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EECS

Department of Electrical Engineering and Computer Science

NEWS

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In This Issue

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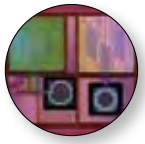


A Message

From the Chairs of EECS

Khalil Najafi, Chair
Electrical and Computer Engineering Division

Marios Papaefthymiou, Chair
Computer Science and Engineering Division

Welcome to the 2010/2011 edition of the University of Michigan *EECS News*. In this publication, you'll find many examples of how EECS faculty, students, and alumni are making remarkable achievements – as researchers, collaborators, team members, entrepreneurs, mentors, and leaders – and making a positive impact on society.

EECS is a discipline of change, and part of that change includes new opportunities for our faculty. Prof. Farnam Jahanian, former CSE division Chair, has taken a leave of absence to head the NSF Directorate for Computer & Information Science & Engineering. The CSE Chair position has been filled by Prof. Marios Papaefthymiou, Director of the U-M Advanced Computer Architecture Laboratory since 2000, effective July 1. We are delighted to welcome Marios to his new role, and thank Farnam for his past years of energetic, enthusiastic, and effective leadership.

Advancements in today's new and enhanced computing platforms, from millimeter-scale devices to high performance systems in data warehouses, are increasingly tied to energy-efficient computing technology. The remarkable breadth of activity going on at Michigan in this area is reflected in the article on Green Computing that is featured in this issue. Of course, research at EECS reaches into numerous other areas, from assessing the impact of electronic voting systems on elections and democracy to the development of technology that will lead to improved diagnosis and treatment of cancer. You'll find these stories and many others in the Research Briefs section beginning on page 12.

In 2010/11, the Center for Wireless Integrated MicroSystems (WIMS) entered a new chapter in its history, with Prof. Ken Wise handing the reins over to Prof. Yogesh Gianchandani, after leading WIMS for 10 remarkable years as an NSF Engineering Research Center. Furthermore, the department established a new Center for Nanoscale Photonics and Spintronics, led by Pallab Bhattacharya, Charles M. Vest Distinguished University Professor. Two new labs were also established during this past year: the Michigan Integrated Circuits Laboratory (MICL), directed by Prof. Dennis Sylvester, and the Power and Energy Lab, overseen by Professors Ian Hiskens and Heath Hofmann.

Technology has greatly contributed to the reality of a global marketplace and new ways of doing not only business, but research as well. The activities of our faculty, students, and alumni reflect this global outlook. Prof. Zhong entered into a research partnership with Shanghai Jiao Tong University on renewable energy, Profs. Hiskins and Hoffman are participating in the U.S.-China Clean Energy Research Center, and the Department has entered into collaboration with Nanyang Technical University to explore power consumption reduction in System-on-Chip design. More and more of our students are taking advantage of the opportunities for study abroad, and our alumni are leading international companies, encouraging students to adopt a global perspective (see pp. 40–42, 44 for specific examples).

We are delighted to announce that Mark Kushner, George I. Haddad Professor of Electrical Engineering and Computer Science, has joined the ranks of the National Academy of Engineering as one of its newest members. Since coming to Michigan with an already stellar dossier, Prof. Kushner has made a significant impact in the department and the University in the interdisciplinary area of plasma science research, and we look forward to his continuing contributions. Eight of our young faculty have earned NSF CAREER and Young Investigator Awards in the past year and a half, and a great number of additional faculty honors and awards are highlighted on pp. 24–28.

In the realm of technology transfer, the highly successful Internet security company Arbor Networks was purchased by Tektronics Communications in late 2010. Ambiq Micro was launched in 2010 and has secured venture funding. On pp. 19–20 we report on other startups that have been launched, have won business plan competitions, or have otherwise met important milestones. Also – two groups of students have developed mobile apps that will be released as official U-M apps, and another student has built the largest solar energy farm in Michigan!

We are sharing more student news than usual in this issue, and it's still just a byte of the information we could include. Our students participate in interdisciplinary teams and have won national competitions. Team Michigan, the robotics team led by Prof. Edwin Olson, placed first in international competition, while an EECS programming team placed second, also in international competition. Don't miss gaining a glimpse of what else our students are achieving by perusing pp. 29–37.

Our alumni are building successful ventures, leading at international companies, and giving back. We've spotlighted four of them in this issue: Greg Joswiak of Apple, Inc., Curtis Ling of MaxLinear, Meera Sampath of Xerox, and Syed Ali of Cavium Networks. We hope that many of our alumni will join us for the 2011 Michigan Engineering Homecoming Weekend in October, and attend the lectures by our CSE and ECE alumni Merit Award Winners, Mark Abel of Intel and Syed Ali of Cavium Networks.

We hope you enjoy this snapshot of what's been happening in EECS since last year, and stay in touch with us. Together we can continue to do great things!

Green Computing: *Higher Energy Efficiency from Silicon to the Cloud*

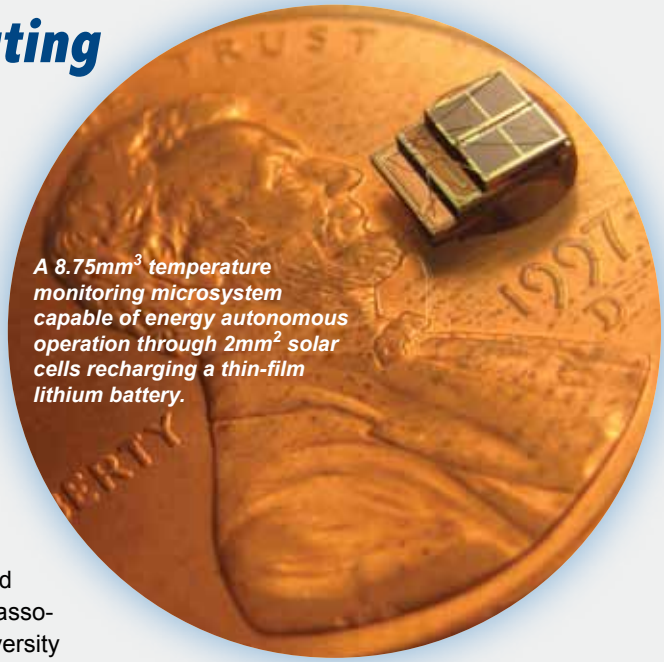
For decades, researchers and industry have been focused on increasing computing performance by increasing transistor density and shrinking the size of computing devices. But with the continued scaling of computing systems to sizes only theorized a decade ago, combined with the prevalence of mobile devices, social networking, cloud computing, and the cost of powering huge data centers, the computing paradigm has changed. Energy efficiency is now a primary consideration at all levels of computing.

How can we power a computing system the size of a grain of rice? How can mobile devices be made smaller, lighter, and more powerful while using less energy? And how can data centers, which today consume 2% of all electricity in the United States, be made more energy efficient while maintaining or even increasing performance?

Green Computing:
Sea of Sensors and mm³ Computing

A Computing Revolution on Nanowatts of Power

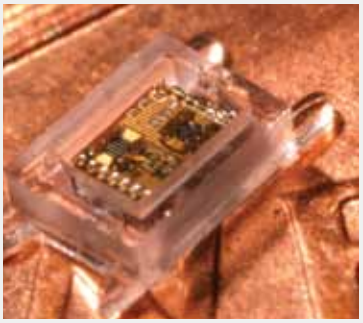
Computing has reached the threshold of millimeter-scale computing, considered to be the next electronics frontier, with a completely functional device called an Intraocular Pressure Sensor Monitor (IOPM). Measuring 1.5mm³, the IOPM is the first complete computing system of its size.



A 8.75mm³ temperature monitoring microsystem capable of energy autonomous operation through 2mm² solar cells recharging a thin-film lithium battery.

The IOPM is sized for implantation in the eye to monitor pressure for the treatment of glaucoma, a condition that leads to blindness. It contains an ultra-low-power microprocessor, a pressure sensor, memory, a thin-film battery, a solar cell, and a wireless radio with an antenna that can transmit data to an external reader device held near the eye. It runs on 5.3 nanowatts; one nanowatt is a billionth of a watt.

The IOPM is the product of a team of researchers. Prof. David Blaauw and Prof. Dennis Sylvester and their group designed the microprocessor and associated technology; Prof. Ken Wise, William Gould Dow Distinguished University Professor of Electrical Engineering and Computer Science, and his group created the sensor and designed the packaging; and Paul Lichter, Chair of the Department of Ophthalmology and Visual Sciences at the U-M Medical School, is running the implantation studies.



The IOPM contains a MEMS pressure sensor, integrated solar cell, and microbattery in a biocompatible enclosure. Its cubic-millimeter size enables implantation through a minimally invasive incision.

Keeping the IOPM running is a solar cell that recharges a tiny 1mm planar battery. The solar cell works in both indoor and outdoor light, and the implanted microsystem can collect pressure data indefinitely.

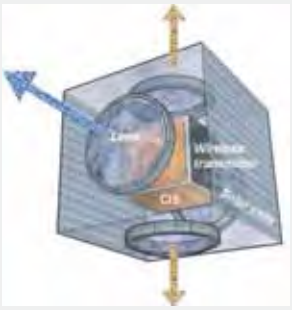
The chip that lies at the heart of this device is known as the Phoenix Processor. One of its key design features is its ability to run on extremely low power when the microprocessor is not in use.

The technology behind the Phoenix Processor spawned the company Ambiq Micro, co-founded in 2010 by Dr. Scott Hanson (BSE EE '04, MSE EE '06, PhD EE '09), Prof. Blaauw and Prof. Sylvester.

Other promising medical uses for these millimeter-scale sensors include monitoring the pressure surrounding tumors to determine whether a tumor is growing or shrinking, and measuring intracranial pressure. It is anticipated that similar systems will be able to track pollution, monitor structural integrity, perform surveillance, or make virtually any object smart and trackable. The 8.75mm³ sensor pictured at the top of the page monitors temperature, and can be adapted to other applications. It is a complete microsystem containing a near-threshold ARM processor, two 1mm² solar cells, a battery, and a power management unit. The energy-harvesting solar cells allow it to run nearly perpetually.

i-Cube: A Smart Imaging Sensor Network

The IOPM operates as an independent unit to monitor pressure in one eye. When many sensors are created to work together, they are known collectively as a wireless sensor network (WSN). Each individual sensor in the network is called a node.



The i-Cube consists of four imagers, solar cells, image processor/wireless link, and battery.

Prof. Euisik Yoon and his group have been developing an Imager Cube (i-Cube) in mm size that runs on sub mW of power for environmental monitoring and surveillance within a WSN. The sensor node captures, processes, and transmits images, and includes motion triggered wake-up, object identification and both 2D image capture and 3D depth profile capture.

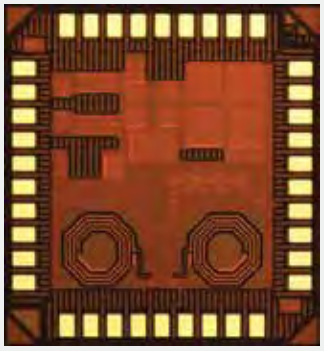
Founded: 2010
Co-Founders:
Scott Hanson, David Blaauw, Dennis Sylvester

ambiq micro

Ambiq Micro Inc. designs miniature computing systems for applications in medical devices, powered credit cards, energy meters & monitors, electronic shelf labels, home & building automation systems, environmental monitors, asset tracking devices, and consumer products.

Low-Power Communication for Millimeter-Scale Sensors

Sensor devices, particularly those in WSNs, must transmit the information they are acquiring – and often must do it at precise intervals. Presently, this communication activity is one of the major consumers of energy in sensor devices. EECS researchers are developing lower-power solutions to communication in WSNs, especially to accommodate millimeter-size sensors.



A low power radio designed to harvest a wakeup signal from any GSM cellphone tower broadcast, which can be used to more efficiently synchronize wireless sensor networks.

Prof. Wentzloff and PhD student Jonathan Brown created a special type of wake-up receiver (WRX) designed for wireless sensor nodes called a clock-harvesting receiver (CRX). Unlike a wake-up receiver, which must remain on perpetually, a CRX can be duty-cycled to save energy. In addition, the CRX grabs its signal from a Global System for Mobile Communications (GSM) tower to determine when to wake-up and send packets of information. GSM is a worldwide standard used by AT&T and T-Mobile in the United States. This research was a winning entry in the 2011 DAC/ISSCC Student Design Contest, a highly competitive international contest that includes some of the best designs coming out of academia.

An integrated 60GHz radio transmitter and antenna targeting mm-scale sensor network applications. The antenna is used both as a resonator for frequency generation, and as the radiating element, eliminating the need for an off-chip crystal reference.

In related work, Prof. Wentzloff and PhD student Kuo-Ken Huang have successfully replaced the bulky and power-hungry off-chip crystal reference that is used as a timer in most computing devices with an on-chip antenna system that serves as its own reference to become a wake-up radio. The next goal for this technology is to reduce the radio's power consumption to make it compatible with millimeter-scale batteries.

Sensors for Body-Area Networks Could Enable New Healthcare Applications

Prof. Wentzloff is also investigating new technology that will exploit the wireless communication standard being developed by IEEE for body area networks (similar to IEEE 802 standards that determine specific frequencies for different modes of wireless communications). Body area networks involve sensors placed on someone's body that talk to each other, or that talk to something external or internal to the body. For example, an individual could have an internal sensor that monitors blood levels related to their diabetes or seizure disorder that communicates with a patch on the skin, which in turn could communicate with a cell phone application. Body area sensor networks may also be used to detect falls in the elderly, or to alert nurses when very ill patients try to get out of bed.

As more and more computing components are being scaled down to extremely small sizes, such as these body-area sensors, designers are finding an increasing amount of variability in the quality of the embedded components. Also, the need for these devices to operate at extremely low, i.e., near-threshold and sub-threshold, voltages makes them more susceptible to failing because of minute variations that arise during manufacturing. Prof. Sylvester is investigating ultra-low power and ultra-small sensing platforms for devices such as body-area sensors with the goal of making these devices commercially viable. The work is being done as part of the $10M, five-year multi-institutional NSF project known as Variability Expedition (see also pg. 13). He intends to design and fabricate a custom sensor processor that will incorporate a customized core built by ARM Limited as well as novel energy efficient peripherals.

ntc near-threshold computing

NTC at All Levels of Computing

Researchers at Michigan have advocated a new technique called near-threshold computing (NTC) for reducing power consumption across all levels of computing. The impetus for this technique is described in the invited paper, *Near-Threshold Computing: Reclaiming Moore's Law Through Energy Efficient Integrated Circuits*[1], authored by Prof. David Blaauw, Prof. Trevor Mudge, and Prof. Dennis Sylvester, graduate student Ron Dreslinski, and post-doc Michael Wieckowski.

It is common knowledge in the industry that chip designers have been able to double the density of transistors in a semiconductor chip of the same size every few years in accordance with Moore's Law. However, designers can no longer find a way to effectively power or cool the transistors in conventional CMOS design, making power a primary design constraint that can be considered more important than performance.

Using NTC, the operating voltage for processor circuits is lowered to near the threshold voltage at which the transistors transition between being on and off, thereby reducing power consumption. Yet, while NTC can yield 10x more energy efficiency than conventional designs, it also leads to a degradation in performance. For this reason, Michigan researchers have been exploring and applying novel design techniques to offset this performance degradation.

NTC is now being successfully applied at Michigan to all levels of computing, from the most power hungry processes to miniscule devices that run on virtually no energy at all, and other research groups in both academia and industry have begun working at near-threshold voltage.

[1]"Near-Threshold Computing: Reclaiming Moore's Law Through Energy Efficient Integrated Circuits," Ronald G. Dreslinski, Michael Wieckowski, David Blaauw, Dennis Sylvester, Trevor Mudge, February 2010, *Proceedings of the IEEE*.

Green Computing:
Mobile Computing

As we move up in scale to the class of computing that includes handheld computing devices, such as iPods, iPads, and cell phones — designers have unique challenges as they determine the appropriate tradeoff between performance and power, and as they work to extend battery life in any way possible. EECS faculty are achieving improved energy efficiency in these devices through novel methods of wireless communication, software, systems engineering, architectural design, and even through energy recycling.

Communicating Information Between the Real World and the Digital World

A critical component in the transmission of real-world information is moving from an analog signal, which reflects a real-world quantity (i.e., sound, pressure, temperature, humidity) to a digital signal for computation and communication. This translation is accomplished with the help of analog-to-digital converters (ADCs); these ADCs function as interfaces to the real world and are incorporated into the wireless receivers that are built into every cell phone and similar devices as well as the receivers used in infrastructure monitoring and in implantable medical devices.

Prof. Mike Flynn and his group have designed novel ADCs with record-breaking energy efficiency. His group recently designed a complete wireless receiver system that is both energy efficient and very flexible, accommodating multiple radio frequency (RF) bands and standards. With this design, a single wireless receiver can communicate with different types of wireless signals such as WiFi and Zigbee – something most phones can't do. This design was also a winner in the 2011 DAC/ISSCC Student Design Contest. Low-power receivers are critical for the growing field of environmental wireless sensors and implantable neuroprosthetic devices.

Prototype of a wireless flexible receiver system.

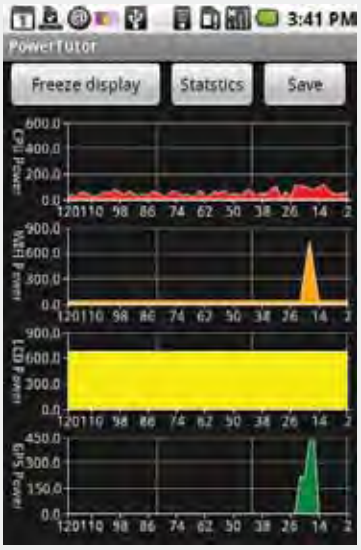
In related research, Prof. Flynn is directing a project to monitor the safety of the country's bridges and infrastructure. As principal investigator for the Center for Compressive Sensing, Flynn and colleagues Prof. David Wentzloff, Prof. Mingyan Liu, Prof. Wayne Stark, Prof. Anna Gilbert (Mathematics), and Prof. Jerry Lynch (Civil and Environmental Engineering) are devising new theory and techniques for the collection, communication, and processing of information received from wireless sensor nodes, specifically from sensors attached to bridges and buildings. These nodes are being designed for ultra-low power consumption. The team brings expertise in analog and RF circuits, wireless systems, networking, compressive sampling, and infrastructure monitoring.

Software Solutions to Energy Consumption in Low-Power Mobile Computing

Software that runs on low power platforms, such as mobile devices, must make efficient use of resources to preserve battery life and perform efficient network communications. Otherwise, devices run out of power quickly or operate slowly. Prof. Robert Dick and Prof. Morley Mao are devising ways to allow users and developers to know how much power is required by specific applications on handheld devices, and then decide which applications and devices to use.

Under their direction, PhD students Mark Gordon, Lide Zhang, and Birjodh Tiwana created an application called PowerTutor that displays the power consumed by major system components, such as the processor, network interface, display, Global Positioning System receiver, and different applications. PowerTutor allows software developers to see the impact of new applications and different design techniques on power efficiency. It is available as a free download on the Android market, and already thousands of individuals are using it.

