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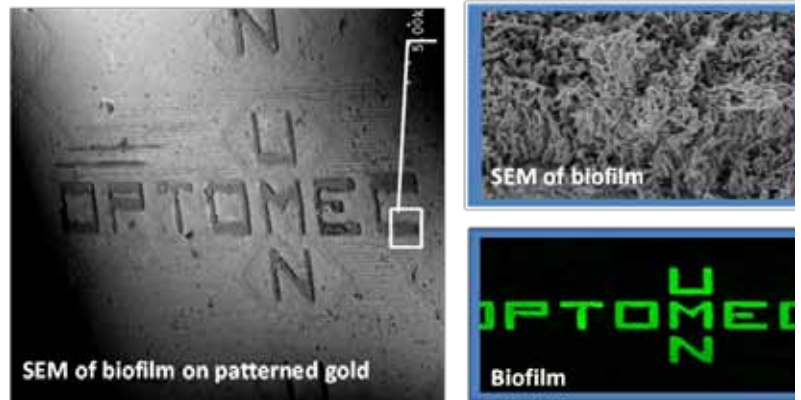
Exploring bacterial biofilms in micro-fabrication to test electrical conducting and insulating properties

In a “thinking outside the box” research project sponsored by the National Science Foundation’s Grant Opportunities for Academic Liaison with Industry (GOALI) program, the Department of Electrical and Computer Engineering (ECE) Prof. Rhonda Franklin, principal investigator, and her co-investigator Department of Microbiology Prof. Daniel Bond created a means to study how electrons move from *Geobacter sulfurreducens* bacteria to gold electrodes. This project supports Prof. Franklin’s interest in developing novel methods for characterizing the high-frequency electrical properties of non-traditional materials like biofilms for their potential to advance high-speed circuit design. The opportunity became possible through the two-department collaboration and a partnership with Dr. Mike Renn of Optomec, a local Twin Cities company.

Bond was searching for a method to study and to measure electrical current flow during the bacterium’s growth process on patterned gold circuits. The bacterium’s form is similar to a tiny cylinder. When the bacteria grow on printed electrodes, they form a spherical shape *enmasse* covering the tops and sides of the gold structure boundaries.

“Prof. Bond believed our collaboration would be important to developing a keen understanding of ‘how’ this bacteria deliver electrons,” says Franklin. “I viewed the project as a wonderful opportunity to provide my research team with interdisciplinary research skills that would be valuable to their careers as electrical engineers.” Renn became interested because Optomec developed an aerosol jet spray tool that could be used with metal and dielectric surfaces for biological applications.

It was Franklin’s previous work on developing porous silicon that resulted in the collaborative research with Bond. Franklin’s research group had expertise in developing and using advanced fabrication processes to create novel high-performance, high-speed electronics. Working with bacterial structures presented a strange yet exciting and compelling challenge to Franklin: what if her research team



Images of bacterial biofilms developed using microfabrication methods (U of MN Nanofabrication Center), microbiological processes (U of MN), and Aerosol Jet® printing processes (Optomec).

could translate integrated circuit techniques into use for microbial circuits? If they could make the circuit work, then Bond could research the film and its function so that there could be an avenue for developing novel biological circuits.

The problem presented technical and logistical challenges including how to:

- develop repeatable test circuit configurations to regulate the biological test findings
- create an electrical test circuit fabrication process and a biological film growth process that would be compatible with the requirements of a microfabrication laboratory and a microbiological laboratory environment
- create a characterization approach and suitable interfaces that would allow for accurate biological testing (a wet environment) and RF electrical testing (a dry environment)
- create a hospitable research environment for living organisms
- maintain control in multiple environments (two labs, one industrial site, and transportation between the various sites)

During the ensuing three years of research, Franklin’s team included now-graduated Drs. Hosaeng Kim and Young Seek Cho, current graduate student Jordan Alstad, and a post doctoral member Dr. Ying Liu of Bond’s team. Kim worked on the electrodes; Cho worked on the patterning processes. In collaboration with Optomec, Alstad (who continued Cho’s work) now works on modeling and RF test methods for the patterned electrodes. These electrodes were prepared by a special material process that allows patterned biological films to grow on circuits developed by using integrated circuit processes in the U of MN’s Nanofabrication Center. Liu methodically refined the bacterial film growth process allowing for the biological and high-frequency characterization testing.

