2010 Undergraduate Teaching Award, one of IEEE's most prestigious honors.The criteria considered include: excellence in teaching, creative development of curriculum, authorship of course materials, involvement with undergraduate students through activities such as advising, project supervision, or advising for student organizations; and attracting students to the engineering profession, and quality of the nomination.

Sang-Hyun Oh, Ph.D., received a Doctoral New Investigator Award from the American Chemical Society (ACS) Petroleum Research Fund (PRF) to support his research on plasmonic photovoltaics. This award aims to promote the careers of young faculty by providing $100,000 start-up funding to support fundamental research in the petroleum and energy fields. In addition, Oh and Ph.D. student Nathan Lindquist in ECE, in collaboration with Chemical Engineering and Material Science professor David Norris, and Ph.D. student Prashant Nagpal, had

an article published in *Science* describing a simple and reproducible technique to create ultrasmooth patterned metals for applications in plasmonics and metamaterials. Link: www.sciencemag.org/cgi/content/abstract/325/5940/594.

Marc Riedel, Ph.D., received the prestigious National Science Foundation's CAREER Award. His proposal is titled "Computing with Things Small, Wet, and Random – Design Automation for Digital Computation with Nanoscale Technologies and Biological Processes."

Sachin Sapatnekar, Ph.D., was named Editor in Chief for the *Transactions on Computer-Aided Design of Integrated Circuits and Systems* by the IEEE's Council of Electronic Design Automation.

Ahmed Tewfik, Ph.D., designated University of Minnesota expert, explained the digital transition switch and provided an audio sound clip for the U of M's Web site for use by reporters.

Jian-Ping Wang, Ph.D., has been promoted to Professor.

ECE Alumni

Oregon State University Assistant Professor Ted Brekken (EE Ph.D. '05), received the CAREER Award from the National Science Foundation. (Ned Mohan, Ph.D., advisor) The Faculty Early Career Development (CAREER) Program is a Foundation-wide activity that offers the National Science Foundation's most prestigious awards in support of the early career-development activities.

ECE Faculty Changes

Jae Moon, Ph.D., accepted a position at Korea Advanced Institute of Science and Technology (KAIST) in Daejeon, South Korea, where he will be initiating a new program in communications and storage.

Jaijeet Roychowdhury, Ph.D., accepted a position in the Department of Electrical Engineering and Computer Science at the University of Carlifornia-Berkeley.

In Memory

Professor Paul Cartwright, long-time professor of electrical and computer engineering and former Institute of Technology assistant dean for student affairs, died of cancer at age 93.

During his 37 years at the University, Cartwright's major interest was fostering the success of IT undergraduate students. He introduced major changes in student counseling activities; increased the student retention rate by providing innovative tutoring programs; helped to advance effective engineering-related student organizations; developed an "IT House" dormitory program; and developed many other imaginative programs that increased the graduation rate of engineering students.

CyberOptics endows graduate fellowship in memory of its founder Dr. Steven K. Case

Steven K. Case

CyberOptics Corporation, headquartered in Golden Valley, Minn., endowed the *Dr. Steven K. Case Optics Fellowship* in memory of its founder, Dr. Steven K. Case, with a gift of $25,000. Case died June 16 in a plane crash in Crystal, Minn.

"Dr. Case's innovative application of optics established the foundation for CyberOptics which today is a leading provider of sensors and inspection systems for the global electronics and semiconductor markets," says Kathleen P. Iverson, CyberOptics CEO and president. "We are creating this fellowship in Dr. Case's memory to aid full-time graduate students who are working toward a graduate degree with a focus on optics and are enrolled in the University of Minnesota Institute of Technology's Electrical and Computer Engineering Department."

"We are honored that CyberOptics has chosen to make this generous gift to aid our graduate optics students with their education," says David Lilja, Louis John Schnell Professor and Electrical and Computer Engineering Head. "It is a fitting tribute to Steve's past dedication and caring for students. He was an outstanding Electrical and Computer Engineering (ECE) faculty member and made tremendous contributions to ECE teaching and research missions."