In related work, Prof. Mao, along with graduate students Feng Qian and Zhaoguang Wang and researchers from AT&T, have shown that complex interactions take place between mobile devices and the cellular network that can have a large impact on performance. These interactions take place in a layered network architecture that intentionally hides lower-level protocols from



PowerTutor provides on-line component- and application-level power consumption estimation for battery-powered embedded systems such as smartphones.

developers working in the application layer. While this layered approach simplifies development, it can cause developers to inadvertently create inefficiencies in their code. Based on their findings, the team built a new technology that allows researchers and developers to see those interactions, allowing them to diagnose the specific inefficiencies and create significantly more efficient apps.

Prof. Dick has several research projects that focus on ways to manage power and temperature in computing devices, since higher power leads to higher temperatures, higher energy consumption and lower reliability. For example, in one project he is investigating the management of power consumption and temperature of integrated circuits (ICs) on a single die that were designed to be identical, yet picked up variations through the manufacturing process. His group is using software and built-in sensors to determine the temperature of an IC so that work can be switched to cooler processors when the temperature gets too high. In the process he is able to work around variations in ICs, an important capability for modern computing.

Managing Energy and Power at the System Level

EECS faculty are investigating the variables that contribute to energy use in a complete system, and are finding ways to lower overall power requirements.

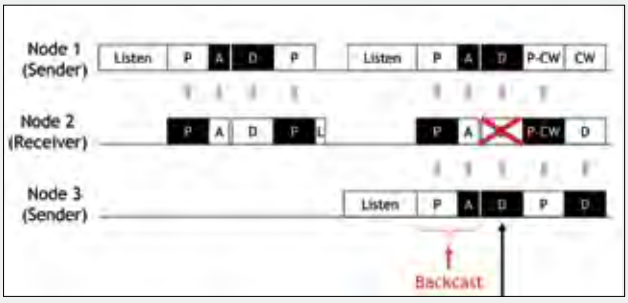
Prof. Prabal Dutta, along with colleagues from Brown University, has developed energy metering and tracking hardware and software that allows application and system designers to understand precisely when, where, and why energy is consumed in low-power systems like wireless sensor networks. They investigated a common technique called low-power listening (LPL), in which a radio receiver samples channel energy to determine if incoming traffic is pending, and found that in many real-world systems, false positives – wakeups resulting from environmental interference and noise – dominate the system power budget.

To address false positives, the researchers designed a new synchronization primitive called Backcast that identifies pending traffic with very low false positives and false negatives. The researchers then built a new data link layer, called A-MAC, that achieves comparable or better performance on a wide range of communications workloads than the current state-of-the-art. This work won the Best Paper Award at *Sensys'10,* the 8th ACM Conference on Embedded Networked Sensor Systems, and has garnered the interest of major low-power RF semiconductor vendors. Prof. Dutta's research team is now designing a next-generation software radio that will support Backcast and A-MAC and which will provide microwatt sleep power and better support for low-power communications (wakeup radios, hardware accelerators, and a power-proportional timer).

Prof. Zhengya Zhang discovered that it is possible to achieve a power savings of 30–40% when systems and circuits designers work together in the design process. For example, IC designers design their circuits to be 100% reliable, often sacrificing power efficiency for this accuracy. However, systems designers are able to design algorithms that ensure that only correct data is output even when dealing with circuit designs that are not 100% reliable. He believes that the perfect targets for this team approach between circuit and system designers are signal processing and communications, particularly cell phones and communications devices which are pervasive and where battery life is so critical.

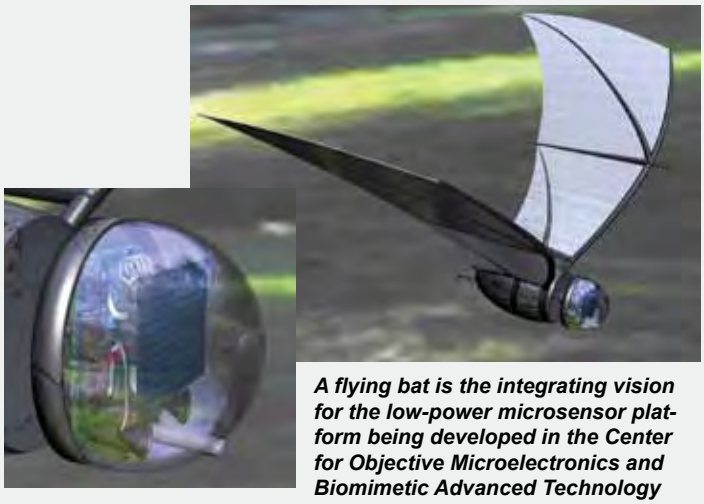
In the area of sensor devices, Prof. Zhang also sees the possibility for huge improvements in energy efficiency by incorporating data processing into the sensors. Traditional sensors simply collect data and pass it on to a central node, and it takes a significant amount of energy to send this information. However, if the sensor includes some computing capabilities, the data sent could be dramatically reduced. Working with Prof. Dick, who will focus more on the systems level, he anticipates that the resulting power savings could easily reach 35%.

Prof. Dick is working to automatically design and customize distributed sensing and actuation systems to their operating environments. By allowing designers to specify their requirements instead of low-level implementation details, it becomes possible to remove some of the burden of considering the energy efficiency and reliability implications of numerous possible design decisions from the designer, and transfer it to computers running design automation algorithms.



Three wireless nodes employing Backcast and A-MAC.

Low-Power Design for an Autonomous Flying Robot



A flying bat is the integrating vision for the low-power microsensor platform being developed in the Center for Objective Microelectronics and Biomimetic Advanced Technology (COMBAT).

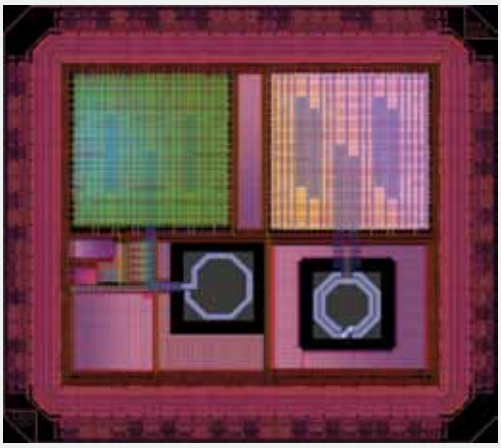
EECS faculty are investigating methods to achieve low power while maintaining high-speed processing for a micro-autonomous sensing robot being developed in the Center for Objective Microelectronics and Biomimetic Advanced Technology (COMBAT). In this project, a bat-like device weighing approximately one pound will be sent out into a combat situation to detect a variety of elements, take photos, and transmit the information back to its base.

Part of the bat's mission will be to provide a 3D map of the area. Prof. Blaauw and Prof. Sylvester are developing the technology to do this quickly and efficiently, yet with very low power because the bat will be able to carry only a very small battery. One of the key ways to dramatically reduce power is to decrease the voltage, however this slows down processing speed. By employing parallel processing and novel architectural design, they intend to raise the processing speed while retaining low voltage. At the same time, Prof. Wentzloff is researching energy-efficient receiver architectures that incorporate an RF MEMS filter-bank frontend to increase battery lifetime.

Prof. Yoon is developing a vision chip which will serve as the "eye" of the micro flying robot, providing optical flow information for autonomous navigation. His group is focusing on low-power, low-payload silicon image sensors, with the goal of achieving higher accuracy with lower power in very small autonomous navigation systems than has been achieved in digital processors. Challenges in this research include finding a new way to calculate optic flows using optimally engineered algorithmic equations and reducing the power needed for hardware processing through the use of mixed-signal circuits.

Recycling Energy for "Zero Power" Computing

Prof. Marios Papaefthymiou explores technologies for designing computer chips that rely on charge recycling to operate at unprecedented levels of energy efficiency. Just as hybrid automobiles reclaim and recycle kinetic energy, energy-recycling computers recover and re-use electric energy. The topic of research for several decades, such energy-recycling computers have the theoretical potential to operate with zero power consumption, provided they work at sufficiently slow speeds. In recent years, Prof. Papaefthymiou's research group has been pioneering technologies that can realize this energy-saving potential in practice without sacrificing performance. In particular, the group has demonstrated several GHz-speed energy-recycling chips, including a 2GHz floating-point unit (FPU), that recover a substantial fraction of the energy required for their operation during each clock cycle. It has furthermore demonstrated ultra-low-power energy-recycling signal processing chips that work at a voltage as low as half of their device threshold voltage, while achieving order-of-magnitude improvements in operating speed compared to their conventional counterparts at the same low voltage supply levels.



Ultra energy-efficient signal processor with 1GHz energy-recycling clock.

The more mature aspects of Prof. Papaefthymiou's technologies are being transferred to the marketplace through Cyclos, a semiconductor intellectual property (IP) company that provides building blocks, enabling tools, and design expertise for realizing energy-recycling computers. Largely in stealth mode for the past several years, Cyclos has been working with its partners to integrate energy recycling into high-performance computer chips, with the first announcement of a high-volume product expected in early 2012. According to Prof. Papaefthymiou, Cyclos' technologies will usher in a new generation of faster computer chips for medical, mobile, and cloud applications—all with extremely low power consumption.

Cyclos Semiconductor

Founded: 2004
Co-Founders: Alexander Ishii, Marios Papaefthymiou

Cyclos Semiconductor specializes in design technologies for ultra low-power chips targeting mobile, wireless, automotive, medical, and server farm applications.

Green Computing:
High Performance Computing

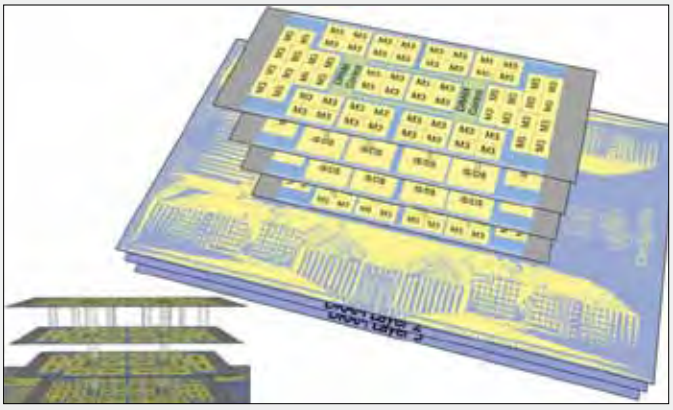
At the opposite end of the computing spectrum from millimeter-scale computing, which runs on mere nanowatts, is high performance computing that operates at hundreds of watts. These computers employ the maximum number of transistors per chip of any computing system, forcing chip designers to become increasingly creative in finding ways to achieve maximum efficiency in the circuits. Such high performance computers are typically found in large warehouse-size data centers.

Centip3De: Stacked Processors for Efficient High Performance Computing

One of the newest approaches Michigan researchers are employing to increase energy efficiency in high performance computing is 3D integration of stacked circuits, in a prototype chip called Centip3De. Faculty leading the research in this area are the Bredt Family Professor of Engineering Trevor Mudge, Prof. Dennis Sylvester, and Prof. David Blaauw, with David Fick and Ron Dreslinski as the lead graduate students. This research earned a third winning prize at the 2011 DAC/ISSCC Student Design Contest.

Centip3De stacks circuits in 3D to simultaneously save energy and increase performance in ultra-high performance, energy efficient, general purpose computing. It leverages unique aspects of near-threshold computing in conjunction with 3D integration using through-silicon vias to create highly energy efficient computation clusters, and achieves energy efficiency improvements of >5x compared to state-of-the-art commercial multicore processors today.

Centip3De is a near-threshold 7-layer 3D system containing 128 ARM Cortex-M3 cores and 256MB of stacked DRAM. It is believed to be the most ambitious circuit design ever undertaken at a university, totaling 93 million transistors across four 3D-stacked silicon layers, and will be back from fabrication later this summer.

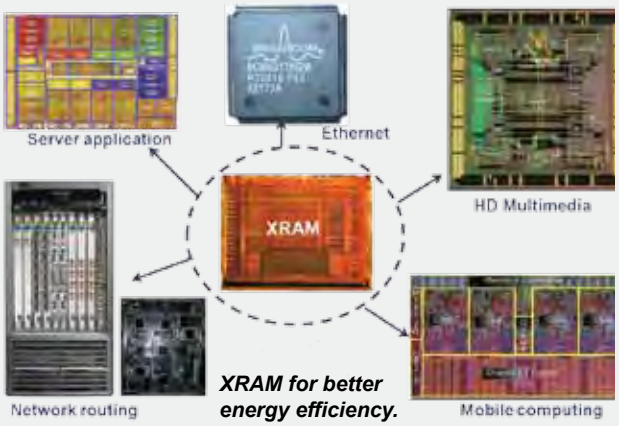


Centip3De is a 7-layer many-core system that operates at near-threshold voltage.

ARM and U-M: A Long-Term Research Collaboration with Increasing Impact

The presence of ARM cores in Centip3De is indicative of the close relationship between Michigan and ARM Limited, a UK-based company that licenses intellectual property for energy-efficient processors used in mobile handsets and a wide range of other applications. Last year, Prof. Mudge and several of his U-M colleagues, including Prof. David Blaauw and Prof. Dennis Sylvester, renewed a previous five-year, $5 million research partnership with ARM. Facilitating the partnership is ARM Vice President of Research and Development, and former student of Prof. Mudge, Dr. Krisztian Flautner (BSE CE '96; MSE CSE '98, PhD CSE '01). Early research conducted by Prof. Mudge and Dr. Flautner led to a patent for one of ARM's first power management offerings, Intelligent Energy Manager (IEM). The IEM enables a device such as a cell phone to extract less power from the battery when it is not in use. ARM technology was also employed in the Phoenix processor, technology that led to the spinoff company Ambiq Micro. An ARM core will also be part of the ultra-low power body-area sensing device being developed by Prof. Sylvester.

XRAM: Making Multi-Core Designs Work



XRAM for better energy efficiency.

To accommodate sustained increases in transistors in modern chips, designers turned to multi-core architectures. However, while transistor counts continued to rise, after a point they no longer led to improved performance due to limitations in the ability of the network fabric, or interconnect fabric, to connect the transistors on the different cores. As a result, designers have moved to an interconnect-centric architecture, in which system efficiency is now determined by the interconnect fabric rather than the processing ability of the cores.

Professors Blaauw, Mudge, and Sylvester developed a high-speed, low-power interconnect fabric known as XRAM to increase the scalability and energy efficiency of multi-core designs. XRAM is a crossbar structure that was modeled after the overall structure of static random access memories (SRAM), while employing novel circuit techniques to make it smaller, faster, and more energy efficient than competing methods. It enables a high degree of parallelism in high-performance computing, which allows for continued improvements in power-performance in data centers. The faculty intend to apply the technique to mobile phones and similar devices in the future.

Power Mongers: Tackling Power Challenges in Data Centers

With the explosion of the Internet, on-line searches, and cloud computing, the world is now dependent on massive, high reliability, high performance data centers. Data centers allow us to store information securely, without loss; they enable 24/7 global business processes, and they do this with lightning-fast responsiveness. The energy cost in providing these types of services, however, is high. Data centers are typically provisioned with processing power for maximum traffic levels, which in fact only occur 1% of the time. In addition, they generally include redundant systems for backup and failure protection purposes. Finally, because data centers include a high concentration of power-hungry servers, they exist in air-conditioned, engineered environments. EECS faculty are employing a variety of methods to increase the efficiency of these large data centers.

PowerNap eliminates idle power.

Prof. Thomas F. Wenisch takes a holistic approach that includes the designs of servers, facilities, and the software that runs on data center systems. To reduce server energy consumption, he is working with graduate student David Meisner on a project called PowerNap. PowerNap is a server architecture that eliminates idle power, and has been shown to save as much as 74% of a server's energy usage. It operates by transitioning rapidly between a high performance active state during periods of work and a coordinated low-power nap state while idle. This architecture provides greater power savings than conventional power management techniques such as dynamic voltage and frequency scaling, with negligible impact on performance.

Similarly, Prof. Dick is taking a software approach to improving power consumption and performance in data centers by determining when it makes sense to have different tasks share the same processor, or different cores on the processor. The result saves energy, thereby also lowering temperatures in the data center. Prof. Wenisch is also working with Prof. Trevor Mudge on new kinds of high-density storage technologies that will increase storage system responsiveness while decreasing power usage and heat output.

Turning his attention to data center infrastructure, Prof. Wenisch has investigated a number of ways that the power and cooling systems in these massive facilities can be built with energy efficiency in mind. His work has looked at ways to understand how heat flows through a data center to make cooling systems more intelligent. His group has also developed "power routing," in which two power feeds go to each server from different sources and servers coordinate to switch between these feeds to avoid overloading any source. These innovations allow data centers to power more servers with less infrastructure.

Conclusion

From data warehouses filled with racks of high-performance computers – to the handheld communications and multimedia devices that keep us connected to the world and to each other – to millimeter-scale devices that have the potential to dramatically change the way we interact with the world, energy efficiency is a key element in the design of all modern computing systems.

With one of the largest and fastest growing circuits and systems research groups, Michigan faculty and students are meeting this challenge at all levels of computing, while breaking new barriers and creating new technology to do it.

Societal Impact of Energy Efficient Computing at U-M

Going Green – lowering the energy needed to run data centers

Infrastructure – ensuring the safety of bridges and buildings through sensors

Health – enabling new implantable devices to monitor a range of health issues

Communication – extending battery life on mobile computing devices

Environment – monitoring air and water quality with millimeter-scale sensors

Security – detecting dangerous chemicals with millimeter-scale sensors

Research Briefs

Research Projects Into E-Voting Critical to Democratic Systems Worldwide

Prof. Halderman appears on CNN to explain how his research team hacked into the Washington, DC voting system and some of the ramifications of e-voting security shortcomings.

Prof. J. Alex Halderman conducted two research projects into the security and reliability of e-voting this year, providing vivid demonstrations of how democracy is endangered, rather than enhanced, by poorly implemented voting systems.

Vulnerabilities in Washington DC E-Voting System

In October 2010, shortly before November elections, the Washington, D.C. Board of Elections invited the public to join in a test of their new Internet-based absentee voting system prior to going live. Within thee hours, the U-M research team led by Prof. Halderman, which included graduate students Eric Wustrow and Scott Wolchok, had found a vulnerability. Two days later, they were in complete control of the election server; they hacked the system to change all votes and unmask voters' secret ballots. As a "calling card," they rigged the system so that voters were greeted with the University of Michigan fight song, "The Victors," after each new ballot was cast. At the same time, the team defended the system against actual malicious attackers from abroad. Prof. Halderman's team noticed these incoming attacks from computers in Iran and China and added firewall rules to block them.

Vulnerabilities in India's Electronic Voting Machines

Prof. Halderman was part of an international trio of researchers who demonstrated that electronic voting machines in India, the world's largest democracy, are vulnerable to fraud. The researchers discovered that the machines suffered from serious weaknesses and demonstrated how dishonest look-alike components could be used to rig them for fraud; they even demonstrated how a rigged voting machine might be remotely controlled using a smartphone app and Bluetooth radio. This research came with a price: the Indian government responded by jailing one of the team, Indian researcher Hari Prasad (he has since been released). On a subsequent trip to India, Prof. Halderman was detained, threatened with deportation, and banned from discussing his research.