continued on page 2 **bacteria**

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2012 ECE Open House and Senior Design Show
Tuesday, May 1 from 9 a.m. to 4:30 p.m.
Register at www.ece.umn.edu

The most difficult problem facing the team was patterning—the process of masking metals to control bacterial growth so that it occurred only on the desired circuit patterns. It was necessary to mask areas on the gold circuits with a product that the bacteria would avoid. After trying a number of surface growth inhibitors from the integrated circuit industry, the team with its partner Optomec, identified a liquid version of Teflon® which served the purpose. Using CAD data the liquid Teflon® was sprayed on the specific areas of the chip to inhibit bacteria growth using Optomec’s Aerosol Jet© printing process. The interdisciplinary work was successful through the melding of various fabrication processes—microfabrication for the printed circuits, aerospraying for the dielectric masking (non-IC based process), and biofilm growth. (see photo p. 1).

“In this project, we (electrical engineers) were constantly reminded that we were working with a living organism with myriad variables to create the perfect circuit to evaluate the biofilm’s electrical performance,” says Franklin. “Even process times varied considerably. Circuits can be built fairly quickly once a process is developed; however, at the moment, growing bacteria over dimensions measured in microns takes days.”

Using Bond’s collected data, the ECE group is analyzing the electrical behavior of these biologic films at RF/microwave frequencies (low to mid-range GHz) to determine if the bacteria are insulating, conducting, or both (semiconducting). “Our goal is to develop a test circuit and method that allows us, in real time, to measure the bacterium through its life cycle,” says Franklin. “For now, we are providing some of the first high-frequency data about the its insulating and conducting properties when dead. In addition, we are working to identify funding for the next stage of research—testing living bacteria on the chip during its life cycle.”



Prof. Franklin’s research team: (l to r) Young Seek Cho (Ph.D.’10, postdoc, currently in Korea), Prof. Rhonda Franklin, Nate Jastram (EE’10, attending University of Colorado), Jordan Alstad (EE’10, currently Franklin’s graduate student), Casey Murray (MSEE’10, currently Franklin’s Ph.D. student).

As with all research, this project led to new questions:

- Could a bacterial substance be incorporated into custom design circuits for fuel cell research?
- Could the bacteria be used as a sensor?
- Could communication circuits be built using biological circuits?
- Could the bacteria work in RF microfluidics for tuning and cooling of electronics?
- Is there an application to biomedical nano-fluidics?

“Interdisciplinary research is both challenging and rewarding,” says Franklin. “It requires a lot of time to incubate, test, and evaluate to move the research forward. But it offers an environment in which to create and to innovate while providing the catalyst for new areas of research.”

Director of the Advanced Research Projects Agency Energy Dr. Arun Majumdar visits Prof. Wang’s lab



Dr. Arun Majumdar, (left) the Director of Advanced Research Projects Agency - Energy (ARPA-e), toured Prof. Jian-Ping Wang’s (far right) research lab to view his work on the development of a revolutionary-type high-energy-density permanent magnet by total elimination of a dependence on rare-earth materials.

Dr. Arun Majumdar, Director of Advanced Research Projects Agency Energy (ARPAe), toured Prof. Jian-Ping Wang’s research lab to view his work on the development of a revolutionary-type high-energy-density permanent magnet that would result in elimination of a dependence on rare-earth materials. The developed magnet material will be low-cost and high-performance and will be used to produce motors for electric vehicles and wind turbines to achieve high performance green technologies. The University of Minnesota, the lead institution, is working with Oak Ridge National Labs on this project.

“Our persistent and successful effort on this material recently resulted in a large grant awarded by the Advanced Research Project Agency for Energy (ARPA-E), Department of Energy,” Wang says. “This project is not only critical for the fast growing green energy industry in Minnesota, but also for our national security, considering the limited supply sources of rare-earth materials in the world.”

Dr. Majumdar was in the Twin Cities to attend a Renewable Energy Summit hosted by Minnesota Senator Al Franken at Metro State University.