The University of Minnesota's 21st Century Graduate Fellowship Endowment will match dollar-for-dollar the payout of the endowment established by CyberOptics.

If you wish to support this memorial fellowship fund #6342, you may do so online at www.ece.umn.edu or contact Anastacia Quinn Davis at 612-625-4509 or e-mail: aqdavis@umn.edu.

Better Living through Magnetism


Randall Victora, Ph.D.

University of Minnesota Electrical and Computer Engineering Professor Randall Victora, Ph.D., specializes in research on the theory and simulation of magnetism and magnetics. He works with students to provide solutions to problems posed by magnetic recording technology and bio-magnetism applications.

Having worked both in industry and academia, he has been recognized by two Information Storage Industry Consortium (INSIC) Technical Achievement Awards, the second, in 2006, for pioneering work in the conception and experimental confirmation of exchange-coupled composite recording media for the INSIC Extremely High Density Recording (EHDR) Research program in advanced hard disk storage technology. This media allows technologists to break the connection between thermal stability and switching field, thus allowing higher densities to be reached.

Currently, Victora and his research team of six graduate students are working in six different research areas. The first is titled "System design of heads and media for 4 terabit per square magnetic recording," funded by INSIC. Victora is working to address the difficulties posed by thermal fluctuations.

"Because today's recording media has grains with radii of only a few nanometers, we're seeing the laws of physics exhibited in the problem of unstable storage," says Victora.

Victora explains, "All matter vibrates due to heat. As human beings, we are so large that we don't notice small vibrations, but at the size of today's recording media, vibration is noticeable and problematic. The bounce causes the magnetization direction to become unstable. Thermal fluctuations can flip bits of information, resulting in misinterpretation of data."

Current hard drives are composed of randomly-ordered storage grains that retain data. Victora's group is trying to design a high-density system based on bit-patterned media, whereby groups of grains are replaced by lithographically defined bits of high uniformity. This will allow the fundamental magnetic unit to be larger, and thus better resist thermal fluctuations and ensure reliability of stored data.

A second area of Victora's research involving data storage, and funded by Seagate, is to find a way to characterize inter-granular quantum mechanical exchange and anisotropy dispersion. In data recording, it has been has found that the magnetization direction of distinct grains affect each other and can cause a realignment, thus causing data error. Victora is seeking to find ways to characterize the media, so that experimentalists will be able to recognize which media formulations are prone to this problem, and should be avoided.

A third area of Victora's research applies to magnetic recording and is titled "Micro-magnetic Model for a Complete Write Head," also funded by Seagate. Victora is searching for a clever, new approach to treat the interactions of various parts of the write head, while still allowing the calculation to fit within computer memory.

Victora also is researching bio-magnetism to provide a breakthrough in tumor destruction. Working with Jian-Ping Wang, Ph.D.,Victora is seeking a method to heat particles that are adjacent to tumors by subjecting them to AC magnetic fields. This allows the tumor to be destroyed without harming the patient. This work is funded by the National Science Foundation.

With funding from National Science Foundation through the University of Minnesota's Material Research Science and Engineering Center (MRSEC) and with experimental data from Bethanie Stadler, Ph.D., Victora is studying the use of spin torque to switch magnetic nanowires and thin films. This research uses electron spin to switch thin films of magnetic materials essentially through conservation of angular momentum.

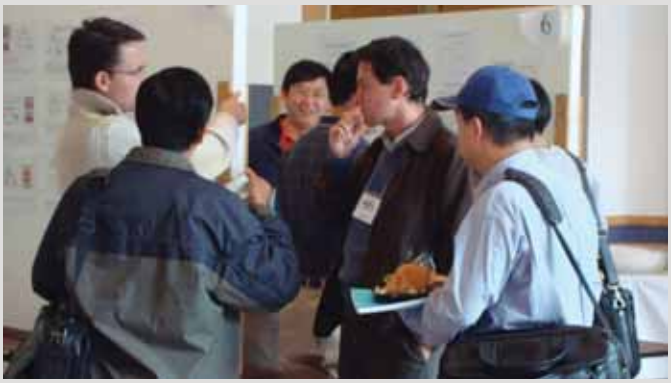
Just completed is "Magnetic Resistance in Presence of Defects," Victora's research into resistance changes that are dependent on differences between the orientation of magnetization in neighboring layers, all in the presence of defects. This National Science Foundation funded research involved quantum mechanical calculations of spin transport. His group has demonstrated that surface roughness of only 1 atomic distance (0.25 nm) will cause resistance of a small wire to increase by a factor five, which will decrease the relative signal obtained by a sense head and adversely affect wires connecting different parts of an integrated circuit.