Solar Power without Solar Cells: A Hidden Magnetic Effect of Light

In defiance of traditional equations of motion, Prof. Stephen Rand and his student William Fisher have discovered a previously undetected brand of optical rectification in which, under the right circumstances, including the use of everyday sunlight, light's magnetic field can create optical rectification in non-traditional materials. "You could stare at the equations of motion all day and you would not see this possibility. We've all been taught that this doesn't happen," said Prof. Rand. "It's a very odd interaction. That's why it's been overlooked for more than 100 years." This research may lead to very inexpensive solar power. "To manufacture modern solar cells, you have to do extensive semiconductor processing," Fisher said. "All we would need are lenses to focus the light and a fiber to guide it. Glass works for both. It's already made in bulk, and it doesn't require as much processing. Transparent ceramics might be even better."

The research was reported in the article, "Optically-induced charge separation and terahertz emission in unbiased dielectrics," by William Fisher and Stephen Rand, *Journal of Applied Physics*, March 21, 2011.

MABEL Walking Over Rough Ground

The bipedal robot known as MABEL, designed by Prof. Jessy Grizzle in collaboration with Carnegie Mellon University, is now walking on uneven surfaces. In her most recent attempt, filmed by Discover Channel Canada, she recovered from a 5" step. MABEL walks on the balls of her feet, so her balance mimics a natural human gait. This is accomplished through advanced control algorithms and results in walking motions that are more energy efficient and more agile than almost all other robots. MABEL will soon be superseded by the new robot ATRIAS, to be designed and built in collaboration with Carnegie Mellon and Oregon State Universities. ATRIAS will not be attached to a boom, and is expected to make great strides in maneuvering rough terrain while she learns to hop, skip and jump.

Generating Matter and Antimatter

Associate Research Scientist John Nees and Prof. Emeritus Gérard Mourou, working with Dr. Igor Sokolov, research scientist in the Department of Atmospheric, Oceanic and Space Sciences and colleagues, proved theoretically that a vacuum actually contains matter and antimatter that can generate new particles. They developed new equations that show how a high-energy electron beam combined with an intense laser pulse could rip apart a vacuum into its fundamental matter and antimatter components, and set off a cascade of events that generates additional pairs of particles and antiparticles. The researchers have developed a tool to put their equations into practice in the future on a very small scale using the HERCULES laser in the Center for Ultrafast Optical Science. Their work has potential applications in inertial confinement fusion, which could produce cleaner energy from nuclear fusion reactions.

The research was published in the paper, "Pair Creation in QED-Strong Pulsed Laser Fields Interacting with Electron Beams," in *Physical Review Letters 105*, 195005 (2010).

Weaknesses Exposed in Common Digital Security System

Prof. Valeria Bertacco, Prof. Todd Austin, and doctoral student Andrea Pellegrini have demonstrated and disclosed a fault-based attack to the popular RSA authentication algorithm that is accomplished by manipulating voltage levels in portable electronics systems to access private key data. Their paper, "Fault-based Attack of RSA Authentication," describes the security weakness and proposes a solution. RSA authentication is a popular encryption method used in media players, laptop computers, smartphones, servers, and other devices. Retailers and banks also depend on it to ensure the safety of their customers' information online. For this research, the team won the Margarida Jacome Best Poster/Demo Award from the Gigascale Systems Research Center.

"Hijack" System Enables a New Class of Peripherals for Smartphones

Prof. Prabal Dutta has led a research project to develop a technique and associated hardware for enabling a new class of external cubic-inch sensor peripherals by harvesting power and enabling communications through the headphone jacks found in smartphones.

Highjack is a hardware/software platform that integrates an energy harvester, microcontroller, and associated circuitry into a compact module that provides a standardized interface to the smartphone.

Highjack researchers won first place in the ISLPED 2010 Low Power Design Contest with an early design. The have since constructed and given away 20 modules for use by open-source developers. Prof. Dutta envisions the potential for a range of sensor peripherals, including ozone, carbon monoxide, DVM, blood pressure, blood glucose, and others. His team has already created four such modules as a demonstration: a module with temperature/humidity sensors, a PIR motion sensor and potentiometer; a 3-lead EKG sensor; a basic soil moisture sensor; and a breakout board for fast prototyping on the latest generation of HiJacks.

State-of-the-Art Energy Harvesting System for Machine Monitoring

Prof. Khalil Najafi and his group have built an energy harvesting device that will convert vibrations to electricity with 10x greater efficiency and power than other devices in its class. This vibration energy harvester is specifically designed to turn the rhythmic motions of factory machines into energy to power wireless sensor networks. These sensor networks monitor machines' performance and let operators know when they need to pause the product line because of a malfunction. Current sensors on the market are powered by battery or wall plug, which dramatically increases their installation and maintenance costs. The system charges to 1.85 volts in 50 minutes with no pre-charge or external power source. It is 27 cubic millimeters in size and can provide more than 200 microwatts of power when exposed to a vibration frequency of 155 Hertz. These new devices could have applications in medicine and the auto industry, such as powering medical implants in people or acting as heat sensors on vehicle motors.

Variability-Aware Software for Efficient Computing with Nanoscale Devices

Prof. Dennis Sylvester is the lead researcher from Michigan in a new $10M, five-year NSF Expeditions in Computing program called "Variability-Aware Software for Efficient Computing with Nanoscale Devices," known more simply as the Variability Expedition. He will work on ultra-low power and low-cost embedded wireless sensors, in particular those used for body-area sensing. The goal of the overall project, run by Prof. Rajesh Gupta, UC-San Diego, is to address with the help of software the errors that are increasingly occurring in nanoscale devices due to manufacturing errors, device wear-out, and performance variation as well as performance degradation due to the use of increasingly lower voltages. The Variability Expedition team will employ novel software and hardware techniques that work around deviations that arise in system components to essentially create a new class of computing machines that are both adaptive and highly energy efficient.

Research Briefs

Organic Laser Breakthrough

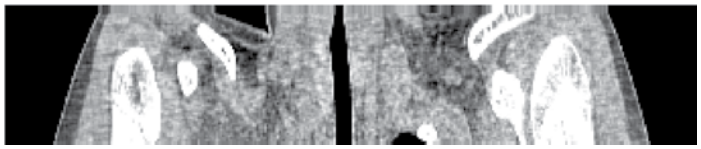
Prof. Stephen Forrest and Princeton graduate student Stephane Kéna-Cohen achieved a long-sought-after optics phenomenon that may lead to more efficient and flexible lasers for telecommunications and quantum computing applications. They demonstrated polariton lasing in organic semiconductor material at room temperature. Organic semiconductors offer a wider range of properties than their inorganic counterparts and are easier for chemists to tailor for specific purposes. The team is currently developing organic lasers that can be excited with electricity rather than light. The research was published in the article, "Room-temperature polariton lasing in an organic single-crystal microcavity," *Nature Photonics 4*, 2010, pp. 371–375.

Keeping Social Networking Private

As part of an NSF-funded research project, and in collaboration with Boston University and the U-M School of Information, Prof. Kristen LeFevre is developing privacy tools to assist social media users in protecting their private data in a simplified manner. Her group developed a novel tool that uses machine learning to automatically recommend policy configurations to users based on a limited amount of input. The research resulted in a Best Student Paper award for student Lujun Fang at the *2010 World Wide Web Conference*, and was presented at the *2010 ACM CCS Conference*.

Elliot Soloway's Work in Mobile Learning Documented in Pearson Foundation Video

The work of Prof. Elliot Soloway, a thought leader in the use of mobile technologies for education, has been documented in a video entitled "Educating the Mobile Generation," which was produced by the Pearson Foundation and the Mobile Learning Institute. Prof. Soloway believes that handhelds are the only scalable way to get computers in the hands of all students and has developed collaborative education software for handhelds – despite that fact that many schools ban smartphones from use.



An image slice from a traditional CT scan of a patient's lungs.

A CT scan using the new "model-based image reconstruction" technique, which enables either finer resolution at current X-ray radiation or ¼ the X-ray radiation with current resolution.

Higher-Definition CT Scans at Lower Radiation Doses

Prof. Jeff Fessler is principal investigator on a new program to improve the image quality of lower-dose CT (computed tomography) scans for diagnosing and monitoring lung disease. CT scans help physicians diagnose and treat medical conditions such as tumors, fractures, blood clots, and emphysema by providing more detail than conventional X-rays. Increased CT scan use, however, means greater radiation exposure. Prof. Fessler and his collaborators in the U-M Health Systems and scientists at GE's Global Research Center are developing complex algorithms to increase the clarity of CT images with a quarter of the radiation.

Mark Haynes, center, and Xueyang Duan, PhD students in Applied Physics and Electrical Engineering, respectively.

Safer Medical Imaging with Microwaves

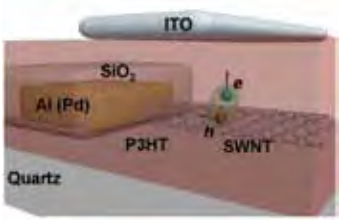
Research being conducted by Prof. Mahta Moghaddam and her group could lead to safer medical imaging practices in hospitals and labs. The specific goal of this project is to develop an alternative method to X-ray imaging for breast cancer detection that is safer and uses nothing stronger than the radio frequency waves present when operating a cell phone. Current methods for mammography use relatively high levels of ionizing radiation, and result in a large percentage of false positives (which lead to unnecessary biopsies) and false negatives (which miss malignant tumors). A recent experiment proved the success of a preliminary stage in the development of this new technology.

Synchrotron X-Rays from a Table-Top Source

Researchers in the High Field Science group of the Center for Ultrafast Optical Science have recently used the high intensity, table-top HERCULES laser to demonstrate X-ray beams with peak spectral brilliance rivaling those generated in expensive and large synchrotron particle accelerators. Anticipated areas of applications include highly sensitive medical diagnostics and the ability to observe chemical reactions that happen in quadrillionths of a second. The researchers involved include EECS and NERS professor Karl Krushelnick, research scientists Vladimir Chvykov, Galina Kalintchenko, Anatoly Maksimchuk, and Victor Yanovksy, as well as researchers at Imperial College London and Instituto Superior Téchnico Lisbon. The work is described in the article, "Bright spatially coherent synchrotron X-rays from a tabletop source," in *Nature Physics* 6, 980-984 (2010).

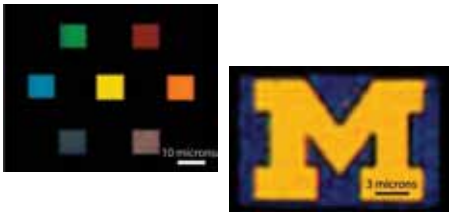
U-M, Shanghai Jiao Tong University Partner on Renewable Energy Projects

U-M and Shanghai Jiao Tong University in China are partnering to fund renewable energy and biomedical technology projects, and among the first projects funded will be research on high efficiency hybrid solar cells based on carbon nanotube enhanced nanostructures. Prof. Zhaohui Zhong will lead this research. "The globalization of research is beginning to transform the way big problems are tackled, and the University of Michigan will be at the forefront of this emerging trend," stated VP for Research Stephen Forrest.



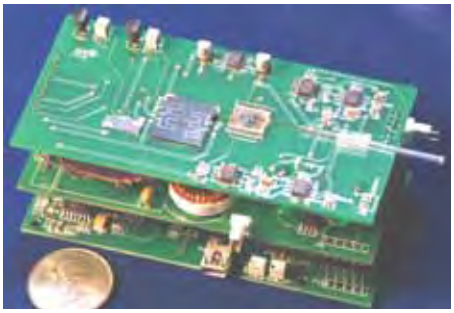
BioBolt: Minimally Invasive Brain Implant

Prof. Euisik Yoon and his group have developed a minimally invasive and low power neural interface that wirelessly transmits the brain's neural signals, or thoughts, to control a computer. The device could one day be used to reactivate paralyzed limbs, control epilepsy, or diagnose certain diseases like Parkinson's. Unlike existing brain implants, BioBolt does not penetrate the cortex and is completely covered by the skin, which greatly reduces the risk of infection. BioBolt achieves lower power consumption by using the skin as a conductor, or signal pathway.



More Efficient LCDs Through Nanostructuring

Prof. Jay Guo developed a new type of color filter through nanostructuring which may pave the way toward smaller, more efficient, higher-definition liquid crystal display (LCD) screens. By using this technique, his team was able to create the smallest color pixel U-M logo (12-by-9 microns), which is equivalent to 1/6 the width of a human hair strand. Prof. Guo's process makes displays easier to manufacture and more efficient. This technology is applicable to projection displays and wearable, bendable, or extremely compact displays. The research was published in the article, "Plasmonic nano-resonators for high resolution color filtering and spectral imaging," in *Nature Communications*, August 24, 2010.

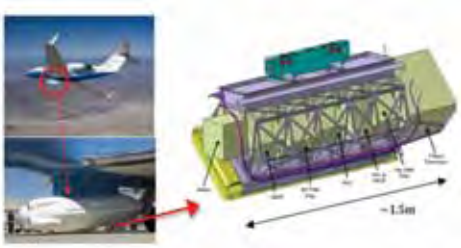


A Palm-Size, Completely Integrated Micromachined Gas Chromatograph

Prof. Ken Wise and his group achieved the first palm-size, completely integrated micromachined gas chromatograph. The device includes temperature control electronics, an embedded Cypress processor, and a USB interface, integrated on four 10cm x 4cm printed circuit boards. Power electronics are included to allow the programmable control of temperature over a wide range while driving the preconcentrator to produce sub-second injection pulses using thermal desorption. The first application of this system will be in detecting explosives in urban warfare settings, mounting it on a remotely controlled Scarab robot developed by the University of Pennsylvania.

New Theory Resolves Long-Standing Questions About Short Pulses in Quantum Cascade Lasers

Prof. Ted Norris and colleagues in the Center for Ultrafast Optical Science as well as colleagues at MIT and Harvard have proven that ultrashort pulses are possible in quantum cascade lasers (QCLs), which opens up new possibilities for being able to generate short pulses from QCLs across the infrared region of the spectrum. Potential applications of QCLs include the sensing of gases and pollutants in the environment, collision avoidance mechanisms in vehicles, free-space optical communications, and medical diagnostics.The results have been published in the article, "Ultrafast Rabi flopping and coherent pulse propagation in a quantum cascade laser," *Nature Photonics*, August 29, 2010.



Soil Moisture Study Aims to Clarify Climate Change

A new $26-million NASA project led by Prof. Mahta Moghaddam aims to help clarify how ecosystems exchange carbon with the atmosphere, an important piece of missing knowledge in the quest to understand, predict, and adapt to climate change. The project's goal is to provide crucial missing information that will help determine whether the North American continent is a net source or sink of carbon. Researchers from U-M, NASA's Jet Propulsion Laboratory, Harvard University, MIT, Oregon State University, NASA's Goddard Space Flight Center, the U.S. Department of Agriculture, and Purdue University are taking part.

Prof. Moghaddam will oversee the design and fabrication of a radar instrument called the Airborne Microwave Observatory of Subcanopy and Subsurface (AirMOSS), a table-top-sized, high-powered, low-frequency radar that NASA/JPL collaborators will build for the project. A leader in developing radar algorithms for subsurface characterization, Prof. Moghaddam is also developing computational techniques to analyze the signals it sends back.

U-M Researchers Selected for Yahoo! M45 Supercomputing Initiative

Yahoo! has expanded the scope of their Hadoop-based M45 supercomputing initiative to provide universities with the opportunity to conduct research not otherwise possible without a resource of its scale. M45 consists of approximately 4,000 processors with 1.5 petabytes of storage. U-M faculty utilizing M45 include Eytan Adar, Michael Cafarella, Robert Dick, Georg Essl, Z. Morley Mao, Qiaozhu Mei, Brian Noble, and Thomas F. Wenisch.

U.S. – China Clean Energy Research Center (CERC) and Clean Vehicles Research

Prof. Ian Hiskens and Prof. Heath Hofmann are conducting research into clean vehicles as part of the U.S. CERC Clean Vehicle Consortium, a $50M five-year program including several U.S. and China governmental, academic, and industrial team members. Prof. Hiskens, the co-leader of the vehicle-grid interactions thrust, is focusing on the impact of Plug-in Electric Vehicles on the nation's electrical grid. He is developing control algorithms for integrating large numbers of vehicles into the grid in a way that assists grid operation and reliability. As it currently stands, the nation's grid would not be able to handle widespread use of electric vehicles. Prof. Hofmann will concentrate on vehicle electrification, which includes electric motors and power electronics as well as control and system integration which impacts fuel economy and emissions. Specifically, he'll investigate the development of computationally efficient simulation tools for electric machines.

Rebuilding Liberia's Universities and Infrastructure

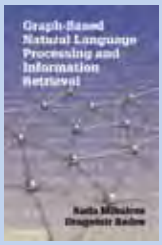
Prof. Herbert Winful is leading the College of Engineering's effort to help rebuild Liberia's universities and infrastructure as part of an $18.5M program funded by the U.S. Agency for International Development to develop centers of excellence in engineering and agriculture at the University of Liberia and Cuttington University. The program, Excellence in Higher Education for Liberian Development, is led by RTI International. U-M's contribution includes a faculty and student exchange program, an educational component focusing on women in engineering, and an effort to identify and implement engineering-based solutions to community problems.

NEW BOOKS

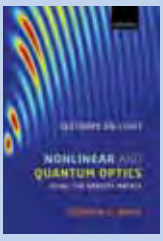
Prof. **Valeria Bertacco** and her former student Ilya Wagner have co-authored a new book entitled *Post-Silicon and Runtime Verification for Modern Processors.*

Prof. **Igor Markov** and graduate student Jin Hu have co-authored a new book with Andew B. Kahng and Jens Lienig entitled *VLSI Physical Design: From Graph Partitioning to Timing Closure*.

Prof. **Semyon M. Meerkov** is co-author on the book, *Quasilinear Control: Performance Analysis and Design of Feedback Systems with Nonlinear Sensors and Actuators*, with EE graduate student ShiNung Ching, Aerospace Engineering graduate student Yongsoon Eun, Prof. Cevat Gokcek (Michigan State), and Prof. Pierre T. Kabamba (Aerospace Engineering and EECS).



Prof. **Dragomir Radev** has co-authored a new book with Prof. Rada Mihalcea of University of North Texas entitled, *Graph-Based Natural Language Processing and Information Retrieval,* which demonstrates a number of connections between these two activities.



Prof. **Stephen C. Rand's** new book, *Lectures on Light: Nonlinear and Quantum Optics Using the Density Matrix,* attempts to bridge the gap between introductory quantum mechanics and the research front of modern optics and scientific fields that make use of light.

Marios Papaefthymiou Named Chair of Computer Science and Engineering

Prof. Marios Papaefthymiou has been selected as the new Chair of Computer Science and Engineering. He received his B.S. degree in Electrical Engineering from California Institute of Technology, and his M.S. and Ph.D. degrees in Electrical Engineering and Computer Science from Massachusetts Institute of Technology. He joined the faculty at U-M in 1996 after three years on the faculty at Yale University. Prof. Papaefthymiou has been the Director of the Advanced Computer Architecture Laboratory at U-M since 2000.