Alumni Awards

Alumni Robert F. Hartmann (EE'65) and Bruce J. Bergman (EE'64) honored with University of Minnesota Outstanding Achievement Awards



Robert F. Hartmann ('65)



Bruce J. Bergman ('64)

The Outstanding Achievement Award recognizes graduates or former students of the University who have attained unusual distinction in their chosen fields or professions, or in public service, and who have demonstrated outstanding achievement and leadership on a community, state, national, or international level. The award includes a crystal obelisk and citation from the Board of Regents and the University president.

Robert F. Hartmann (BEE'65) received an Outstanding Achievement Award from University of Minnesota President Eric W. Kaler on Oct. 29, 2011, during the College of Science and Engineering (CSE) Second Annual Leadership Celebration.

Upon graduation, Hartmann served as design engineer and design manager of MOS integrated circuits at North American Rockwell, Electronic Arrays, Signetics and Fairchild Semiconductor where he designed and laid out the F-8 microprocessor. By 1980, Hartmann was president and co-founder of Source III in San Jose, Calif., providing strategic and technical consulting to gate array vendors and end customers. With Paul Newhagen and Michael Magranet, Hartmann co-authored the definitive 600-page technical book titled *Gate Arrays: Implementing LSI Technology*.

In 1983, Hartmann and his co-authors became co-founders of Altera Corporation and within nine months introduced the world's first programmable logic device, the EP300. In addition to leading all of Altera's initial product concept and design work, Hartmann, as the vice president of engineering, helped to raise \$23.2 million in start-up funds. He also helped guide the company to go public in 1988. By 1994, Altera had \$100 million in annual revenue and 923 employees.

Today, Altera has approximately \$2 billion in annual revenue and 2,600 employees. Hartmann and his team established the company as one of the top two suppliers of high-density programmable logic devices.

Hartmann holds seven U.S. patents and brought nine products to market during his tenure at Altera. He has established the Robert F. Hartmann Scholarship Fund and the Robert F. Hartmann Chair in Electrical and Computer Engineering at the University of Minnesota.

For a detailed article about Hartmann's contributions and views of his career, please refer to *Signals*, Feb. 2011, Vol. XI, Issue 3: "Robert Hartmann, Altera, and Silicon Valley's Golden Age."

The University of Minnesota also will confer the Outstanding Achievement Award on CSE graduate **Bruce J. Bergman** (EE'64 and University of Southern California MBA '71), of Bergman and Associates, Naples, Fla. Bergman will accept his award at a future ceremony held at the University campus in Minneapolis, Minn.

In a career that spanned more than 30 years, Bergman was a successful developer of avionics controls and specialized computer

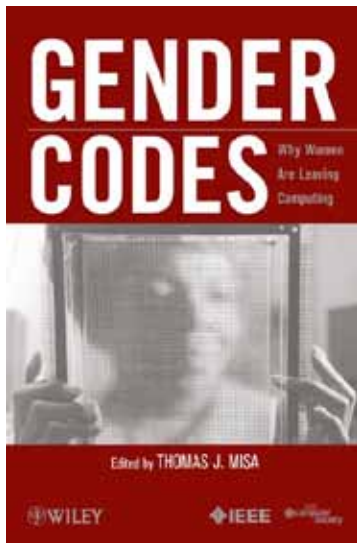
systems for aerospace applications as well as computer storage and networking; a master of business turnarounds, start-ups, and reorganizations; and a creator of successful IPOs and a celebrated raiser of venture capital and debt financing.

From 1996-1998 as President and CEO of Brocade Communications Systems, Inc., of San Jose, Calif., Bergman raised more than \$30 million in two rounds of venture capital requests, grew annual revenues from zero to \$25 million and gained the dominant market share in the switched SAN market. Brocade is now publicly traded with a peak valuation that exceeded \$20 billion.

