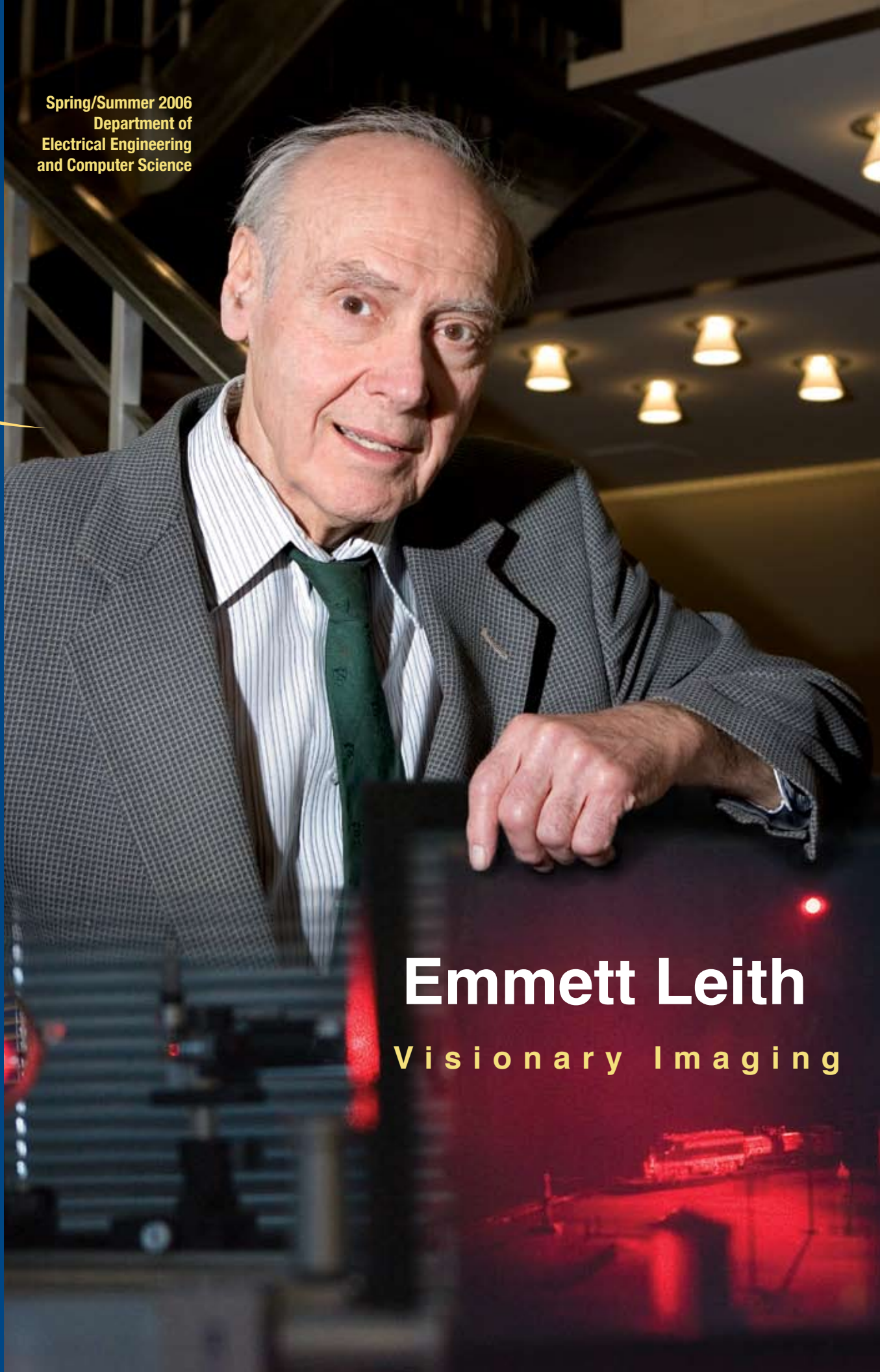
THE UNIVERSITY OF MICHIGAN

EECS News

Spring/Summer 2006
Department of
Electrical Engineering
and Computer Science



Emmett Leith

Visionary Imaging

In This Issue

Electrical Engineering and Computer Science

1301 Beal Avenue
Ann Arbor, Michigan
48109-2122
PH 734 764-2390
FX 734 763-1503
www.eecs.umich.edu

Editor: Catharine June
Design: Liene Karels

A Message from the Chair

I write this near the end of another academic year. Seniors will graduate soon, some taking positions in industry and others planning for graduate school. Underclassmen will take summer jobs, and faculty will more fully engage with their research and graduate students. Summer will be busy!