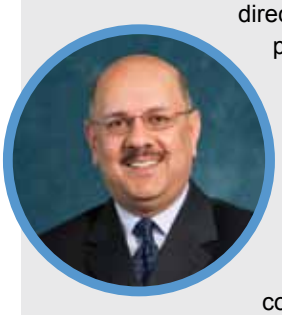
Prof. Papaefthymiou conducts research in the area of high-performance energy-efficient computers. Over the years, Prof. Papaefthymiou's research group has spearheaded the exploration of practical energy-recycling technologies that can be used to design computer chips that operate at unprecedented levels of energy efficiency. Currently, the research focus of his group is on ultra-low-power energy-recycling circuitry and architectures for high-speed digital signal processing, portable computers, and bio-embedded networks. Prof. Papaefthymiou is also active in the area of algorithms for parallel and distributed computer systems, including multicore architectures.

In addition to his in-depth expertise in computer science and engineering, Prof. Papaefthymiou brings to his position a broad knowledge of current computer practices and an appreciation of technology transfer issues through his extensive industry consulting and direct involvement with startups. In particular, his work on energy-recycling design technologies has formed the basis for Cyclos Semiconductor, a semiconductor intellectual property startup that provides building blocks and enabling tools for the development of energy-efficient computers. Prof. Papaefthymiou co-founded Cyclos in 2004 and serves as its Chief Scientist and Chairman of the Board.

Prof. Papaefthymiou has authored over 100 research papers and has been awarded eight U.S. and international patents with several pending. He has served as Associate Editor for the *IEEE Transactions on the Computer-Aided Design of Integrated Circuits, IEEE Transactions on Computers*, and *IEEE Transactions on VLSI Systems*. Among other conferences and workshops, he has served as General Chair and Program Chair for the *ACM/IEEE International Workshop on Timing Issues in the Specification and Synthesis of Digital Systems* and as Technical Program Committee Member for the *IEEE/ACM International Conference on Computer-Aided Design*, the *Conference on Design, Automation and Test in Europe*, and the *International Workshop on Power and Timing Modeling, Optimization, and Simulation*. His distinctions include faculty recognition awards from Yale College, the EECS Department at U-M, and the Graduate School at U-M, an ARO Young Investigator Award, NSF CAREER and ITR Awards, and several IBM Partnership Awards.

Farnam Jahanian Selected to Head NSF CISE Directorate

Prof. Farnam Jahanian has been selected by the National Science Foundation to head its directorate for Computer & Information Science & Engineering (CISE). CISE is the federal agency that supports research in computer and information science and engineering.



Jahanian, who stepped down as Chair of the CSE Division to take on this role at CISE, has been a member of the Michigan faculty since 1993. He will remain on the faculty and return to Michigan after his appointment at CISE is complete.

Regarding his new role, Jahanian commented, "The discipline of computing has exploded into the forefront of science, medicine, commerce, and arts. Its transformative societal impact will continue to accelerate in the coming decades. I am thrilled to join the leadership team at NSF as the CISE Directorate continues to play a critical role in enabling this transformation through its support for long-term basic research and training of computing professionals."

WIMS Center Celebrates 10 Years, and Looks to the Future

The NSF Center for Wireless Integrated MicroSystems celebrated 10 years of innovation in the realm of wireless integrated microsystems at a day-long symposium May 18, 2010 that included talks and poster presentations. Attendees included local and state officials, industrial partners, researchers, and students. The Center, which continues as a major research unit in the Department, has spawned 15 startup companies. A few of the major achievements that were supported by the Center include: an active cardiovascular stent; an intraocular pressure sensor; cochlear implants; neural interfaces for the treatment of major diseases such as epilepsy and Parkinson's; innovative packaging; high functioning energy scavengers; as well as environmental and infrastructure monitoring microsystems. Prof. Ken Wise (left), William Gould Dow Distinguished University Professor, directed the Center between 2000–2010. Prof. Yogesh Gianchandani (right) is the new Director of WIMS.

Prof. Leo C. McAfee, Jr. retired December 31, 2010, after 39 years at Michigan, leaving a legacy of hope and achievement. Family, friends, and former students came from all over the country to celebrate his career. As the first African American professor hired by the College of Engineering in 1971, former students recalled how he gave hope and encouragement to them and to other under-represented minorities in the program.

As Education Thrust Leader for the Center for Wireless Integrated MicroSystems (WIMS), he influenced the lives of hundreds of future engineers during his tenure. In partnership with Michigan State University, he and his colleagues produced more than 80 summer and academic year courses, attended by more than 4,000 students. He personally attended almost every Saturday morning Detroit Area Pre-College Engineering Program outreach event. Prof. Ken Wise, former Director of the WIMS Center, stated in his remarks, "Over 60% of those students were minorities and over 50% were women. And of those graduating from high school, over 60% have gone on to college careers in science and engineering. That is having impact–and that is changing lives."

Professor McAfee conducted research in the area of numerical and circuit modeling of integrated circuits, networks for automated semiconductor manufacturing, and computer network devices. He and his group were important contributors to the SECS Message Service (SMS) protocol, which was adopted as a standard by SEMI (Semiconductor Equipment and Materials, Inc.) in 1989. This standard had a significant impact on semiconductor factory automation.

Events

Data Mining Workshops Bring Together Researchers from Across the University

The explosion of data available today and the myriad possibilities for its use were the impetus for Prof. Dragomir Radev to launch a workshop on "Data, Text, Web, and Social Network Mining" in April 2010. That workshop brought together over 100 U-M and external researchers and was by every measure a success. In April 2011, Prof. Radev and Prof. Michael Cafarella repeated the workshop with the assistance of graduate student Vahed Qazvinian. A broad range of units from across U-M participated in the workshop, including engineering units and several domain units in the natural sciences, medical sciences, social sciences, and humanities. External attendees were in attendance from Yahoo!, Ford Motor Company, the Michigan Department of Human Services, Kalamazoo College, the University of Nottingham, and a number of consulting and software development firms. Both workshops were sponsored by EECS, the School of Information, and Yahoo!

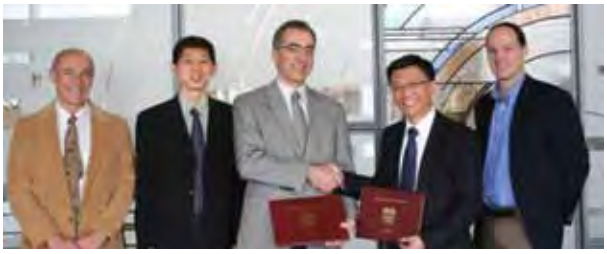
NNIN/C Michigan Symposium

The 2011 National Nanotechnology Infrastructure Network Computation (NNIN/C) Michigan Symposium, hosted by Michigan, brought together 50 leading researchers from 15 institutions to review recent progress and developments, and to discuss future challenges in the field. The focus of the symposium was Advanced Modeling and Simulation of Micro/Nano Electro Mechanical Systems (MEMS/NEMS) and Nano/Micro-fluidic Devices. MEMS/NEMS and devices are poised to revolutionize communications, instrumentation, and computational systems.

GLOBAL PARTNERSHIPS

Meeting the Challenges for Low-Power System-on-Chip Design

A collaborative effort between U-M and Nanyang Technological University (NTU) has been initiated to reduce power consumption at three levels in System-on-Chip (SoC) design: circuits, systems, and devices. Researchers are aiming for a new generation of ultra-low-power SoCs, called green SoCs, for mobile communication and computing devices. The two universities will conduct joint research, project design, and development, and will also play host to staff and student exchange programs. In addition, both organizations will be involved in the coordination of joint academic events. The anticipated result will be significant advances in the areas of low-power RF/mm-wave ICs; energy harvesting; ultra-low-power wireless sensor node design; and biomedical ICs.



Nanyang Technological University (NTU) signed a Memorandum of Understanding with U-M on April 26, 2010. L-R: Prof. Erdogan Gulari, Associate Dean for Research and Graduate Education, College of Engineering (U-M), Prof. Yeo Kiat Seng, Interim Director of VIRTUS (NTU), Prof. Khalil Najafi, Chair of ECE (U-M), Prof. Kam Chan Hin, Chair of EEE (NTU), and Prof. Dennis Sylvester, Director of the Michigan Integrated Circuits Laboratory (U-M).

Tech Transfer

With a focus on startup companies spun-off from technology developed by faculty and students in the EECS Department.

Security Spinout Acquired in Tech Transfer Success Story

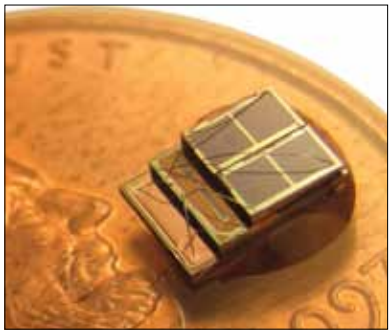
Arbor Networks, the Internet security company founded by Prof. Farnam Jahanian and his then-doctoral student G. Robert Malan in 2000, was acquired in late 2010 by Tektronix Communications, a division of Danaher. Jahanian and Malan formed Arbor based on findings and techniques developed throughout two research projects led by Jahanian at the University of Michigan that demonstrated fundamental limitations in the core routing architecture of the Internet and led to a system for detecting and resolving network-wide anomalies, such as distributed denial-of-service (DDoS) attacks and routing exploits. Today, Arbor has over 280 employees worldwide and is a leading provider of security and network management solutions for next-generation data centers and carrier networks, including the vast majority of the world's Internet service providers and many of the world's largest enterprise networks. Arbor's R&D operations are centered in Ann Arbor.

Omni Sciences, Inc. Developing Laser-Based Missile Defense for Helicopters

Prof. Mohammed Islam and his startup company Omni Sciences, Inc. are developing technology to protect combat helicopters through the development of mid-infrared supercontinuum lasers, which jam heat-seeking weapons' sensors. "Battlefield terrain in places like Afghanistan and Iraq can be so rough that our troops have often had to rely on helicopters, and they can be easy targets for enemies with shoulder-launched missiles," said Prof. Islam. "Our lasers give off a signal that's like throwing sand in the eyes of the missile." Prof. Islam created the first mid-infrared supercontinuum laser to operate in longer infrared wavelengths. It is not visible to the human eye, but releases heat. This heat mimics helicopter engines' electromagnetic signatures, confusing heat-seeking missiles. Omni Sciences is building a second-generation prototype of the device, in anticipation of commercializing the technology.

Moving Fast to Bring Ubiquitous Computing to the Marketplace

Ambiq Micro, Inc. is on the fast track to success, having secured $2.4M in venture capital funding in 2010 from ARM Limited, Cisco, Inc., and others. Ambiq also received funding from the U-M student managed Frankel Commercialization Fund.



Founded in 2010, Ambiq Micro Inc. is a fabless semiconductor company that has developed ultra-low power mixed-signal solutions for a new generation of wireless electronics. The company reports that it has produced 32-bit ARM Cortex™-M class processors that are more energy efficient than the simplest 8-bit solutions on the market today. Applications for the processor include medical devices, environmental monitors, consumer products, home and building automation systems, security, and energy monitors.

Quantum Signal moved their company to Saline, MI with plans to expand and add as many as 20 new jobs in the next year. The company specializes in product design, consulting, and advanced research, especially for intelligent sensing, data analysis, visualization, and robotics applications. Particular areas of growth in recent years are vehicle vision and control systems, led by U-M graduate Dr. Victor Perlin, and the their "Reactor Zero" group, which focuses on real-time interactive simulation for both the entertainment industry and for critical research contracts.

Department News

Startup Companies in Competition

Ambiq Micro
Ultra-low power mixed-signal solutions for wireless electronics

The company received $250K in the 2010 Draper Fisher Jurvetson-Cisco Global Business Plan Competition.

Arbor Photonics
High power, fiber laser solutions for advance materials processing for microelectronics manufacturing, solar cell processing, and industrial materials processing applications

The company earned 2nd place overall and $150K in the 2010 Accelerate Michigan Innovation Competition. They have also received NSF funding to build high power, short pulsed fiber lasers.

Evigia
Wireless sensing, identification and tracking products and solutions targeting military, security, and commercial applications

The company earned $25K in the category Defense & Homeland Security in the 2010 Accelerate Michigan Innovation Competition.

Reveal Design Automation
Software tools to verify correctness of complex, digital chip designs

The company earned 2nd place and $15K in the 2010 Accelerate Michigan Innovation Competition, 6th place in the 2010 Rice University Business Plan Competition, and the Outstanding Presentation Award in the 2011 Michigan Business Challenge.

MiEND Drug Screeners
Neurodegenerative drug screening services

The company earned 3rd place and $10K in the 2010 Accelerate Michigan Innovation Competition.

Christopher Cadotte, Andrew Smith, Angelique Johnson and their checks for $27K.

Angelique Johnson (MSE EE '07, PhD EE '11) and her new company, MEMStim, took top honors and prize money in the 2011 Michigan Business Challenge and Eugene Applebaum Dare to Dream Grant program for U-M startups. Ms. Johnson partnered with MBA students Christopher Cadotte and Andrew Smith in the competition. She studied under Prof. Ken Wise, and conducted research as a member of the Center for Wireless Integrated MicroSystems (WIMS).

MEMStim makes customizable microfabricated stimulators. The company plans to sell MEMS electrode leads to medical device companies for integration into their targeted nerve stimulation devices. Ultimately, the company is committed to improving the standard of patient care in neurostimulation. The team intends to use the award money to quantify regulatory risks and further develop a prototype of the device.

The team received $20K for the Pryor-Hale Award for Best Business, $5,000 for the Williamson Award for Outstanding Business and Engineering Team, and $2,000 for the Outstanding Presentation Award from the Michigan Business Challenge. In addition, they received a $1,500 assessment grant from the Dare to Dream Grant Program for the purpose of establishing the feasibility of their business. They followed up this win with a second prize win at the San Diego State University Venture Challenge.

Crossbar

A new company is being launched based on technology developed by Prof. Wei Lu called Crossbar Inc. The company is located in Santa Clara, CA, and specializes in memory storage.

Students Develop iPad App to Assist Users with Fine Motor Disabilities

ASK Applications, a company in the making composed of computer science students, has created ASK Messaging, an iPad app that helps individuals with fine motor control disabilities or vision impairment and who have extreme difficulties in using keyboard interfaces to successfully navigate menus and compose and send messages. The app has been tested at C.S. Mott Children's Hospital and at The Bridge School in California.

In March 2010, the ASK team won the Center for Entrepreneurship's Bay Area Pitch Competition and $1000. The team also took second place in the University Mobile Challenge Pitch Competition at the Mobile World Congress in Barcelona in February. Most recently, the team took first place overall in the Spring 2011 U-M Mobile Apps Challenge. Team members are undergrads Erica Christensen, Kimberly Hunter, Scott Jenks, Chelsea LeBlanc, Chris McMeeking, and Michelle Noronha.

ASK Applications member Chelsea LeBlanc shows the home page for ASK Messaging.

K-12 Outreach

U.S. Computational Linguistics Team Coached to Victory

For the fourth year, Prof. Dragomir Radev led U.S. high school student teams in successful competition at the *2010 8th International Linguistics Olympiad* in Stockholm, Sweden. Using computational linguistics, experts can develop automated language technologies such as search engines and translation software.

Team members claimed one gold, three silver, and two bronze medals in individual competition at the Olympiad, plus two honorable mentions, the most medals ever. In addition, the U.S. Blue team ranked first in overall composite team score. Twenty-six teams of high school linguists from eighteen countries competed in the Olympiad.

Summer Workshop for High School CS Teachers, Administrators

In August 2010, the Department held its second annual CS4HS, a two-day workshop for Michigan high school teachers and administrators that explored the use of technology in learning and the direction of curricula in computer science education. Organized by Dr. Jeff Ringenberg and sponsored by Google and the College of Engineering, the workshop featured a keynote speech by Nancy Butler Songer, U-M Professor of Science Education and Learning Technologies, a tour of the Ann Arbor Google facility, interactive lab sessions, and additional lecture and panel sessions.

NANOCAMP

NNIN Nanoscale Science, Engineering & Technology

As a member of the NSF-funded National Nanotechnology Infrastructure Network (NNIN), the ECE division offers the popular NanoCamp program, recently held on April 2. NanoCamp gave more than 50 middle and high school students the opportunity to learn about nanotechnology and access the Lurie Nanofabrication Facility. The NNIN is an integrated network of facilities that serves the needs of nanoscale science, engineering and technology researchers throughout the world.

Introducing Electric Vehicle Technology to High Schoolers

With funding from the Department of Energy, EECS and Mechanical Engineering have been developing a range of activities that are aimed at helping K–12 students learn about transportation electrification. Collaboration with the science department at a local high school led to the development of a sequence of eight modules, suited to junior/senior physics students, that cover the basics of electric vehicle technology. David Hiskens, current EE undergraduate student, wrote the modules as a high school student.

Also, a three-day summer camp for high school students was held during 2010. The camp program was structured around lectures, field trips, and laboratory sessions, providing students with a variety of opportunities to learn about and experience the latest electric vehicle technologies.

Wireless Communications Camp

As part of Camp CAEN, high school students were able to take a summer course that introduced them to basic concepts of electrical engineering with a focus on wireless communications systems. In the course, taught by Prof. Wayne Stark, Dr. Kurt Metzger, Dr. Chih-Wei Wang and graduate students Paul Chowdhry and Divya Paul, students built and tested circuits, learned and employed C programming language to program a DSP, and used MATLAB – all skills that are relevant to virtually any engineering career.

William Gould Dow Distinguished Lecturership

This lectureship is the highest honor bestowed on a guest speaker by the Department, and honors William Gould Dow (1895–1999), former faculty member, Department Chair, and pioneer in electronic engineering education.

This past year's William Gould Dow lecturers were selected by faculty in the areas of Solid State and Control.

James D. Meindl
Joseph M. Pettit Chair in Microelectronics
Georgia Institute of Technology
"Nanoelectronics in Retrospect, Prospect and Principle"

David C. Munson, Jr. (Dean, College of Engineering), Ken Wise (William Gould Dow Distinguished University Professor), James D. Meindl, Khalil Najafi (Schlumberger Professor of Engineering and Chair, Electrical and Computer Engineering)

Pravin Varaiya
Nortel Networks
Distinguished Professor Emeritus
Department of Electrical Engineering and Computer Sciences, UC Berkeley
"Selling Wind Randomly"

Demos Teneketzis (Professor of EECS), Pravin Varaiya, Khalil Najafi (Schlumberger Professor of Engineering and Chair, Electrical and Computer Engineering)

Distinguished Lectures

2010–2011 AY Distinguished Lectures in Computer Science and Engineering

ROBERT F. BRAMMER
VP for Advanced Technology and CTO
Northrop Grumman Information Systems
Cybersecurity and Global Climate Change: Complementary or Conflicting National Priorities?