As President and CEO of ATG Cygnet, Inc., San Jose, Calif., from 1995-1996, Bergman restructured the company, raised \$3 million in debt financing, revamped the senior management team, filled out the development team, and completed a detailed strategic and business plan—all in the first four months. As President and CEO of Proteon, Inc., Westborough, Mass., he implemented a new strategic plan for refocusing the company, raised \$25 million in software license sales, and further reduced expenses thus restoring Proteon, Inc. to strong profitability within seven months. From 1983-1993, Bergman as President and CEO of Xylogics, Inc., Burlington, Mass., repositioned this ailing minicomputer marketing-based company into a growing and profitable OEM supplier of I/O products in the UNIX open systems market. Xylogics, Inc. was ultimately sold to Bay Networks for more than \$300 million. Bergman also served as President of Plastech Research, St. Paul, Minn., in 1983, and from 1971-1983 as Product Manager at Control Data Corporation in Minneapolis, Minn. where he successfully introduced several disk drive products including the Storage Module Drive, which became the company's most successful product. From 1965-1971, Bergman, as development engineer and lead engineering manager, helped Honeywell develop specialized computer and avionics products for commercial and military aircraft and aerospace customers.

Currently, Bergman serves on the boards of Qcept Technologies, and DataCore Software. He also has served on 10 other boards during his career including Acopia Networks (2004-2007); iVivity (2001-2007); Sistina Software (1999-2003) (sold to Red Hat in 2003); Ciprico, Inc. (1999-2002); Brocade Communications (1996-1998); among others.

In 2007, Bergman established the Bruce J. Bergman Fellowship in Electrical Engineering. For a detailed article about Bergman's career, please refer to *Signals*, Spring 2006, "Engineering a Business Career."



Prof. Tom Misa
ECE Professor and
Director of
Charles Babbage Institute

Gender codes: why women are leaving computing

by Prof. Tom Misa

For the wrong reasons, our book *Gender Codes* landed in the *Washington Post* this past summer, a year after it was published by the IEEE Computer Society Press. When we launched this project at the Charles Babbage Institute (CBI), we had the aim of contributing to the historical literature on gender in computing.

While the analysis of gender is an established staple in many historical fields, scholars in the history of computing were way behind the curve in examining the differing experiences and expectations of women and men. We soon learned, however, that gender in computing was far from merely an “academic” problem.

Female colleagues across the College of Science and Engineering (CSE) told me—one poking my arm for emphasis—that this was a “real” problem, needing serious attention. Women constitute only ten percent of the faculty in CSE departments, roughly paralleling national figures. Despite impressive efforts, the number of female faculty remains low, even though recently, the number of women undergraduate students is on the rise.

The problem of women in computing is really two issues, with history at the center. Historians specialize in documenting and understanding changes across time. While political historians might seek to understand changes in voting patterns, and cultural historians might try to examine the effects of the Cold War on American culture, historians of computing have focused on the emergence of computing. They may have examined how computing concepts (both hardware and software) were realized, how computing scientists and engineers sought professional status, and how networked technologies, such as the Internet, were invented and what effects they have had on business and society; but, they did not look at the issue of gender.

When you look at the emergence of computing from the perspective of gender, two strikingly different periods snap into focus. From the early 1960s until the mid-1980s, computing was uniquely hospitable to women. *Cosmopolitan* magazine was encouraging women to

enter computing in the mid-1960s with such pithy pronouncements that programming was “just like planning a dinner.” Noted computer scientist Grace Hopper was quoted, “You have to plan ahead and schedule everything so it’s ready when you need it. Programming requires patience and the ability to handle detail. Women are ‘naturals’ at computer programming.” Women flooded into the field as programmers, researchers, managers, and even as entrepreneurs running their own companies.

While most engineering and physical science fields struggled to achieve women’s participation rates (e.g. in undergraduate majors) of around ten percent, computing peaked in the mid-1980s at nearly four times this level. Women then gained 37 percent of undergraduate computer science degrees, and composed fully 38 percent of the white-collar IT work force.

We still don’t know why women found computing so attractive, although surely it must have something to do with the excitement of the field, the great employment opportunities, and the relatively few barriers to their advancement. In 1980, Diane Chikoski, who was Burroughs’ director of programming for small computer systems, noted positively, “Tasks are assigned according to talents, interests, and career goals.”

Then, in the mid-1980s, the bottom dropped out: women began leaving computing. Slowly and steadily, women opted out of computer science as a major, so that when our book was going to press, the current figures had slid to a dismal 11 percent. Worse, the proportion of women in the white-collar IT workforce slipped by nearly a quarter down to 29 percent. It makes no sense that just when computing became pervasive, with the rise of personal computing, gaming, and mobile computing, the field was left increasingly to men.