In addition to his research and teaching, Victora is the 2009-2010 president of the IEEE Magnetics Society. The Magnetics Society publishes *Transactions on Magnetics* (the fourth most downloaded IEEE journal) and hosts two annual major conferences plus minor conferences.

Victora is a member of the Scientific Advisory Board of the Data Storage Institute, Singapore, the largest independent magnetic recording research organization in the world, and has been the director of the University of Minnesota's Center for MicroMagnetics and Information Technology (MINT) since 2003.

For more information about Victora and his research, go to www.ece.umn.edu/facultyECE/ECEFACULTYRANDALLVICTORIA.html.

Center for Micromagnetics and Information Technology (MINT) Celebrates 25 Years of Research Reviews



Lively discussions ensued during the breaks at the 25th MINT Research Review held in October, 2009.

25th Annual MINT Research Review participants heard 26 research findings presentations provided by faculty and students, and viewed posters and industry displays.

Drs. Arkajyoti Misra (left) and Nathan Curland of Seagate Technology take time to discuss the findings presented at the research review.

In October, the Center for Micromagnetics and Information Technology (MINT) held its twenty-fifth annual research review for students and industry leaders. Twenty-six research findings presentations were offered to more than 80 participants. Topics included thin film magnetic recording media, magnetic heads, MRAM and spintronics, and other applications. Each year, industry participants fund the research, and the findings are reported at the MINT annual research review.

MINT was created as a way for faculty to interface with the data storage industry. Created in 1984, MINT is a research center at the University of Minnesota centered in the department of Electrical and Computer Engineering. It focuses on data storage technologies, including magnetic recording, materials, and signal processing for storage.

State-of-the-art lab equipment available includes: magnetization and anisotropy magnetometers, magneto-optical magnetometers, electron microscopes and spectrometers, thin film deposition systems, magnetic recording, and electrical characterization systems.

Current MINT faculty include Electrical and Computer Engineering faculty Randall Victora (MINT director), Jian-Ping Wang, Bethanie Stadler, and emeritus Professor Jack Judy; Chemical Engineering and Materials Science faculty Chris Leighton and William Gerberich; Chemistry faculty Wayne Gladfelter; and Physics faculty Dan Dahlberg.

For more information, visit the MINT site at www.ece.umn.edu/groups/mint/.

The 25th Annual MINT Research Review participants enjoyed lunch and had time to make new acquaintences and discuss topics of interest. Emeritus Professor Jack Judy (front, navy sweater) is MINT's founder.

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University of Minnesota Solar House Team finishes in top five

In its first-ever entry, the University of Minnesota finished fifth in the 2009 Solar Decathlon, a competition held every two years and sponsored by the Department of Energy. Twenty international teams competed to build the most attractive and energy-efficient, solar-powered house. Team Germany came in first place overall, followed by the University of Illinois and Team California.

The University of Minnesota team took first place in two of the ten contests: Engineering and Lighting Design. More than 150 University of Minnesota students participated including those from architecture; mechanical, electrical and civil engineering; construction management; and graphic and interior design.

Named ICON, the University's Solar House is rooted in the familiar shape of an American family home. The team modified the traditional roof line to create a solar gable form with the appropriate angles and surface area for solar collection in Minnesota. All appliances are Energy Star rated, incorporating technologies that use 10-50 percent less energy and water than standard models.

For more information, go to: www.solardecathlon.umn.edu/project/index.html.