NIELS PROVOS
Principal Software Engineer,
Infrastructure Security
Google
Real-World Challenges of Web-Based Malware

JOHN GUTTAG
Dugald Jackson Professor
of Electrical Engineering and
Computer Science
Massachusetts Institute
of Technology
Shortening the Healthcare Control Loop

LISA PORTER
Director
Intelligence Advanced Research
Projects Activity (IARPA)
IARPA: Be the Future

TIM HOWES
Co-Founder, Chairman, and CTO
RockMelt
Stories from the Trenches of Silicon Valley

RANDY KATZ
United Microelectronics Corporation
Distinguished Professor
University of California, Berkeley
A Computer Scientist Looks at the Energy Problem

2010–2011 AY Distinguished Lectures in Electrical Engineering and Computer Science

RICHARD (RICK) P. WALLACE
President and CEO
KLA-Tencor Corporation
From Bursley to the Boardroom

RICK BOLANDER
Managing Director and Co-Founder
Gabriel Venture Partners
Value Creation: The Role for EECS

CHARLES M. LIEBER
Mark Hyman Professor of Chemistry
Harvard University
Semiconductor Nanowires: A Platform for Nanoscience and Nanotechnology

NADER ENGHETA
H. Nedwill Ramsey Professor of
Electrical & Systems Engineering
University of Pennsylvania
Taming Light and Electrons with Metamaterials

MICHAL LIPSON
Associate Professor and
McArthur Fellow
Cornell University
Manipulating Light on Chip

SAJEEV JOHN
Professor, Department of Physics
Photonic Band Gap Materials: Light Trapping Crystals

Many of these lectures have been videotaped and are available on the EECS website.

Endowed Professorships

FARNAM JAHANIAN

Edward S. Davidson Collegiate Professor of Electrical Engineering and Computer Science

Farnam Jahanian's research is in the areas of distributed computing, network security, and network protocols and architectures. He has led several large-scale research projects that have ultimately revolutionized how cyber threats are addressed on the Internet. His seminal work on Internet routing stability and convergence has been highly influential within both the network research community and the Internet operational community. His research on Internet infrastructure and security formed the basis for the successful Internet security services company Arbor Networks, which Prof. Jahanian co-founded in 2000. The author of over 90 published research papers, Prof. Jahanian is the recipient of numerous awards for his research, teaching, and commercialization activities. He is a Fellow of ACM, AAAS, and IEEE.

SETH PETTIE

Morris Wellman Faculty Development Professor

Seth Pettie's research focuses on algorithms and data structures for fundamental combinatorial optimization problems, distributed algorithms, and extremal combinatorics. Prof. Pettie was the recipient of an NSF CAREER award in 2008 and a grant from the U.S.-Israeli Binational Science Foundation. During his graduate studies, his papers "An Optimal Minimum Spanning Tree Algorithm" and "A New Approach to All-pairs Shortest Paths on Real-weighted Graphs" won Best Paper awards at *ICALP 2000 and 2002*. Prior to joining Michigan, he was a Humboldt Research Fellow at the Max Planck Institute for Informatics from 2003–2006. His research is published in the top journals in theoretical computer science, including the *Journal of the ACM* and *SIAM Journal on Computing*.

FAWWAZ ULABY

Emmett Leith Distinguished University Professor of Electrical Engineering and Computer Science

Fawwaz Ulaby, Chen-To Tai Professor of Electrical Engineering and Computer Science, was named Emmett Leith Distinguished University Professor of Electrical Engineering and Computer Science in honor of Prof. Emmet Leith (1927–2005), former faculty member of the department and inventor of practical holography. During his distinguished career, Prof. Ulaby served as U-M's Vice President for Research, he directed the NASA-funded Center for Space Terahertz Technology, and he was founding Provost for the King Abdullah University of Science and Technology. His many honors and awards include: member of the U.S. National Academy of Engineering; Fellow of AAAS and IEEE; William Pecora Award; NASA Achievement Award; Geoscience and Remote Sensing Distinguished Achievement Award; and the Thomas Edison Medal.

THOMAS F. WENISCH

Morris Wellman Faculty Development Professor

Thomas F. Wenisch's research is focused on computer architecture with particular emphasis on data center architecture, energy efficient server design, multiprocessor and multicore systems, multicore programmability, and performance evaluation methodology. Prof. Wenisch was the recipient of an NSF CAREER award in 2009 and has received grants from NSF, Intel, Google, HP, and ARM Limited. His work on "Making Address-Correlated Prefetching Practical" was recently featured in *IEEE MICRO Top Picks in Computer Architecture of 2009*. He is inventor on one patent and co-inventor on three patents. His research is published in top journals from *IEEE* and *ACM*.

New Faculty

HONGLAK LEE

Assistant Professor

PhD, Computer Science, Stanford University, 2010

Honglak Lee's research is focused on machine learning and its application across a broad range of perception challenges, from computer vision and robotics to speech recognition and natural language processing. His research is aimed at developing sophisticated algorithms for unsupervised and semi-supervised learning of hierarchical features for artificial intelligence and large-scale data mining applications. Other areas of interest include supervised learning, probabilistic graphical models, convex optimization, and high-dimensional data analysis.

JOHN C. SCHOTLAND

Professor

PhD, University of Pennsylvania, 1996

John Schotland's research is focused on theoretical optical physics with applications to biomedical imaging. Areas of current interest include wave propagation in random media, optics of nanoscale systems and quantum optics. Inverse problems, particularly inverse scattering problems, are a unifying theme which connects these areas. Prof. Schotland's primary appointment is with the Department of Mathematics, and he also shares an appointment in the Department of Biomedical Engineering.

Faculty Honors + Awards

NSF CAREER and Young Investigator Awards

Leaders and Best

MICHAEL CAFARELLA
2011 NSF CAREER Award
"Building and Searching a Structured Web Database"

MONA JARRAHI
2011 NSF CAREER Award
"Next Generation Photomixer-Based Terahertz Sources"

2010 DARPA Young Faculty Award
"Plasmonics-Enabled Ultra-Short Carrier Lifetime Photoconductors for High Power Terahertz Generation"

PEI-CHENG KU
2010 DARPA Young Faculty Award
"Nitride Semiconductor Single-Photon Emitters and Photon Entanglement"

RAJ NADAKUDITI
2011 ONR Young Investigator Award
"Fundamental Limits and Algorithms for Quiet Signal Detection, Estimation and Classification"

MINA RAIS-ZADEH
2011 NSF CAREER Award
"MEMS Reconfigurable Filters for Multi-Band Low-Power Radios"

SILVIO SAVARESE
2011 NSF CAREER Award
"Toward Discovering the 3D Geometrical and Semantic Structure of Objects and Scenes"

ZEESHAN SYED
2011 NSF CAREER Award
"Computationally Generated Biomarkers"

ZHENGYA ZHANG
2011 NSF CAREER Award
"Removing Energy Barrier Towards Capacity-Approaching Information Transmission and Storage"

Faculty Honors and Awards

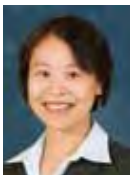
HKN Professor of the Year Award

ELLIOT SOLOWAY
2011

DAVID WENTZLOFF
2010

EECS Awards

ACHILLEAS ANASTASOPOULOS
Outstanding Achievement Award for service as Chair of the EE:Systems Graduate Program, for outstanding teaching evaluations, and for sustained research excellence.



MINGYAN LIU
Outstanding Achievement Award for outstanding contributions to teaching and mentoring of undergraduate and graduate students, and for innovative research in wireless networks.

SCOTT MAHLKE
Outstanding Achievement Award for innovative research in the fields of compilers and computer architecture to produce customized computer systems that overcome challenges in performance, power consumption and reliability.

MAHTA MOGHADDAM
Outstanding Achievement Award for outstanding contributions to teaching and mentoring of undergraduate and graduate students, and for world-renowned research in subsurface radar imaging.

AMIR MORTAZAWI
Outstanding Achievement Award for excellent service and accomplishments as EE Graduate Committee Chair for the past five years, as well as outstanding contributions to teaching, research, and service.

MICHAEL WELLMAN
Outstanding Achievement Award for outstanding service and teaching and innovative and groundbreaking research in computational market mechanisms for distributed decision making and electronic commerce.

College of Engineering Awards

MICHAEL BAILEY
Outstanding Research Scientist Award

JESSY GRIZZLE
Stephen S. Attwood Award

GREG WAKEFIELD
Service Excellence Award

VALERIA BERTACCO
Education Excellence Award

H.V. JAGADISH
Service Excellence Award

DAVID CHESNEY
Thomas M. Sawyer, Jr. Teaching Award

ERIC MICHIELSSEN
Research Excellence Award

MICHAEL FLYNN
Education Excellence Award

AMIR MORTAZAWI
Service Excellence Award

KHALIL NAJAFI, TED ZELLERS, YOGESH GIANCHANDANI, MICHAEL FLYNN, DENNIS SYLVESTER, KEN WISE
Ted Kennedy Family Team Excellence Award

Faculty Honors + Awards

University Awards

TONY ENGLAND
Exemplary Diversity Engagement and Scholarship Award (National Center for Institutional Diversity)

KHALIL NAJAFI and **KEN WISE**
Distinguished University Innovator Award (Office of the Vice President for Research)

JAMIE PHILLIPS
Undergraduate Teaching Award

TONY GRBIC
Henry Russel Award

KAMAL SARABANDI
Distinguished Faculty Achievement Award

AL HERO
Distinguished Faculty Achievement Award

BRIAN NOBLE
Undergraduate Teaching Award

DUNCAN STEEL
Distinguished Graduate Mentor Award

MAHTA MOGHADDAM
Faculty Recognition Award

TED NORRIS
Distinguished Graduate Mentor Award

KEN WISE
Technology Transfer Career Achievement Award (Office of Technology Transfer)

National and Professional Honors and Awards

DAN ATKINS was recognized with a University of Illinois College of Engineering Distinguished Alumni Award.

PETER M. CHEN has been named a Fellow of the Association for Computing Machinery (ACM), "for contributions to reliable storage and virtual machines."

SATINDER SINGH BAVEJA was elected as a Fellow of the Association for the Advancement of Artificial Intelligence (AAAI) for his significant contributions to reinforcement learning, including seminal theoretical results on algorithm properties and the foundations of dynamical system representations.

TONY GRBIC was awarded the 2011 Outstanding Young Engineer Award from the IEEE Microwave Theory and Techniques Society (MTT-S) for outstanding early career contributions to the microwave profession. He also received the 2011 Booker Fellowship from the United States National Committee of the International Union of Radio Science (USNC/URSI) for outstanding contributions to radio science.

PALLAB BHATTACHARYA was awarded the 2010 Welker Award from the International Symposium on Compound Semiconductors (ISCS) for exceptional research conducted in the field of compound semiconductors.

JESSY GRIZZLE was named a Fellow of the International Federation of Automatic Control (IFAC) Fellow for outstanding contributions to nonlinear control theory and to applications in automotive and robotic systems.

National and Professional Honors and Awards cont.

FARNAM JAHANIAN has been named a Fellow of the American Association for the Advancement of Science, "for his distinguished contributions to the dependability and security of network systems." He was also selected as the 2011 NEF Entrepreneur of the Year by New Enterprise Forum for his role in co-founding and growing security firm Arbor Networks.

DAVID KIERAS has been elected into the CHI Academy by the Association for Computing Machinery's Special Interest Group on Computer-Human Interaction (SIGCHI) for "extensive contributions to the study of HCI and the shaping of the field." He also received the Jack A. Kraft Innovator Award from the Human Factors and Ergonomics Society, "in recognition of his contributions in the area of computational models of human performance."

MARTHA POLLACK was re-elected to a three-year term on the Computing Research Association (CRA) Board of Directors.

DRAGOMIR RADEV was recognized as the North American Computational Linguistics Olympiad, which he co-founded, received the Linguistic Society of America's Linguistics, Language and the Public Award.

KAMAL SARABANDI received the 2011 IEEE Judith A. Resnik Award for contributions to space-based, microwave and millimeter polarimetric radar remote sensing of the Earth's surface for civilian and military applications.

DENNIS SYLVESTER was named IEEE Fellow for his contributions to energy-efficient integrated circuits.

Mark J. Kushner

Member, National Academy of Engineering

Medard W. Welch Award

Mark Kushner, George I. Haddad Professor of Electrical Engineering and Computer Science, has been elected to the National Academy of Engineering (NAE), class of 2011, "For contributions to low-temperature plasmas for semiconductors, optics, and thin-film manufacturing." Prof. Kushner is Director of the Michigan Institute for Plasma Science and Engineering (MIPSE), and he also directs the Department of Energy Plasma Science Center on Control of Plasma Kinetics, a collaboration of 10 universities and national laboratories. He has courtesy appointments in the Department of Nuclear Engineering and Radiological Sciences, and in the Applied Physics Program at Michigan.

Prof. Kushner was also presented with the 2010 Medard W. Welch Award from the American Vacuum Society (AVS) at the *AVS 57th International Symposium & Exhibition*. He received this award for outstanding contributions to modeling and physical understanding of plasmas, especially those used in thin-film etching, deposition, and surface modification.

Before coming to Michigan, Prof. Kushner served as Dean of Engineering at Iowa State University, where he established the Engineering Policy and Leadership Institute and initiated the 2050 Challenge to focus education, research, and outreach on addressing the most pressing of societal issues. Prior to this, he was a faculty member at the University of Illinois at Urbana-Champaign in the Department of Electrical and Computer Engineering. He served in many administrative roles at UIUC, including as Assoc. and Asst. Dean in the College of Engineering and head of Electrical and Computer Engineering.

Prof. Kushner's research area is low-temperature plasmas, their fundamental properties, their interaction with surfaces and their technological applications. His research group develops multi-scale computer models employing hybrid methods which combine a variety of computational techniques to address different physical phenomena. These modeling platforms are widely used by industry and university collaborators. His research group has also made significant advances in understanding the integration of plasma transport, chemistry, and surface interactions. His research addresses many impact areas of low-temperature plasmas, including lasers, lighting sources and displays, pulsed power, materials processing, dusty plasmas, biological and environmental applications, and feature evolution in microelectronics fabrication.

Faculty and Student Outstanding Paper Awards*

"A 47 Gb/s LDPC Decoder with Improved Low Error Rate Performance," by Venkat Anantharam, Borivoje Nikolic, Martin J. Wainwright and Prof. **Zhengya Zhang** received a Best Paper Award at the *2010 Symposium on VLSI Circuits*.

"A Compact Very Low Phase-noise Voltage-controlled-oscillator at X-band," by Morteza Nick and Prof. **Amir Mortazawi** received the Best Student Paper Award at the *2011 International Microwave Symposium*.

"Algorithms for Simultaneous Sparse Approximation. Part I: Greedy Pursuit," by Joel A. Tropp and Profs. **Anna Gilbert** and **Martin Strauss** received the Best Paper Award from the *European Association for Signal Processing*.

"D4AR Models for Automated Remote Progress Tracking and Support of Decision-enabling Tasks in the AEC/FM Industry," by Mani Golparvar-Fard, Feniosky Peña-Mora, and Prof. **Silvio Savarese**, was awarded the Best Student Paper Award at the *2010 6th International Conference on Innovation in Architecture, Engineering and Construction*.

"Disentangling Wireless Sensing from Mesh Networking," by **Thomas Schmid** (research fellow), Roy Shea, Mani B. Srivastava, and Prof. **Prabal Dutta** received the Best Paper Award at the *6th ACM Workshop on Hot Topics in Embedded Network Sensors*.

"Design and Evaluation of a Versatile and Efficient Receiver-Initiated Link Layer for Low-Power Wireless," by Prof. **Prabal Dutta**, Stephen Dawson-Haggerty, Yin Chen, Chieh-Jan Mike Liang, and Andreas Terzis received the Best Paper Award at the *8th ACM Conference on Embedded Networked Sensor Systems (SenSys)*.

"DoublePlay: Parallelizing Sequential Logging and Replay," by graduate students **Kaushik Veeraraghavan, Dongyoon Lee, Benjamin Wester, Jessica Ouyang**, and Profs. **Peter M. Chen, Jason Flinn**, and **Satish Narayanasamy** received the Best Paper Award at the *16th International Conference on Architectural Support for Programming Languages and Operating Systems (ASPLOS)*.

"High-Resolution, Low-Power Time Synchronization an Oxymoron No More," by **Thomas Schmid** (research fellow), Prof. **Prabal Dutta**, and Mani B. Srivastava received the Best Paper Award at the *9th ACM/IEEE International Conference on Information Processing in Sensor Networks*.

"LiteGreen: Saving Energy in Networked Desktops Using Virtualization," by Tathagata Das, Pradeep Padala, Venkata N. Padmanabhan, Ramachandran Ramjee, and Prof. **Kang G. Shin** received the Best Paper Award at the *2010 USENIX Annual Technical Conference*.

"Mapping of Sand Layer Thickness in Deserts Using SAR Interferometry," by EE graduate student **Adel Elsherbini** and Prof. **Kamal Sarabandi**, received second prize in the Student Paper Competition at the *2010 U.S. National Committee-International Union of Radio Science (USNC/URSI), National Radio Science Meeting*.

"Minimum Energy-per-Bit Wireless Multi-Hop Networks with Spatial Reuse," by **Changhun Bae** and **Wayne E. Stark**, received the 2011 Journal of Communications and Networks (JCN) Best Paper Award. The paper was published in a special issue of *JCN*, vol. 12 no. 2, 2010, pp. 101–113.

"Performance Bounds for Sparse Parametric Covariance Estimation in Gaussian Models," by Prof. **Al Hero III**, Alexander Jung, Dr. Franz Hlawatsch, and Dr. Sebastian Schmutzhard, received a Best Student Paper Award at the *2011 International Conference on Acoustics, Speech and Signal Processing (ICASSP)*.

"Properties of and Improvements to Time-Domain Dynamic Thermal Analysis Algorithm," by **Xi Chen,** Prof. **Robert Dick**, and Prof. Li Shang, received a Best Paper Award at the *2011 Design Automation & Test in Europe Conference (DATE)*.

"quFiles: The Right File at the Right Time," by **Kaushik Veeraraghavan**, Prof. **Jason Flinn**, Edmund B. Nightengale, and Prof. **Brian Noble** received the Best Paper Award at the *8th USENIX Conference on File and Storage Technologies.*

"SimPL: An Effective Placement Algorithm," by **Myung-Chul Kim, Dong-Jin Lee** and Prof. **Igor Markov**, received the IEEE/ACM William J. McCalla Best Paper Award at the *2010 International Conference on Computer-Aided Design (ICCAD)*.

"Techniques for Enhanced Distinction of Planar Retro-Reflective Arrays," by Prof. **Kamal Sarabandi** and **Jacquelyn (Jackie) Vitaz** (PhD EE '10), received first prize in the Student Paper Competition at the *2011 U.S. National Committee-International Union of Radio Science (USNC/URSI), National Radio Science Meeting*.

"The Distributed Constraint Satisfaction Problem: Formalization of Algorithms," by Makoto Yokoo, Prof. **Edmund H. Durfee**, Toru Ishisa, and Kazuhiro Kuwabara was awarded the Influential Paper Prize from the *International Foundation of Autonomous Agents and Multi-Agent Systems*.