To remedy the situation, educators and professionals began focusing on women’s career expectations, the importance of role models, the positive effects of “pair programming” and other educational innovations. Unfortunately, the field of computing remains distinctively lop-sided in gender.

CBI is planning interviews with women computer scientists, programmers, and engineers who were attracted to computing so strongly in the 1960s and 1970s. Our goal is to find new, constructive insights into the present ‘gender gap’ by paying attention to these notable, yet hidden, women and their success stories.

Thomas J. Misa directs the Charles Babbage Institute, is a faculty member in the ECE department, and teaches in the Program for History of Science, Technology, and Medicine. His retrospective of Steve Jobs appeared in a recent issue of Science.

Gender Codes drew on a two-day international workshop held at CBI in May 2008. Colleagues were invited from around the world, and we included our own Departments of Electrical and Computer Engineering (ECE), Computer Science and Engineering (CSE), the program for the History of Science and Technology, and CSE’s Dean’s office. International travel was supported by the University’s Office of International Programs and the Deutsche Forschungsgemeinschaft.

Where are they now



Hushrav Mogal (Ph.D.'10)
Synopsys, Inc.

Adaptability and diverse knowledge aids recent grad in industry job

Synopsys, Inc., senior research and development engineer Hushrav Mogal, (Ph.D.'10) had a job before he even completed his doctoral dissertation defense. "I found out about the job opening at Synopsys, mailed my resume, and contacted the engineer involved in hiring," says Hushrav. "I met with him at a conference and continued to talk and to interview with the company while I was finishing my dissertation. I was hired September 2008 and graduated January 2010."

Synopsys is a world leader in electronic design automation (EDA), and supplies the global electronics market with the software, IP and services used in semiconductor design and manufacturing. Currently, Hushrav writes software for an analysis tool which analyzes the timing of digital chips. He says his ECE coursework in algorithms and software skills he acquired working as a Ph.D. student continue to be helpful to him.

Hushrav says the biggest surprise he found in the workplace is the disparity between academic and industrial methods of solving problems. "I didn't expect that," says Hushrav. "My field is practical and I thought we were doing the same thing in school as what was being done on the job."

Hushrav explains his coursework stressed that variable speeds in chips must be statistically analyzed. He learned to focus on the variation in chip properties when predicting how fast or how slow the range in time would be.

"In industry, a different approach is used to account for the delay variation of circuits," he says. "Industry's model largely uses advanced margining to analyze the program. Unpredictability and variability of chip properties are recognized but the problem-solving consideration relies on an adaptation of existing margining techniques."

Hushrav says this model continues to be the industry standard because it is trusted and successful. When faced with further refinement problems, the industry solution is to advance the margining, without radically changing the established method. Hushrav predicts that as process technology advances become more complex, a new model for analysis may emerge.

Hushrav says his academic preparation of knowing the issues and how to solve the problems has equipped him to work within the

ambiguity of the industrial methodology. "No one expects you to know everything upon coming into a job straight out of school," he says. "What they do expect is that you can define a problem correctly and solve it independently." To that end, Hushrav says that ECE students must learn to gain independence in solving problems.

One of the best learning experiences he had at the University was working on a difficult statistical timing project. He hoped to publish his work, but before he could complete it, he found that someone else had already published their findings. His advisor, Prof. Kia Bazargan and co-advisor Prof. Sachin Sapatnekar, encouraged him to continue with the project. He was eventually able to improve upon his solution. "There was a thrill in that," he says. "Each problem you work on is an opportunity to improve your skill – it counts."

He credits his doctoral program with providing him the problem-solving experiences upon which he now relies. He says, "ECE students should look to be broader in their approach to things. In addition to the EE circuit and simulations experience, I also had a strong background in software development. I've found that skill set to be a good and useful mix. Eventually you will be writing software, so it's good to have the background."

"In industry, the goal is to get the job done—the first solution you have will probably not be the final solution," he says. "I learned to persevere to solve problems during my Ph.D. program. These are complex systems we work with and it's difficult to get it right the first time."

continued from page 11 - Adams

are not unusual. Don't expect rewards to come quickly—big paychecks come after 5-10 years."