Our CSE faculty have moved into their new building. The interior truly is spectacular – full of natural light, even on a cloudy Michigan winter day. The large, multistory atrium, complete with a spiral staircase, is busy with students studying, but also will host major events. Conference rooms and student spaces abound for group work. You are invited to stop by the next time you are on campus! In other construction news, just a few days ago we received the go-ahead from the State to begin work on the renovation and expansion of our cleanroom and related labs, now known as the Michigan Nanofabrication Facility (MNF). The price tag on this project has climbed past $40M, funded by alumni and industry. It is anticipated that the construction will require two years to complete. In another project, we'll begin other renovations in the EECS Building late this summer. Most of the initial construction will occur on the first floor, with classroom renovations and a major redesign of the atrium to accommodate a student-faculty commons, computer lab, and improved space for student groups.

One of the real pleasures I experienced earlier this semester was an extended visit to meet with EECS alumni in California, both in the Bay Area and in Los Angeles. I can report that our alumni are successful in their careers, interesting to speak with, and intensely loyal to U-M. At one dinner I attended, the alumnus to my left proudly stated that he had 15 family members who had attended Michigan. The alumnus to my right replied, "Oh that's nothing," and proceeded to announce an even longer list of family members who had Michigan degrees! In this Newsletter, you can read notes about some of our alumni.

Likewise, I invite you to read about activities of our current students. Our student groups are involved in a phenomenal range of activities each year. It was gratifying to see our HKN chapter (ECE honor society) win a national Outstanding Chapter Award once again. This is becoming an annual affair! On the CS side of our department, the CSE Scholars group is equally impressive.

This issue of the Newsletter features the research of two of our most distinguished faculty. Kang Shin is a pioneer in real-time computing and control. After his early work in robotics and airplane control, he gravitated toward problems related to computer and communication networks. In addition to founding the Real-Time Computing Laboratory at U-M, Kang is credited with building the software group within the CSE Division of EECS. It is a tribute to Kang that today this group has strengths in networks, databases, security, and programming languages. Please read more about Kang and his seminal contributions, beginning on page 9.

The second faculty member featured in this issue is Emmett Leith, who is pictured on the cover. Emmett was slated to retire on December 31, 2005, but sadly he passed away just before Christmas. We had held his retirement reception only weeks earlier. There we celebrated his achievements in the development of both synthetic aperture radar and holography. In my estimation, Emmett came within a whisker of winning a Nobel Prize. He was a phenomenal thinker, as evidenced in the description of his career, beginning on p. 4. The department has custody of Emmett's early holograms and plans to display them in the EECS atrium. Smithsonian, eat your heart out! Emmett had a sense of humor that matched his scientific genius. A colleague had recently remarked to Emmett that he was surprised that Emmett was still coming in to work everyday. Emmett was asked whether there was anything else he enjoyed as much as coming in to work. Emmett replied, "Yes, I enjoy going home. But, I can't go home unless I first come in!" Another story relates to Emmett's habit of driving very old automobiles. In one instance, he was driving his auto across the country to attend a technical conference. This car leaked oil badly, so Emmett rigged up a pan underneath the engine to catch the oil. He then would stop every 50 miles or so to empty the pan back into the crankcase! There are many similar stories about Emmett, demonstrating his frugality, his sense of humor, and his resourcefulness.

Outside of his scientific accomplishments, Emmett is perhaps best known for growing an orange tree in his yard in Michigan. He built a large enclosure for the tree to shelter it from Michigan winters, and he and his wife, June, gathered large numbers of oranges from the tree each year. That tree grew and grew and grew. Given the setting, it seemed bigger than life. So was Emmett. We shall miss him dearly.

David C. Munson, Jr.

Memorial Tribute

Emmett Leith (1927 - 2005)

Inventor of Practical Holography

Emmett Leith passed away December 23, 2005, at the age of 78. This came just five weeks after a retirement reception held in his honor, attended by former and current students, colleagues, and friends. We now celebrate the life and career of a remarkable individual – a brilliant innovator, visionary researcher, remarkable teacher, and very unassuming gentle friend.