*Names in **bold** are U-M faculty or graduate students, unless otherwise identified.

Staff Awards

Dr. Dennis Grimard, Managing Director of the Lurie Nanofabrication Facility, received the 2011 College of Engineering's Judith A. Pitney Staff Service Career Award, which recognizes the significant contributions of a single CoE staff member with at least 10 years of service.

Becky Turanski, Graduate Coordinator for the program in Electrical Engineering: Systems, received a 2011 College of Engineering Staff Excellence Award for sustained excellence during her time at the College of Engineering.

Connor Field: Solar Energy Farmer

Connor Field is banking on a future in solar power, and is already selling electrical energy he's converted from the sun's rays that fall on his field in western Michigan. In 2009, Connor and his father, attorney Sam Field, decided to take advantage of a program offered by Consumer's Energy to sell renewable energy to the company at a fixed price. They planned and built what is now the largest solar energy farm in Michigan, in Charleston Township.

He's combining a major in economics with a second major in electrical engineering to learn more about the photovoltaic materials that are used in solar panels. "The more I learn about the actual technology of the panels and other equipment, the better off I am," said Connor. He will also be participating in the Summer Undergraduate Research in Engineering (SURE) program this summer working with Prof. Jamie Phillips on the project, "Solar Cell Device Making."

Following the recommendations of a National Renewable Energy Lab study, Connor designed a rack system that allows the solar panels to be set at different angles seasonally to take maximum advantage of the position of the sun. His farm is the most efficient of the large arrays in the state due to its unique adjustable angle racking system.

"The solar market is just coming into its own," said Connor. "For the past 30 years or so there weren't enough players in the market to drive the costs down or to innovate at the production level. In recent years, regulatory changes in Europe have caused much larger demand for the actual solar equipment, which provides more incentive for people to get into the market and start producing in new and innovative ways. Through that experimentation I think costs are going to come down dramatically."

Connor has already seen a significant reduction in the price of solar panels since he started his solar energy business. With his engineering and economics background, combined with his enterprising spirit and passion for renewable energy, Connor is set to make a real difference in the renewable energy industry in Michigan.

Michigan Mobile Phone Ensemble Continues to Break New Ground

The Michigan Mobile Phone Ensemble, a group of students that uses software on iPhones and iPads to enable multimedia performance art, has performed three times this year while expanding the sophistication and breadth of their performances. The group, led by Prof. Georg Essl, participated in an original theatrical piece written with the ensemble in mind for the Center for Performing Arts Technology's 25th Anniversary. They also expanded the novel use of sensors and projection in their fall and winter recitals.

1,000 Pitches THINK BIG.

Students Toss Best Pitches

This year's 1,000 Pitches contest drew participation from over 3,000 students, with winning prizes going to the business plans of two students from EECS. Keith Porter (CE undergrad) won in the category *Michigan Matters* for his project, "Metro Detroit Computer Exchange," a computer sales business model that incorporates providing exchanged computers as donations. Patrick Theisen (CS undergrad) won in the category *Best Mobile App* for his project, "miParty," a party-tracking app lists all registered campus fraternity parties in one location.

Keith Porter

Patrick Theisen

Student News

Autonomy Team Takes Home 1st Prize

Michigan's Autonomy team took first place in both the static judging and race categories at the 3rd International Autonomous Surface Vehicle Competition (ASVC) conducted by the Association for Unmanned Vehicle Systems International and the Office of Naval Research. With electrical and computer engineers figuring heavily in this year's team, they came in ahead of two-time defending champion University of Central Florida.

In this student robotics competition, teams raced ASVs of their own design through an aquatic obstacle course which required littoral area navigation, channel following, and autonomous docking. Ryan Wolcott, the team's electrical lead, stated, "Once we built up a decent foundation of EECS students, everything started to fall into place. We had the ability, unlike several other teams, to log practice run data and reuse it to fully stress test our autonomous platform; we could go through several different scenarios and software changes and see how the vehicle would respond. EECS students combined to design and assemble the electronics box, wire the entire vehicle, and develop software for our autonomous platform."

Interdisciplinary Teams

MRacing Team Drives to Finish in Formula Student Germany

The MRacing Team finished an impressive second of 91 teams in the international Formula Student Germany competition. The students finished first in acceleration, going from 0 to 70 mph in 3.9 seconds, second in endurance, and third in autocross. Formula SAE rated them the number one student team in America and number three in the world.

In charge of the electronics were Jacob Oberlin (BSE CE, CSE graduate student), who was also the Chief Powertrain Engineer, and Nathan Lusk (EE/ME undergraduate student and 2011 team captain).

Among Oberlin's responsibilities were wiring harness construction, engine tuning, and data acquisition. He stated, "during competition it was my responsibility to be out on track watching the live telemetry feed on a laptop and radioing the driver if something needed to be changed. We use one of the most advanced electronics control systems in FSAE." During the endurance race in Hockenheim, Oberlin told the second driver Garret Huff to turn up the traction control in order to conserve fuel. They finished the race with approximately 0.5L of fuel left out of a 7L tank.

Lusk has taken on the responsibility of team caption for the 2011 racing season, as well as continuing to contribute to the electronics of the car along with Eli Atkins (EE undergrad).

Solar Car Team Wins American Solar Challenge – Gears Up for World Solar Challenge!

With clock speeds reaching 100 mph in testing, Infinium raced to its 3rd consecutive win at the 2010 American Solar Challenge, finishing more than two hours ahead of its nearest competitor. This marked the sixth North American title for the team.

The team is now actively perfecting the next car, Quantum, for the 1,800-mile World Solar Challenge across the Australian outback in October. The team has reached third place four times in the World Solar Challenge, and this year is pushing hard for the win. Quantum is a solar-powered electric vehicle with an aerodynamic and light carbon fiber body, a high-performance battery and energy-efficient regenerative braking. To reach their goal of making Quantum fast and light, the team weighed every single part of Infinium, even the bolts and individual wires, and reduced the weight of Quantum wherever possible.

Infinium crosses the finish line and wins the 2010 American Solar Challenge.

Among the many EECS students on the team are Ryan Mazur (EE), Jonathan Meed (CE), and Paul Sorenson (EE). Ryan was a driver of Infinium during the American Solar Challenge, and will be a driver in the World Solar Challenge this year. He leads the micro-electrical engineering division of the team, which includes the Battery Monitoring System, driver controls in the steering wheel, the telemetry system, software, printed-circuit boards, and the motor controller. Jonathan is a Micro, meaning he's a member of the micro electrical group. "We develop custom solutions for everything from our Battery Protection System to a Lighting Board, to a Steering and Display Board and even a board that sends out all the cars vital information like battery voltage and speed over wifi to our chase vehicles," stated Jonathan. As a "Power Electrical," Paul works on the power electrical systems. Power electricals are responsible for the high-voltage systems, including the battery and solar panel array. Paul designed and built the battery pack for Quantum as head of the battery division.

Ryan Mazur (EE) at the wheel of Quantum, Jonathan Meed (CE) at the computer.

Team Michigan Wins MAGIC and $750,000!

Team Michigan, a team of more than 20 students led by Prof. Edwin Olson, won a $750,000 grant for finishing first in the 2010 Multi Autonomous Ground-robotic International Challenge (MAGIC). Sponsored by the U.S. Department of Defense and its Australian counterpart, MAGIC challenged academic and industry participants from around the globe to develop and demonstrate emerging unmanned technologies that could close the technology gap faced today in urban combat zones, rescue situations, and other scenarios where human participation is not safe or feasible.

Prof. Edwin Olson, Rob Goeddel, Pradeep Ranganathan, Andrew Richardson, Ryan Morton, Mihai Bulic, Johannes Strom, Andrew Dallas (Soar Tech)

The MAGIC competition took place in stages over more than two years, and initially involved 23 teams. The final stage took place between the top five teams, including Team Michigan, at a location in Australia that was undisclosed until shortly before the event.

Over the two-year course of MAGIC, Prof. Olson and his student team faced the task of visualizing, specifying, building, and refining a number of autonomous robots that would be able to communicate with each other and operate with minimal human involvement, and which would be able to complete the competition's indoor and outdoor surveillance and reconnaissance missions, which included identifying friendly and unfriendly humans and locating and disabling mock bombs in the field without harming simulated civilians.

Prof. Olson decided early on that his strategy would include fielding the largest number of robots, built from commodity parts, with the primary R&D focus on the robots' distributed artificial intelligence and advanced perception sensor processing technology. The strategy worked beautifully, and the team fielded a highly cooperative "swarm" of 14 robots in the final stage that efficiently mapped the 500-meter by 500-meter indoor/outdoor game arena and swiftly accomplished mission objectives.

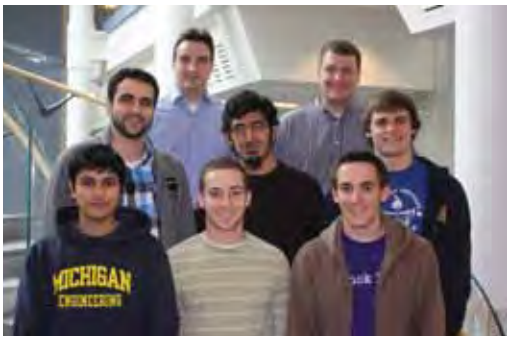
Robots enter the field in Australia.

EECS Students Create Apps for U-M

In two stories that highlight student creativity, the strength of the mobile apps development movement at U-M, and a fundamental shift in the way software is developed, two separate groups of EECS students have created mobile applications that have been purchased by the University for use as official apps.

Mark Yang and Kevin Chan

The "Michigan" iPhone app, which is available in iTunes, was originally created by Kevin Chan and Mark Yang as a project in Prof. Elliot Soloway's Mobile App Development class in Winter 2010 (both have since graduated). The app allows you to search for someone in the U-M directory, navigate campus, access the Magic Bus system, and even check out what's being served in the dining halls.



Front: Apoorva Bansal, Stephen Wald, Matthew Viscomi

Middle: Nader Jawad, Yousuf Jukaku, Daniel Jonik

Back: Advisors Jeff Fleszar, Jeff Ringenberg

In addition, the team of undergrads Apoorva Bansal, Daniel Jonik, Matthew Viscomi, Nader Jawad, Yousuf Jukaku, Stephen Wald, and Andrew Hainen (Art & Design) have now created "Mobile CTools," which allows for quick, clean, and easy access to CTools pages from iOS and Android mobile devices with a focus on a user-friendly UI and intuitive navigation controls. The application provides users with a set of frequently used tools for each of their CTools sites including resources, announcements, and assignments. The University purchased Mobile CTools from the students and expects to release it as an official app sometime in the summer of 2011.

EECS Courses + Contests

Several companies supported contests in EECS courses during the past academic year. Students enjoy the added incentive as well as seeing how relevant their projects are to industry.

EECS 413: Monolithic Amplifier Circuits
Prof. Michael Flynn
Sponsor: Cirrus Logic Inc.

Aswin Rao, Abishek Madhavan, Karan Singh Jain

1st Place: "A High PSRR, Low Drop-Out Voltage Regulator using Feed-forward Ripple Cancellation," by **Karan Singh Jain, Abishek Madhavan, Aswin Rao**

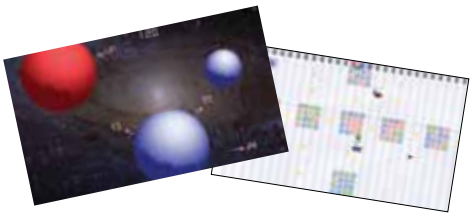
2nd Place: "A 1.2ps Resolution, 76dB Dynamic Range Time-to-Digital Converter Based on a Tunable Vernier Delay Line," by **Suyoung Bang, Dongsuk Jeon, Yejoong Kim**

EECS 494: Computer Game Design and Implementation
Prof. John Laird
Sponsors: Electronic Arts, Firaxis, Microsoft, and Quantum Signal LLC, Reactor Zero Division

1st Place: "The Great Shape Escape," by **Adam Aleksa, Jeffrey Ellis, Joshua Feldman, Stuart VanderBrink**

2nd Place: "Gravity Clash," by **Benjamin Carpenter, Blaine Dietrich, John Bogusz**, **Ryan Resig**

3rd Place: "Kart Attack," by **Noah Judson, Brian Chase**, **Ernest Gillard**



EECS 425: Integrated Microsystems Laboratory
Prof. Euisik Yoon
Sponsor: Center for Wireless Integrated MicroSystems (WIMS)

1st Place: "Thermally-Actuated Micro-Robotic Arm with Large Linear and Rotational Motions," by **Tae H. Kim, Fan Wu, Po-Chia Lai, Rranay Rai**

2nd Place: "Electro-Thermally Actuated MEMS Variable Optical Attenuator," by **Matthew Kim Stites, Aditya Sharma, Ravish Malhotra, Anupam Viswanath**

AMD/Michigan Student Design Contest

Anuj Chandawalla, Sonal Verma, Durgesh Deshpande, Neel Natekar, Maksym Kloka

EECS 427: VLSI Design I
Prof. Zhengya Zhang
Sponsor: AMD

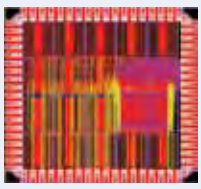
1st Place, Best Project: "Design and Implementation of a 4k Embedded 3T DRAM," by **Anuj Chandawalla, Durgesh Deshpande, Maksym Kloka, Neel Natekar, Sonal Verma**

2nd Place, Most Innovative Project: "Low Power Sub-Threshold 400mV SRAM," by **Haidar Aizat, Kai Boon Ee, Karan Jain, Aswin Srinivasa Rao, Indusekar Reddy**

3rd Place, Best Engineering: "Power and Speed Optimized 16-bit Processor with Out-of-Order Instruction Execution," by **Adam Brackmann, Saurabh Chauhan, Zhen Liu, Abhishek Roy, Ahsen Tahi**

EECS 627
Prof. Dennis Sylvester
Sponsor: AMD

1st Place: "Low-power Variation-Tolerant Compressive Sensing ASIC for Wireless Sensor Nodes," by **Abhishek Roy, Kunal Garg, Phil Knag, Zhen Liu, Praveen Kalish**



2nd Place: "Wolverine: Modified D Flip-Flop for Timing Error Detection in Pipe-Line Processors," by **Inyong Kwon, Josh Kim, Myungbo Kim, Yen-po Chen**

EECS 511: Integrated Analog/Digital Interface Circuits
Prof. Michael Flynn
Sponsor: Analog Devices

1st Place: "A 6-bit 10 GS/s Time-Interleaved 2 bit/step SAR ADC," by **Jaehun Jeong, Seokjun Park, Dongmin Yoon**

2nd Place: "An Energy-Efficient 9-bit Charge Pump Based Pipelined ADC," by **Bharan Giridhar, Amir Javidi, Gyouho Kim**

EECS 556: Image Processing
Prof. Jeff Fessler
Sponsor: KLA-Tencor

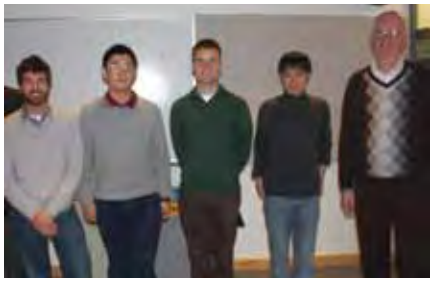
"Detection of Defects in Integrated Circuits," by **Xiyu Duan, Chris Fink, Hao Sun, Meng Wu**

"Using Optical Flow Plane Detection and Depth Maps for Augmented Reality," by **Leng-Chun Chen, Yu-Hui Chen, Yi-Sing Hsiao, Srinath Sridhar**

Clock Network Synthesis Winners

Myung-Chul Kim and **Dongin Lee** (both EE graduate students) received awards in two recent competitions. In March 2010, the pair won first place in the 2010 Clock Synthesis Content at the *ACM International Symposium on Physical Design (ISPD)*. Kim and Lee were advised by Prof. Igor Markov on the project. This victory is the second in a row for Lee and Markov at ISPD. In November 2010, Kim and Lee (again advised by Markov) placed second in the 2010 CADathlon, an all-day programming competition organized by the ACM Special Interest Group on Design Automation at the *Int. Conference on Computer-Aided Design (ICCAD)*.

2010 Graduate Student Honors Competition Highlights Exceptional Research



Andrew DeOrio, Xiaodi Wu, James Boerkoel, Feng Qian, and Prof. John Hayes

EECS held its Seventh Annual CSE Graduate Student Honors Competition on December 8. CSE faculty and a guest judge from Harris RF Communications ranked the finalist's presentations.The finalist in each area and their final standings were: Feng Qian, Software (First place); Andrew DeOrio, ACAL (Second place); James Boerkoel, AI (Honorable mention); Xiaodi Wu, Theory (Honorable mention).

U-M Programming Team Places Second in ACM World Competition

Asst. Coach Dennis Matveyev, Jonathan Plotzke, Mark Gordon, Qifeng Chen, and Coach Kevin Compton

A team of three EECS students has placed second in the highly competitive 2011 ACM International Collegiate Programming Contest, which took place May 27–31 in Orlando, FL. The largest and most prestigious computer programming competition in the world, the competition challenges university students with complex and rigorous real-world problems using open technology and advanced computing methods under grueling deadlines.

The U-M team was one of only two teams to solve all eight problems in the competition, and was one of only four top teams to receive gold medals. 8300 teams from 1900 universities competed in the early rounds of the competition.

Ye-Sheng Kuo

ISLPED Design Contest – 1st Place

Ye-Sheng Kuo (CSE graduate student), Thomas Schmid (CSE post-doctoral researcher), and Prof. Prabal Dutta won first place in the 2010 ISLPED Low Power Design Contest for their design, "Hijacking Power and Bandwidth from the Mobile Phone's Audio Interface."

HKN Outstanding Chapter Award

Lauren Bridge, Matt McCullough, Matt Hilk, Yi Li, Trevor Hunter (VP), Randy Yao, Matt Lauer (President), Maya Spivak, and Kyle Lady

U-M's Beta Epsilon Chapter of Eta Kappa Nu (HKN), the Electrical and Computer Engineering Honor Society, received the national Outstanding Chapter Award for 2009–2010, the sixth straight win for our EECS students! Some of the events they were involved with during that year were outreach efforts in local elementary schools, industry talks to EECS students, managing and running the dB Café, and many social activities.

2010 Graduate Symposium Awards

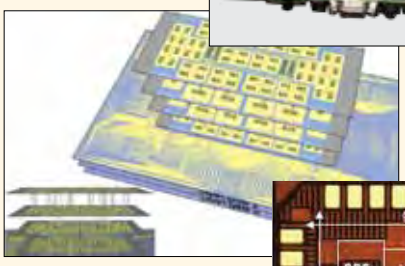
More than 80 research posters were presented by graduate students in Electrical and Computer Engineering at the *2010 College of Engineering Graduate Symposium*, November 12, 2010. Students earned first and second place prizes in each technical session (see www.eecs.umich.edu/eecs/ece/symposium for the names).