During Adams's early career, he had jobs at General Motors and at General Electric. "They were two of the most process-oriented companies in country—GE's policy and procedures manual was three feet thick," he says.

"The second thing you must know before you start your own company is where your experience fits—what market niche you will fill. Then you must know the state of the art of the product, who your competitors are, and what their capabilities are, so you know that your contributions will be viable.

"The most important piece of advice I have to give is – If you are starting a company, don't give your patents to the company; rather, retain ownership and license them to the company."

Adams says patent ownership is important because a person can be forced out of a company and then he or she will no longer benefit from the patents. If the patents are licensed, you can still benefit from them. If a company goes bankrupt the patents are no longer yours to use or to sell. However, when one retains ownership, one can take the patents to a new company, work on improving them, or decide to sell them and make some money from them.

Students



ECE Ph.D. candidate Manohar Ayinala received the University of Minnesota Distinguished Master's Thesis Award 2011-12 and the nomination for the 2012 Midwest Association of Graduate Schools' Distinguished Master's Thesis Award. (Prof. Keshab Parhi, advisor)



Dr. Donatello Materassi received Best Presentation awards in three different sessions at the 2011 American Control Conference. In addition, he received Best Oral Presentation at SIDRA Conference in Pisa, Italy. Materassi is a post-doc working with Prof. Murti Salapaka.



Ph.D. student Sai Madhukar Reddy (CEMS) won Best Poster Award at the Magnetism and Magnetic Material (MMM) 56th Annual Conference in Scottsdale, Ariz., on Nov. 3, 2001. His poster was titled "Towards Epitaxial Fe_{1-x}Gax/GaAs Structures via Electrochemistry for Spintronics Applications." This award is given to the top one percent of posters presented. (Prof. Beth Stadler, advisor)

Faculty



Prof. Massoud Amin was named a 2011 Fellow of the Academic Leadership Program, comprised of five fellows from each of the Big 10 and University of Chicago. Amin also has accepted leadership positions as President of the Minnesota Chapter of the Sigma Xi, The Honor Society For Scientists and Engineers; Vice President of Public Affairs and member of the Board of the International Association for Management of Technology; President, China Center Advisory Council, University of Minnesota; and serves as founding chairman of the IEEE *Smart Grid Newsletter*. Amin gave four keynote addresses and two plenary presentations since October 2011.



Prof. Georgios Giannakis and Pengfei Xia (Samsung) received 2011 IEEE Signal Processing Society Best Paper for "Design and analysis of transmit-beamforming based on limited-rate feedback."



College of Science and Engineering (CSE) Associate Dean Mostafa Kaveh received the Minnesota Federation of Engineering, Science, and Technology Societies' Charles W. Britzius Distinguished Engineer Award. The award was presented at the 48th Annual Engineer's Week Awards and Recognition Banquet held Friday, Feb. 24 at The Nicollet Island Pavilion in Minneapolis.



Prof. Steve Koester and Yogish C. Kudva's "Graphene-Based Wireless Glucose Sensing for the Artificial Pancreas" has been selected for funding by the "Decade of Discovery: A University of Minnesota/ Mayo Clinic Partnership to Conquer Diabetes."



Prof. Mo Li was selected by the Air Force Office of Scientific Research for a Young Investigator award. His research is titled "Exploiting Repulsive and Attractive Optical Forces in Advanced Nanophotonic Systems."



Prof. Tom Luo (left) has been appointed Editor-In-Chief of the IEEE *Transactions on Signal Processing*, the premier publication of the field.



In addition, Prof. Luo, along with Prof. Nicholas Sidiropoulos (below, left) and McMaster University (Hamilton, Ont.) ECE Prof. Timothy Davidson, were selected for a 2011 Best Paper Award by the IEEE Signal Processing Society for "Transmit beamforming for physical-layer multicasting."



Prof. Ned Mohan organized a highly successful workshop to discuss power and energy related curricular reform, attended by nearly 150 ECE faculty, department heads and engineering deans in Napa, Calif. in February. For details, go to cusp.umn.edu



Prof. Keshab Parhi and team's illustration and article appear in the October issue of *Epilepsia* magazine : Y. Park, L. Luo, K.K. Parhi and T. Netoff, "Seizure Prediction with Spectral Power of EEG Using Cost-Sensitive Support Vector Machines," *Epilepsia* , 52(10), pp. 1761-1770, Oct. 2011. You can see the magazine on line at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1528-1167.2011.03138.x/full>



Prof. Guillermo Sapiro and colleagues V. Caselles and R. Kimmel were awarded the International Conference in Computer Vision (ICCV) Test-of-Time Award for their 1995 paper "Geodesic Active Contours." The Test-of-Time Award honors the researchers whose papers have a notably significant following and impact in computer vision and related fields.



Prof. Sachin Sapatnekar began a two-year term as Vice President, Publications of the IEEE Council on Electronic Design Automation. Go to: www.c-eda.org



Prof. Beth Stadler was awarded the Donald I. Johnson Award of Excellence for Best Presentation at the 19th Annual International Anodizing Conference in Montreal, Quebec. The title of her talk was "Using Anodic Alumina to Fabricate Artificial Cilia Sensors."



Prof. Jian-Ping Wang will lead research efforts at the University of Minnesota in collaboration with Oak Ridge National Laboratory to aggressively develop an early stage prototype of bulk iron-nitride permanent magnet material. This new material has the potential to be the "holy grail" of magnets as the highest energy density magnet from earth abundant raw materials. This project will provide the basis for an entirely new class of rare-earth-free magnets for electric vehicle and wind turbine applications that are capable of eliminating the need for costly and scarce rare-earth materials.

Alumni



IEEE has elevated University of Minnesota, Department of Electrical and Computer Engineering alumnus Mark Kroll (BS '75, MS '83, PhD '87) to the grade of Fellow for his contributions to implantable and external defibrillator technology.

2012 ECE Open House and Senior Design Show

Tuesday, May 1

9 a.m. - 4:30 p.m.

Keller Hall, 200 Union St. SE, Minneapolis

Register now for this FREE event at www.ece.umn.edu

9 - 9:15 a.m.

Registration with Coffee and Rolls

9:15 - Noon

ECE Faculty Research Mini Presentations

- Prof. Ramesh Harjani
"Fun with Injection Locking"
- Prof. Jarvis Haupt
"Sensible Sensing - Sparsity, Saliency, and Adaptivity"
- Prof. Ned Mohan
"Research and Education into Renewables and Storage"
- Prof. Marc Riedel -
"Circuit Engineers Doing Biology: A Discourse on the Changing Landscape of Scientific Research"
- Prof. Bethanie Stadler
"Metallic Nanowires for Recording, Storage, Vertical Interconnects and BioNanoBots"
- Prof. Joseph Talghader
"Recent Advances in Microbolometer and Uncooled Thermal Detector Technology"

Noon - 1 p.m.

Appetizer Buffet and Networking

1 - 2 p.m.

Keynote Presentation - Chris Farrell

Economics Editor for American Public Media

Author of *The New Frugality*

Columnist for "Your Money" in Minneapolis *Star Tribune*

ECE Appreciation Award

ECE Distinguished Alumni Award

2 - 4:30 p.m.

Senior Design Show

Coffman Memorial Union, Great Hall

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*"Thank you to all who give to ensure that our programs and labs offer the best educational experience for our students." David Lilja,
ECE Department Head*

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First Cyber Security Summit addresses potential threats and security strategies

The University of Minnesota Technological Leadership Institute (TLI) hosted the first annual Cyber Security Summit Monday, Oct. 3, 2011, with nearly 150 leaders from government, business, and non-profit sectors in attendance. Co-partners included The Khanna Group, The Event Group, and co-sponsors included Unisys, Deloitte, AccessData, and Minneapolis St. Paul Business Journal.

The growing number of attacks on our cyber networks has become, in President Barack Obama's words, "One of the most serious economic and national security threats our nation faces." Although unable to attend the event, Minnesota Senator Amy Klobuchar shared her thoughts about the summit: "As technology and the Internet become an even larger part of our economy, events such as these that spread knowledge and understanding make us all collectively stronger and better prepared for the challenges we face."

Keynote topics included national cyber security strategy and in-depth risk management. William Barker, associate director of the National Institute of Standards and Technology (NIST) and Dr. Ron Ross, senior computer scientist at NIST were keynote speakers. Panels included presentations linking public and private sector resources to strengthen our state and national security.