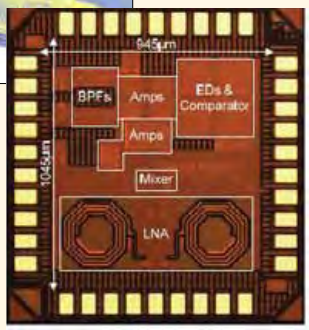
The 2011 Graduate Symposium will be held Friday, November 11, 2011.
The public is invited to come see the exciting research being done by our graduate students.

Outstanding PhD Student Research Award — Scott Rudolph, EE, "A Broadband Three-Dimensional Isotropic Negative-Refractive-Index Medium," 2nd place and $2,500.

Symposium Theme Award — Abdi Zeynu, EE:Systems, "Wind Farm Reactive Support and Voltage Control," 2nd place.

2011 DAC/ISSCC Student Design Contest





Three teams were named winners in the 2011 Design Automation Conference (DAC)/ International Solid-State Circuits Conference (ISSCC) Student Design Contest, a highly competitive international contest for the design of electronic systems. This is the first time three winners have come from the same institution. The winning projects are:

Design and Implementation of Centip3De, a 7-layer Many-Core System, by graduate students **David Fick, Ronald G. Dreslinski, Bharan Giridhar, Gyouho Kim, Sangwon Seo, Matthew Fojtik, Sudhir Satpathy, Yoonmyung Lee, Daeyeon Kim, Nurrachman Liu, Michael Wiekowski, Gregory Chen** and **Profs. Trevor Mudge**, **Dennis Sylvester**, and **David Blaauw.**

Centip3De stacks circuits in 3D to simultaneously save energy and increase performance in ultra high performance, energy efficient, general purpose computing.

A Flexible Wireless Receiver System with a 7b 21 MS/s Filtering SAR ADC, by graduate students **David T. Lin, Li Li, John Bell, Ming-Hao Wang**, and **Prof. Michael P. Flynn**.

This complete wireless receiver system is able to adapt to its environment and to different communication standards.

A 1900MHz-Band GSM-Based Clock-Harvesting Receiver with -87dBm Sensitivity, by graduate student **Jonathan K. Brown** and **Prof. David D. Wentzloff**.

In this project, a clock-harvesting receiver designed for low-power wireless sensor nodes takes the place of a wake-up receiver to conserve the maximum energy possible.

The Year of the Hackathon

2010/2011 was the year of the hackathon at U-M, as students participated in a range of programming events in increasing numbers. These events expose students to new programming and team experiences and in some cases have led to commercial ventures. Following is a summary of programming events sponsored by the Department this year; in all of these events, EECS students led the way!

- **U-M Mobile App Challenge:** This university-wide competition was held twice, in Fall and Spring. EECS grad students Ye-sheng Kuo and Sonal Verma, along with CS-LSA undergrad Jordan Schneider won first place in the fall for their project “HiJack,” and the ASK Applications team (see related story on p. 20) won first place in the Spring for “ASK Messaging.”
- **Yahoo! Hack U:** Student teams participated in a three-day lecture series on open Web technologies and a 24-hour hack session that produced 20 projects; EECS grad student Avishay Livne won first place with “Crowd Wisdom for Crosswords.”
- **48-Hour Mobile Hackathons:** Prof. Elliot Soloway has been a force in encouraging mobile app development at U-M. He held two 48-hour hackathons this year, in which interdisciplinary student teams created over 20 functioning iOS and Android apps. Almost half of the apps from this competition have gone commercial!
- **Facebook Camp Hackathon:** Over 30 students learned about Facebook technology and participated in this Facebook-sponsored 24-hour hack session.
- **OnStar Student Developer Challenge:** EECS students attended a lecture on developing for the OnStar voice recognition system and developed apps in a multi-competition that continued through the Winter term.
- **iOS Showcase:** Apple and student group CSE Scholars sponsored a showcase of student developed iOS apps in the Winter term; 14 original projects were developed and demoed in a special event.

Individual Honors and Awards

Ruzbeh Akbar (EE graduate student) received a 2010 NASA Earth and Space Science Fellowship for the project, "Development of an integrated radar-radiometer estimation algorithm for retrieval of soil moisture from SMAP."

Lan Bai (CSE graduate student) received a 2011 Anna Olcott Smith Award from the U-M Rackham School of Graduate Studies for her work in automating the design of wireless sensor networks.

Guha Balakrishnan (CS undergraduate student) received a 2011 NSF Graduate Research Fellowship to support his graduate studies.

Iverson Bell (EE graduate student) was awarded a 2011 NSF Graduate Research Fellowship for research in the area of propulsion for Space applications.

Sid Yingze Bao (EE graduate student) received a 2011 Rackham International Student Fellowship.

Chris Berry (EE graduate student) received a 2011 Michigan Space Grant Consortium (MSGC) Fellowship for research in the area of terahertz technology for Space applications.

James Boerkoel (CSE graduate student) received a 2011 Rackham Predoctoral Fellowship to support his work in building assistive computational agents.

Brian Buss (EE graduate student) was awarded a 2010 NSF Graduate Research Fellowship for research in controlling glucose levels in ICU patients by using control theory.

Debapriya Chatterjee (CSE graduate student) received a 2010 NVIDIA Graduate Fellowship for his work in developing EDA applications for GP-GPU platforms.

Tanya Das (EE undergraduate student) was selected as third place winner in the 2011 Roger M. Jones Poetry Contest.

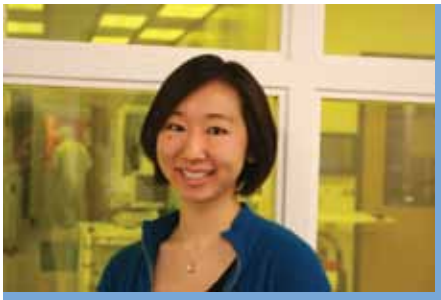
Andrew DeOrio (CSE graduate student) received a 2010 Intel Corporation PhD Fellowship to support his research into the correctness of digital hardware designs.

Nate Derbinsky (CSE graduate student) received a 2011 Rackham Predoctoral Fellowship to support his work in developing long-term memories for artificial intelligence.

Jeffrey Duperret (CS undergraduate student) received a 2011 NSF Graduate Research Fellowship to support his graduate studies.

Joe Greathouse (CSE graduate student) received the Best Student Presentation Award at the 2011 International Symposium on Code Generation and Optimization for "Highly Distributed Dataflow Analysis."

Xin Hu (CSE graduate student) received a 2010 Yahoo! Key Scientific Challenges Program Award for his research in network security.



Anne Itsuno (EE graduate student) was awarded a 2010 NSF Graduate Research Fellowship for research in infrared photodetector devices.

Student News

Individual Honors and Awards cont.

Daya Khudia (CSE graduate student) received a 2011 Rackham International Student Fellowship to support his research into new post-silicon validation solutions.

Gyouho Kim (EE graduate student) received a 2011 Rackham International Student Fellowship.

Hongwei Liao (EE:S graduate student) was awarded a 2011 Rackham Predoctoral Fellowship.

Yong Long (EE:S graduate student) was selected as a 2011 Barbour Scholar.

Mojtaba Mehrara (CSE graduate student) received a 2010 Rackham Predoctoral Fellowship to support his work on compiler technology.

David Meisner (CSE graduate student) received a 2011 Yahoo! Key Scientific Challenges Award to support his research into technologies to reduce power consumption at data centers.

Ashutosh Nayyar (EE:S graduate student) was awarded a 2010 Rackham Predoctoral Fellowship.

Jungsuek Oh (EE graduate student) was awarded a 2011 Rackham Predoctoral Fellowship.

Patrick O'Keefe (EE:Systems graduate student) was awarded a 2010 NSF Graduate Research Fellowship for research in human computer interaction.

Sung Ho Park (EE undergraduate student) was awarded a 2011 Microwave Theory and Techniques Society Undergraduate/ Pregraduate Scholarship.

Amit Patel (EE graduate student) was awarded a 2010 Science, Mathematics & Research for Transformation (SMART) Fellowship to support his research in of Applied Electromagnetics.

Scott Rudolph (EE graduate student) was awarded a 2010 Rackham Predoctoral Fellowship.

Sonal Verma (EE graduate student) was awarded a 2011 Microsoft Graduate Women's Scholarship.

Matthew Tomes (EE graduate student) was awarded a 2010 NSF Graduate Research Fellowship for research in Brillouin MEMS.

Eric Wustrow (CSE graduate student) received a 2011 NSF Graduate Research Fellowship to support his studies in computer security, electronic voting, and government transparency.

Fan Wu (EE graduate student) was awarded a 2010 NSF Graduate Research Fellowship for research in BioMEMS.

Zhengzheng Wu (EE graduate student) received a 2011 Rackham International Student Fellowship.

Kevin Xu (EE:S graduate student) was awarded a 2010 Natural Sciences and Engineering Research Council of Canada (NSERC) Fellowship for research on the topic "Inference in Dynamic Networks for Prediction of Epidemics."

EECS and CoE Awards for 2010 and 2011

Undergraduate

CoE A.D. Moore Award
Caroline Thompson (EE)

CoE Arlen R. Hellwarth Award
Colleen Budd (EE)

CoE Cooley Writing Prize
Calvin McCarter (CS)

CoE Distinguished Achievement Award
Guha Balakrishnan (CE/CS)
Michael Hand (EE)
Peter Ludwig (CS)
Kevin Matzen (CE/CS)
Hongyu Wang (EE)

CoE Epeians Emerging Leader Award
Ajay Suresh (CE)

CoE Henry Ford II Prize
Michael Hand (EE)

CoE Hugh G. Rumler Prize
Tyler Johnson (EE)
Adhiraj Vable (EE)

CoE Mildred & Steele Bailey Prize
Adhiraj Vable (EE)

EECS Commercialization/ Entrepreneurship Award
Jason Bornhorst (CS)
Chen-Yue Zhang (EE)

EECS Instructor's Aide Award
Alexandra Holbel (EE)
Doug Li (CE)
Joshua Musick (CS)
Cassandra Yaple (CS)

Honorable Mention
Pat Pannuto (CSE)

EECS Outstanding Research Award
Guha Balakrishnan (CE/CS)
Mihai Bulic (CS)
Meng Wu (EE)

EECS Outstanding Service Award
Colleen Budd (EE)
Matthew Chegash (CS)
Erica Christensen (CS)
Tyler Johnson (EE)
Anthony Lucchesi (CE)

EECS Richard K. Brown Memorial Scholarship
Zihong Lian (EE)
Daniel Miller (EE)

EECS Senior Outstanding Achievement Award
Rebecca Frank (CE)
Ernest Gillard (CS)
Mark Gordon (CS)
Michael Hand (EE)
Tyler Johnson (EE)
Bradley Rubin (CE)

EECS William Harvey Seeley Prize
Michael Hand (EE)
Paul Rigge (CS/EE)

EECS William L. Everitt Student Award of Excellence
Guha Balakrishnan (CE/CS)
Kevin Matzen (CE/CS)
Shihan Qin (EE)
Maya Spivak (CE)
Robert Steen (CS)
Hongyu Wang (EE)

Graduate

CoE Distinguished Achievement Award
Amin Ansari (CSE)
Etham Aktakka (EE)
Amir Hormati (CSE)
Hongwei Liao (EE:S)
David Shuman (EE:S)
Eric Tkaczyk (EE)

CoE Distinguished Leadership Award
Khaled AlAshmouny (EE)
Nate Derbinsky (CSE)
Daniel Fabbri (CSE)
Paul Hou (EE)

CoE Outstanding Student Instructor Award
Kyla McMullen (CSE)

Arjun Chandran Memorial Scholarship
Bharan Giridhar (EE)

EECS Graduate Student Instructor (GSI) Award
Yuriy Goykhman (EE)
Jin Hu (CSE)
Awlok Josan (EE:S)
Sanghoom Kim (EE:S)
Justin Li "Ning Hui" (CSE)
Morteza Nick (EE)

Honorable Mention
Rob Cohn (CSE)
Zhaori Cong (EE:S)
Alexandra Holbel (EE)
Sammy Lee (EE:S)
Amit Patel (EE)
Joshua Smith (CSE)
Andres Tamez (EE)
Pravalika Vinnakota (EE:S)
Eric Wustrow (CSE)

Yahoo! GSI Award for CSE Students
Amjad Abu Jbara
Andrew Jones
Alex Kuhn
Flavio Kuperman
Jordan Marchese
Robert Perricone
Andrew Richardson
Joshua Smith

Alumni News

A Message From the Alumni Society President

Dear Fellow Maize and Blue EECS Alumni,

With each passing year, I become increasingly amazed at what we have done! Everywhere I look I see the great accomplishments of our alumni, future alumni, and faculty in EECS: from award-winning student teams to research breakthroughs, from new companies to new business leaders, and from astronauts to local volunteer efforts. Thanks to today's professional and social networking tools including Linked In and Facebook, it is easier than ever to stay connected with the EECS Department and your fellow alumni. Take a look at our sites to follow these accomplishments, and don't be bashful about sharing your great news! Join us for Homecoming, stop by the EECS Department whenever you are in town, or get together with fellow alumni. No matter where you are, I hope that you continue to stay connected and wear your Maize and Blue – you are sure to find a fellow Wolverine nearby.

Jamie Phillips (right) with Dhani Jones, NFL linebacker and former U-M linebacker. Jones returned to Michigan to talk about social entrepreneurship and to raise money for U-M C.S. Mott Children's Hospital.

Go Blue!

Jamie Phillips
President, EECS Alumni Society

Homecoming in EECS

Friday, October 28, 2011

8:30 am	Continental Breakfast
9:00 am	EECS Alumni Society Meeting
11:00 am	EECS Merit Award Winner Talk
12:00 pm	Lunch
1:00 pm	EECS Merit Award Winner Talk

College of Engineering Homecoming Events

Friday, October 28, 2011

2:00 pm	Tours
3:00 pm	Apollo 15: Michigan on the Moon
4:00 pm	College of Engineering Barbecue

Saturday, October 29, 2011

Michigan Engineering Tailgate Football Game: U-M vs. Purdue

Homecoming 2011
Our Merit Award Winners for 2011

SYED ALI
MSE EE '81
Chairman, President, CEO, and Founder
Cavium Networks, Inc.

MARK ABEL
BSE EE '79
Associate GM of Software Services and Director of Pathfinding and Innovation
Intel Corporation

Each alumnus will give a special talk to returning alumni, faculty, and students.

Stay Informed About EECS News + Events

You can now receive the Department's Friday morning email message that lists upcoming events and the news items posted on the Web during the past week.

From the homepage, click on the link for Events or News, and follow the option to Subscribe at the bottom of the page.

Learn About Alumni-Related Events

The U-M Alumni Society offers many events of interest to alumni. These include Leaders and Best Seminars held on campus, Quick Study Lectures held on campus and streamed online, and educational programs across the University that are listed in the Online Catalog.

Visit umalumni.com/lifelonglearning.

Distance Learning Opportunities

EECS faculty offer several online courses for engineering professionals and students. For available courses, see http://interpro.engin.umich.edu and click on the link for Online Courses. This Fall, for example, we will offer courses in optics, MEMS, digital communications, high-tech entrepreneurship, and production systems engineering.

2010 COE MERIT AWARD WINNER (ECE)

Frederick (Rick) W.W. Bolander *(BSE EE '83, MSE EE '85)*

David C. Munson, Jr. (Dean, College of Engineering), Rick Bolander, Khalil Najafi (Chair, Electrical and Computer Engineering)

Rick Bolander is Managing Director and co-founder of Gabriel Venture Partners, an early-stage venture capital firm that is helping build innovative, profitable, and sustainable companies in the Internet, information technology, communications, and cleantech sectors.

Mr. Bolander received an MBA from Harvard University after completing his graduate studies at the University of Michigan. He began his investment career in residential real estate after launching Blue Sky Ventures, and began to define his career in venture capital when he joined Apex Investment Partners as a General Partner.

A hands-on, forward-thinking investor, Mr. Bolander has been involved in more than 50 venture deals, and has led over $100 million in early-stage financings in the areas of digital media infrastructure and applications, communications, information technology and the Internet. Among these are AccessLine, Chegg, IPWireless, NetScaler and Kajeet.

Mr. Bolander continues his passion for entrepreneurship, supporting the University by leading sessions at the University of Michigan Boot Camp for Entrepreneurs and serving as a board member for the Center for Entrepreneurship. He endowed the George I. Haddad Innovators Scholarship, and has incubated an accredited academic program on campus that takes students into the community to assist at-risk youth. In his spare time, he can be found cheering on the Wolverines or climbing a mountain (he's already made it to the top of Mt. Kilimanjaro, Mt. Rainer, and Mt. Batur).

2010 COE MERIT AWARD WINNER (CSE)

Dr. Timothy A. Howes *(BSE AS '85, MSE CSE '87, PhD CSE '96)*

Dr. Tim Howes is the co-founder, Chairman, and CTO at RockMelt, Inc., which develops a proprietary Web browser of the same name that integrates a unique technique for surfing the Web, delivering search results, and integrating social media.

Dr. Howes is the co-inventor (while at Michigan) of the Lightweight Directory Access Protocol (LDAP), the Internet directory standard. After completing his Ph.D. at U-M in 1996, Dr. Howes joined Netscape as Directory Architect. He later became CTO of Netscape's server products division and a Netscape Fellow.

In 1999, Dr. Howes co-founded Loudcloud, an early cloud services provider. In 2002, Loudcloud shifted businesses to data center automation and was renamed Opsware. At Loudcloud/Opsware, he served in the role of CTO and ran engineering and operations off and on. In 2007, Opsware was acquired by Hewlett-Packard for $1.65 billion, and Dr. Howes became Vice President and CTO of HP Software, HP's $3B software division. In October 2008, he left Hewlett-Packard to co-found RockMelt.

Dr. Howes has also served on the boards of Blue Coat Systems and SF Jazz, and on the Internet Architecture Board. He lives in Los Altos Hills, CA with his wife and two daughters.

2010 COE RECENT ENGINEERING GRADUATE AWARD (CSE)

Nick Yang *(BSE EE '97)*

David C. Munson, Jr. (Dean, College of Engineering), Nick Yang

Mr. Nick Yang is the founder and Vice Chairman, Kongzhong Corp, and Founder and CEO of Wukong.com (Monkey King Search Limited).

After graduating with his bachelor's degree from Michigan, Mr. Yang received a master's degree in electrical engineering from Stanford. Upon graduation from Stanford, he raised $250,000 in capital from about 20 of his classmates, and started his first company, ChinaRen Inc., a Chinese community site based in China. He served as Chief Technology Officer at ChinaRen until October 2000, when the company was sold to Sohu.com, Inc. for $35 million.

In 2002, Mr. Yang left Sohu and co-founded KongZhong, a mobile Internet business that provides wireless value-added services. KongZhong has become one of China's leading mobile Internet companies. Kong Zhong IPOed on NASDAQ in July of 2004 after only 2 years and 2 months of operation, becoming the fastest company in China to list on any exchange. In 2010, he started his third venture, Monkey King Search.

A former member of the University of Michigan's Solar Car Team, Mr. Yang was also a member of Eta Kappa Nu. When he isn't out conquering business obstacles, he collects art, plays golf, follows Manchester United, England's premier football club, and enjoys family time. He is a Venture Partner at ePlanet Capital.