Plans are under way for the Second Cyber Security Summit on Oct. 1, 2012.

An Entrepreneurial Spirit leads to live-saving and life-enhancing medical devices



Ted Adams (MSEE'69)

Ted Adams (MSEE'69) became an entrepreneur because of his spirit of adventure and, as he says, “a short attention span. I could never stay with a company longer than 5-7 years. I needed to move on to something different. A former boss told me he thought it had to do with the fact that I grew up on a farm in southern Minnesota where we could make anything work.” Adams knew early in his career he needed new challenges to keep enthused and creative.

And, challenge himself he did. The founder of six start-up medical device companies, Adams's work resulted in patents for cardiac defibrillators, patient-programmable hearing aids and, most recently, creating a kidney assist system device that could eliminate the need for dialysis—his newest company's endeavor.

70 patents and counting

Adams says he is most proud of the patents he invented for cardiac defibrillators. “Every one of the defibrillators out there has one of my patented features in it. Eventually, the company (Angeion) sold the package to Guidant (acquired by Boston Scientific) and Medtronic—for a substantial amount. I'm pretty proud of that.”

Adams also is responsible for creating the market for automatic external defibrillators. “You know those emergency-use devices you see in the hallway walls around campus—I was the first to form a

company (SurVivaLink) to work on those life-saving devices.”

But, patents filed don't always make huge financial successes. When it came to hearing aid products, Adams used his knowledge of pacemaker programming to create a self-programmable device for people with hearing loss (AudioScience). “Patients loved them,” he says. “Rather than leaving the audiologist's office and settling for the settings provided, patients could fine tune their own settings at home. It didn't make the audiologists happy, though. The patient would walk out of the audiologist's office and never return, never purchasing another device. Audiologists wouldn't sell it. It was a classic engineering success and business failure. I think Earl Bakken had a couple of those hearing aids.” Some of that knowledge led to his founding of Envoy Medical ten years later, a fully implantable hearing restoration device based on combining hearing aid and pacemaker technology.

Early employers' business failures bring Adams future successes

Adams began his career in the aerospace sector working for Delco Electronics in Milwaukee. He says he loved working on navigation systems for missiles. “Then the bottom dropped out of the aerospace business—a workforce of 8,500 people was reduced to 1,500,” he says. “I took the only job I could find—working for a pacemaker development group at General Electric (GE).

“I was at GE when the first-ever recall of a medical device occurred. Between 500 and 600 units were recalled and after that, GE got out of the pacemaker business. I had to find a job again, so I leveraged my skills to Medtronic where they hired me as pacemaker engineer. Bad things happen, but good things come about because of them. I found that the medical business was an even more rewarding career.”

Surprises in the medical device industry

“The most surprising thing I saw in the early days of the medical device industry

was that virtually all the medical device companies were small companies. Even at GE, the pacemaker division was a small operation. After much business consolidation and growth in the industry, we now have the giants in medical devices that exist today.”

“The other surprise was the speed with which technology advanced, especially in the area of implantable medical devices. One had to keep up with all the technology because things seemed to change completely every 3-5 years. The breakthrough devices of the 1970's are looked upon as primitive by today's standards.”

Advice to new graduates

“Be extremely careful about the first job you take after attending the University,” Adams says. “If you want to be a design engineer, don't take a position in a different area of the field, as a manufacturing engineer, for example. It will be very difficult to change your direction a few years later because you will become expert in that work, making more money, and finding that employers will want you to work in your skilled area rather than you starting over as a rookie in a new area at higher than entry pay level.”

When Adams was a University of Minnesota graduate student, he carried two teaching assistant positions—one in EE and the other in Physics. He credits his experiences as a co-op student for the versatility he possessed as his career progressed. “The work experience was critically important to knowing where I wanted to work within a company.”

Tips for create a start-up

“Get your first job at a large company. Learn the way things are done, how they are organized, how reporting is accomplished, how the mechanisms of communication and documentation happen, and how various functions operate,” he says. “You need to know the procedures and functions of a big company before starting your own.” Adams adds that one should be prepared to work hard, “Sixty-hour weeks

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Keynote Presentation

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