Alumni Spotlight

Greg Joswiak

From EECS at Michigan to Marketing at Apple: The Path to the Post-PC Era

Greg Joswiak
BSE CE, '86
Vice President, iPod, iPhone, and iOS Product Marketing, Apple, Inc.

"For 2010, the iPhone 4 is the biggest leap forward since the original iPhone." In a recent new product video for the latest iPhone, Greg "Joz" Joswiak passionately articulates some of the advancements found in the most recent version of Apple's iPhone. As Vice President, iPod, iPhone, and iOS Product Marketing, Joz has played a pivotal role in the launch of every version of the iPhone and iPod.

According to Joz, during his undergraduate days at Michigan, friends would often joke that his last name, Joswiak, was a combination of the last names of Apple's founders, Steve Jobs and Steve Wozniak (who's known as "Woz"). Despite that, he did not have his sights initially set on a career at Apple: "I was a user of Apple computers, but I also used PCs and big systems like Apollo and Burroughs. My plans regarding employment were of traditional computer engineering roles, not of specific companies."

The connection to Apple came while Joz was working as a student computer consultant at the Business School. A co-worker interviewed with a number of high-tech companies, including Apple, and Apple asked for candidate recommendations for an upcoming recruiting trip to Michigan. His friend named Joz, and when Apple came to town and interviewed him, "it was love at first sight."

Joz began at Apple in June 1986, just two years after the introduction of the Macintosh computer, in Apple's newly formed support organization for the Mac. Within two years, he was running that group. "I was able to advance quickly at Apple, in good part because of the preparation I received at Michigan. My engineering degree provided a very good technical foundation, and the scale and culture of Michigan provided numerous opportunities for learning how to work with others and how to make better things happen as a team than you can as an individual."

Joz's next role at Apple came when he was chosen to lead the communications function for Apple's Developer group, which supports third-party developers as they create applications for the Mac. In this capacity, it became increasingly clear that Joz had a rare blend of tech savvy and powerful communication skills – just the combination that Apple looks for in its product marketing managers – and he became a product manager for Apple's consumer and education products.

"At Apple, the marketing function is a combination of product management – which involves working with executive and engineering teams to determine feature sets, price points, and other product details – and product marketing, which includes working with the people who make ads and other marketing materials, talking to the press and key customers, and other outward-facing activities. Once again, my computer engineering background was an essential technical piece in filling this role effectively."

In 1997, Joz was tapped to lead product marketing for the Powerbook line – a responsibility that grew to encompass all portable products and eventually all hardware products. In 2001, this included a new device called the iPod, which sowed the seeds for the transformational change that the computer industry continues to experience today.

The iPod was released just days after 9/11 at a time when the country faced a severe economic slump. It wasn't an overnight success, but Apple felt its investment in iPod and other, yet unreleased products was strategic. Instead of cutting back, it stepped up its R&D activities to "innovate our way out" of the downturn, a decision that Joz points to as not only courageous, but instrumental in laying the technical foundation for the company's future success.

When demand for the iPod skyrocketed in 2004, the iPod business was divided into a separate division with Joz as its marketing chief. According to Joz, "we saw the iPod and iTunes as something huge, the beginning of the post-PC era, and we identified the phone as a platform for the future that was ripe for reinvention." His responsibilities ultimately grew to include the iPhone and iOS operating system in 2007. And it's become clear that the post-PC era is truly here. "Our goal is to make products that are more compelling, easier to use, and more portable than computers ever could be," Joz states.

He continues, "I've been fortunate to be part of the amazing team at Apple, and it's been phenomenal to see the company grow from a $2 billion market cap in 1998 to become the second most valuable company in the world today. Even more significant has been the opportunity to play a role in the emergence of the post-PC era, a time in which the team at Apple has revolutionized how people create, access, and consume information.

"It's been an incredible experience not only for me, but for other Michigan alums as well. I had the privilege of working with fellow alum Tony Fadell (BSE CE '91), who came to Apple to spearhead development of the original iPod, and who led engineering for subsequent iPod models as well as the first iPhone. As a matter of fact, I find myself surrounded by a number of successful Michigan alums at Apple – there are certainly a lot of us here! I visit Michigan regularly, and we recruit heavily from both the Business School (where an EECS undergrad degree and an MBA provides a leg up for our marketing organization) and the College of Engineering."

Curtis Ling

Making Things Happen

Curtis Ling
MSE EE '90, PhD EE '93
CTO and Co-founder, MaxLinear

Asked what makes an entrepreneur, Curtis Ling, CTO and co-founder of the company MaxLinear, responded, "An entrepreneur starts from nothing, has an idea, and makes that possibility become a reality."

His first taste of this was in his early electrical engineering classes, with a few professors who were "fantastic," recalled Curtis. "We were building things and solving problems, and there was no one to tell you what you could and couldn't do. It was very empowering."

His interest in entrepreneurship grew when, as a graduate student at U-M, he helped his advisor, also new to Michigan, build a lab and research group from scratch. After Michigan, he joined the faculty of the then-recently established Hong Kong University of Science and Technology. As an early faculty member, he was given the freedom to develop his research and shape the new department.

In 1999, he returned to California to gain industry experience in product development, and joined a startup called Silicon Wave to help build the world's first single-chip Bluetooth transceiver. The company was an engineering success, but a business failure, partly because the company didn't choose the correct markets. Its assets were ultimately acquired by Qualcomm, which successfully took the Bluetooth chips to volume production. In 2003, he and seven other colleagues left to start their own company, which became MaxLinear.

MaxLinear – From Startup to Global Player

Having helped build a lab and a department, it was time to build a company. "MaxLinear was founded by eight of us in 2003. At the time, we didn't know what ideas made sense to pursue, but we knew we had a team which could design great products. And we knew that good marketing was critical to determining what products to work on," stated Dr. Ling.

To boot-strap the company, the team raised its own funding from several sources including their own money, revenue from consulting services, and by not paying themselves. With this capital, they began to market the company on their own and visited a number of companies overseas. It was during one of these visits that Panasonic became intrigued by their idea of a low-power, single-chip television receiver, precipitating MaxLinear's transition from consulting to product development. Once they had a prototype, the team was able to attract venture funding in 2004.

Today, MaxLinear is headquartered in Carlsbad, CA, employs 230 people, and has offices across Asia and Europe. The company builds highly integrated RF mixed-signal broadband communication systems on a single chip. The combination of high performance with small silicon die size and low power consumption makes their products very competitive. They were among the first companies, if not the first, to build these broadband products in a generic CMOS process, benefiting from high gate density and low cost. Their products are found in cable and set top boxes, digital televisions, cell phones, cable modems, computers, and cars.

Curtis is now focused on finding the best talent for his company. He'll say that everything else follows from that. "I guess that's what any great organization, such as U-M, focuses on. If you seek excellence, if you want to reach your potential, if you have a lot of drive, then you're welcome."

Advice for Students

"Advice is of limited use – ultimately you have to make your own mistakes," Curtis says. But among the principles he believes in is that people shouldn't place themselves inside a box when they begin their careers. "Entrepreneurship showed me how unimportant it was to pick a career path or a job description and then try to fit into it. Instead, I was able to discover my own unique footprint."

He encourages students to be comfortable taking some risks in pursuit of their passion, despite the chance of what may appear to be failure. "Failure is an essential part of success. That's what makes our country great – we not only tolerate failure, we value it. Be afraid of not learning enough, or not working with the best people. Don't be afraid of failure, which is frequently success in disguise."

"And protect your health." One of Curtis' favorite memories of Michigan was the time he spent training for the Detroit marathon, which he ran four times. He recalled training in the cool fall weather, running on dirt roads by rural farms and simply enjoying the scenery. Curtis is also an avid cyclist and traveler, and fondly recalls his ride from Tibet to Nepal. Add to these passions his love of photography, music, and languages, and it's easy to understand why Curtis says, "There's a lot to love about life."

Alumni Spotlight

Meera Sampath

Creative Problem Solving in Research and Global Enterprise

Meera Sampath
PhD EE:S '95
Director of Xerox India Innovation Hub

"It's a dream job to set up a new research lab at a company known for innovation, especially when it's in your home country," said Dr. Meera Sampath of the facility she helped establish and now directs in India. Called the Xerox India Innovation Hub, it is unique among Xerox's five research facilities – and that's because Meera and her team had something exceptional in mind for this facility. Achieving creative solutions is characteristic of the way Dr. Sampath gets things done.

As a PhD student at Michigan, Meera wanted a simple and automated way of figuring out the root cause when something went wrong with an industrial system, specifically, one that was modeled as a discrete event dynamic system. This is a special and important class of systems whose behavior can be described as a chronological sequence of events. She saw that discrete event systems researchers had not yet been looking at the problem of failure diagnosis, and that while researchers in separate disciplines were looking at diagnosis of problems in industrial systems, they were not looking at discrete event systems.

The papers she would write with her advisors Prof. Stéphane Lafortune and Prof. Demos Teneketzis resulted in a new area of research, namely the diagnosis of discrete event systems, that is very rich today. These papers continue to rank high in major citation indexes.

The Michigan Experience

Coming to Michigan from India may have dropped Meera into a new continent, but she felt right at home. "I had very good friends and excellent relationships with the faculty. It was a very warm and welcoming place. Being in the EECS Department gave me a very broad exposure to people from different places, and people who were extremely good at what they were doing. I remember many late evenings in the EECS building talking with friends and working in the lab. It was a wonderful learning environment."

"My PhD advisors taught me how to be a researcher," she added, "and to communicate effectively. I also learned from them how to handle issues of fairness and inclusiveness, and the importance of taking time to listen to others, to encourage them, and develop the people you work with."

Aside from her studies, Meera enjoyed the bookstores, the parks, central campus, and especially the movies on Top of the Park. Topping it all was her wedding, followed by the birth of her first child at the University of Michigan hospital.

Creating the Xerox Innovation Hub

Before graduating, Dr. Sampath attended a Control Series Seminar where she approached two senior Xerox researchers to talk about a job posting she has seen just the day before. "The next thing I know 15 years have passed and I'm still at Xerox," she stated.

Meera started her career at the Xerox research lab in Webster, NY, where she applied the results of her doctoral work to printing systems. She went on to hold a variety of titles and positions including Principal Scientist, Leader of the diagnostics competence area, Manager of Strategy, and later Group Leader to determine what Xerox's expansion strategy should be in the emerging market. Her group successfully proposed the new facility in India, and Meera was named Director.

"While open innovation is not new to Xerox, we wanted this new research lab to be a model for open innovation and collaboration," explains Dr. Sampath. It is called a "hub" because it brings together researchers from all five of Xerox's global labs as well as other researchers and entrepreneurs from the best academic institutions and research labs in India. The goal for the India hub was to have at least 50% or more of the research done through partnerships with outside individuals and institutions.

Students – Get a Global Perspective

Meera is excited about all that she is doing, but when asked what advice she would want to share with students, she became particularly animated about the importance of a global perspective. She helps introduce children in her own community to another culture by teaching her native language, Tamil, to classes of students. She also directs plays and musicals involving the students, all performed in her native language.

"Companies are looking for global leaders. Globalization means learning to work with the best people around the world," she stressed. "A lot of today's most challenging problems are in the emerging world. It is critical to bring together the best brains, whether they are in India or China or Michigan – and have them work together to solve the most challenging problems of today. Whether it's through appropriate coursework, training programs, or internships overseas, students should give themselves global exposure." ●

Michigan @ ISSCC

EECS alumni working in the area of integrated circuits and systems had a festive reunion at the 3rd annual EECS Alumni and Friends Mixer at the *International Solid-State Circuits Conference (ISSCC)* this past February, which is always held in San Francisco. It was a lively event with more than 100 alumni and friends stopping by to eat, drink, and be merry. Two lucky U-M students walked away with the door prizes!

1990's

Paul Berger (BSE Physics '85, MSE EE '87, PhD EE '90), professor of electrical and computer engineering and physics at The Ohio State University, has been promoted to Fellow status in the Institute of Electrical and Electronics Engineers (IEEE), for "contributions to the understanding, development, and fabrication of silicon-based resonant interband tunneling devices and circuits." In addition, he was name IEEE Distinguished Lecturer for the Electron Devices Society.

Ronald A. DeLap (PhD EE:Systems '94) was named Dean of Engineering, Technology and Economic Development at Lake Superior State University.

2000's

Karl Rosaen (BSE CE '03, MSE CSE '04), who helped develop Google Android, has returned to Ann Arbor to launch a new Web-based company, RealTimeFarms.com.

Sushant Sinha (PhD CSE '09) has been named one of 18 remarkable young technology innovators in India by MIT's Technology Review India. Dr. Sinha was selected for his development of Indian Kanoon, a search engine of Indian laws and court judgments.

Adrienne Stiff-Roberts (MSE EE '01, PhD Applied Physics '04) received a Presidential Early Career Award for Scientists and Engineers (PECASE). Stiff-Roberts is a professor in the Department of Electrical and Computer Engineering at Duke University.

David Papa (BSE CE '02, MSE CSE '04, PhD CSE '10) received the 2010 Outstanding Dissertation Award in the area of "New directions in physical design, design for manufacturing and CAD for analogue circuits and MEMS" from the European Design and Automation Association (EDAA) for his dissertation, "Broadening the Scope of Multi-Objective Optimizations in Physical Synthesis of Integrated Circuits."

2010's

Eric Dattoli (PhD EE '10) received a 2-year postdoctoral position with the National Institute of Standards and Technology (NIST) in Maryland as a National Research Council Research Associate. The position is administered by the National Academies. His project will be to better understand nanowire gas sensing.

Eric Tkaczyk (PhD EE '10) was named both a 2010 Fulbright Fellow and Whitaker Scholar to support research in Estonia to develop portable and affordable cataract assessment technology.

Faculty Alumni

Frederick Beutler, Professor Emeritus of EECS, has become an award-winning photographer in his retirement. In addition to winning a national photographic contest with Nikon, he recently opened a solo exhibition at Gallery 100 in Chelsea. He shared a few of his photos with us – though you may want to visit his Web page to view a more varied selection (web.me.com/fbeutler).

Donor Spotlight

Syed Ali

Giving Back: Syed Ali Education Fund

Syed B. Ali
MSE EE '81
Chairman, President, CEO, and Founder
Cavium Networks, Inc.

Student education takes top priority at Michigan. In addition to their classroom learning, students are working on extracurricular research projects, participating in team projects and organizations, and serving the community. Just a few of their activities are highlighted in this newsletter. To support their efforts, and to help ensure that EECS remains one of the top-tier departments in the world, the Department is delighted to announce the establishment of the Syed Ali ECE Education Fund, thanks to the generous donation of Mr. Ali.

"I wanted to give back," says Syed Ali about the fund. "If it wasn't for Michigan I wouldn't be where I am today." And where he is today is Chairman, President, and CEO of the company he founded in 2000, Cavium Networks, Inc. Cavium Networks, publicly listed on NASDAQ, was named one of the 25 fastest growing technology companies in the United States earlier this year by *Forbes Magazine*; in fact, they were #5.

Syed Ali is committed to assisting and encouraging students in their education. Recalling his own experience at Michigan, he stated, "I received excellent exposure to semiconductor design and technology. At Michigan, you could implement an entire design cycle for a product, including manufacturing it in the lab, and then testing it. This was very unusual for a University, especially at that time." Michigan is still doing a great job according to Ali, who added, "Michigan grads are always among our top performers at Cavium."

About Cavium Networks

Syed Ali founded Cavium Networks in 2000. He saw that the Internet was expanding more and more into business communications and e-commerce, both of which required high security communication. Believing that security could be significantly enhanced by silicon technology, his company successfully offloaded all the heavy computational work onto silicon, which had not been done before.

Today, the company provides highly integrated semiconductor processors that enable intelligent networking, communications, storage, video and security applications to worldwide markets.

To be successful, Syed and his team must determine what will be needed three to four years in the future. "The most satisfying part," he says, "is when the products actually come out, the markets develop, and you have the best product. That's a big high."

For Students

Starting your own company can sound like a daunting avenue to pursue, yet Syed wants students to know that, in his opinion, being an entrepreneur is not that hard. "From the outside it looks very difficult. But if you have the heart, if you have the desire, and if you're willing to take some risks and some downsides, you can do it."

Syed did not step into the role of entrepreneur right out of school. At the time that he founded Cavium Networks, he brought nearly 20 years of experience to the company. He first worked at several smaller companies in product design and development, followed by four key years as Executive Director at Samsung Electronics in Korea where he played a major role in starting and growing Samsung's Flash memory and CPU businesses, and then he co-founded his first startup company, Malleable Technologies (acquired by PMC-Sierra in 2000).

Currently about 50% of Cavium's business is overseas. He'd like students to know that, "Increasingly, if you're coming from an engineering background, being able to understand and work with different cultures is very important. Having the viewpoint of both the U.S. and Asia will help you to be successful in your business. This is true whether you are starting a company, or working in an international organization."

Thanks

The Department thanks this high-tech visionary for reaching out to help today's students follow their own path to success. "It's been a privilege to work with Syed and have his participation in shaping the future," stated Khalil Najafi, ECE Chair. "The Syed Ali ECE Education Fund provides us with the flexibility that is critical to support our students as needs and opportunities arise, allowing them to continue to transform the world with their new ideas and technology."

Your Support Makes a Difference

EECS alumni and friends helped build the Lurie Nanofabrication Facility and the Computer Science and Engineering Building. They established numerous scholarships and fellowships for our students, and their gifts have supported EECS student involvement in the Solar Car Team (winners of the 2010 American Solar Challenge), the U-M:Autonomy team (1st place in the Autonomous Surface Vehicle Competition), UMentorFirst (where our students mentor local high school students in an annual nationwide robotics competition), and a new competitive student team focusing on electric vehicles.

Alumni gifts support student awards in the form of prize money for overall excellence, research excellence, service excellence, and entrepreneurial enterprise. Alumni and industry also support awards for graduate student instructors and undergraduate instructional aides. These student instructors and aides provide invaluable assistance to the faculty teaching the courses and to the individual students. One student who received a Yahoo! Teaching Award was described as, “fantastic, super friendly, and very easy to talk to and ask questions about anything related to EECS.”

Just this past year, the Department created a new Power & Energy lab for undergraduate students to gain experience with power electronics (which provides the interface between solar photovoltaics and the grid), electric machines (to reinforce concepts related to wind generation), and solar photovoltaics.

A new lab space was created for graduate students focusing in circuits and systems. Agilent, Intel, and AMD helped outfit this lab with state-of-the-art computing equipment in an area that fosters student collaboration. Students in this lab recently earned three top prizes at the most prestigious student design contest of its kind.

Intel Corporation outfitted an existing student lab that supports courses in computing systems and logic design with new computers. In this lab, students learn how to construct real digital devices. The new computers will enable students to carry out even more interesting and complex projects.

Companies such as AMD, Analog Devices, Cirrus Logic Inc., Electronic Arts, Firaxis, KLA-Tencor, Microsoft, and Quantum Signal have recently supported in-class contests which the students enjoy. In addition to the monetary awards, all the students gain the opportunity to meet with representatives from the companies and learn about future opportunities.

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