Emmett's worldwide reputation rests primarily on his research in holography, which grew out of his work on synthetic aperture radar (SAR) at the University of Michigan Willow Run Laboratories. For many years shrouded under cover of highly classified research, his early work in SAR created the foundation for major breakthroughs in holography, and provided principles that he would rely on even in his most recent research.

A Vision of the Future:
Synthetic Aperture Radar to Holography

Leith joined the U-M Radar Laboratory of Willow Run Laboratories in 1952, with a Master's degree in Physics. In later writings about his work, Leith said he was in the right place at the right time because of the very interesting work being done in the area of synthetic aperture radar (SAR). The Army wanted to achieve a high-quality imaging radar system – a goal thought to be impractical due to the size an antenna would need to be to achieve high resolution. No airplane could carry such a large antenna. However, if the antenna could be synthesized, such that a five-foot antenna could act like an antenna the size of a football field, perhaps such imaging could be accomplished. To simulate a larger antenna, radar returns were mixed with a local signal. For each transmitted pulse the returns were recorded on a photograhic film as a single line. This process continued as the airplane flew, which resulted in a film strip that contained no recognizable image, just like a hologram. This radar data then needed to be processed.

In the 1950's, when the major developments in SAR occurred, computers were in their infancy and could not handle the gigantic computing task that was required to process the radar data. Based on discussions with R. Varian, one of the inventors of

the kystron, two U-M scientists, Lou Cutrona and Wes Vivian, decided to accomplish the task using optical processing. When it came time to build the radar system, Emmett chose to work on the optical processor.

Within a couple years, Leith developed a completely new theory of SAR, based on physical optics. Leith stated, "this new way of describing SAR in combination with optical processing is what today would be called a holographic viewpoint." Until it was proved, however, many scientists did not give the theory much credit.

The new radar system was ready to be tested in 1957. Eight flights yielded no images – which seemed to vindicate the critics of the new method and threaten continuation of the project. Flight nin, however, stated Leith, "produced some startling results. The terrain was beautifully mapped. The Michigan SAR system became famous." Developed as part of Project Michigan, the new radar system allowed for high-quality mapping of enemy territory from a safe distance, penetrating even fog and darkness at longer distances than previously possible.

Making Holography a Reality

By 1960, Leith had turned his attention to holography, a technique that was first described in 1947 by Dennis Gabor. The concept was to record a wavefield on photographic film and then regenerate the wavefield at a later time by shining a beam of light through the photographic record, called a hologram. At first the technique was simply called wavefront reconstruction.

Gabor's goal was to improve the resolution of an electron microscope. While moderately successful, the resulting images by Gabor were quite fuzzy, and had a twin image. Gabor could not correct this, and many scientists deemed the problem unsolvable. After 1955, holography went into a period of hibernation.

During this period, Emmett became intrigued with the principles of holography, which related to his own data processing work with synthetic aperture radar. He approached Juris Upatnieks, a scientist who had just joined the Willow Run lab in 1960, to get him interested in this new area. Upatnieks recalled that he was not initially impressed by Emmett's description of wanting to take a transparency, record an out-of-focus image, and then take that recording and get a focused image back. However, after being shown a description of this process in the book, *Principles of Optics* by Born and Wolf (1959, now in its 7th edition), in which Gabor's experiment was outlined, he was convinced.

"The Michigan SAR system became famous."

The problem inherent in Gabor's method seemed insurmountable, yet a moment of inspiration led to a unique approach, called carrier-frequency, or more popularly, off-axis holography. Key to this approach was the introduction of a second beam, called a reference beam, which passed around the object and impinged obliquely on the recording medium.

With this method, Leith recalled, "The image from the hologram was indistinguishable from the original object itself, and the process required no more coherence of the light than the original Gabor process. In fact, in further refinement, we devised a system that achieved carrier frequency holography, with coherence requirements that were about 15% less than required for Gabor's original method." This groundbreaking work, accomplished early in 1961, was published in 1962 in the *Journal of the Optical Society of America* (vol. 52). The basic problem was solved, yet further refinements and advances were needed before the technique would capture worldwide attention.

"The image from the hologram was indistinguishable from the original object itself."

Lensless and 3D Photography

Emmett and Juris introduced display holography to the world in Fall 1963. It was publicized as lensless photography because a lens was not used between the object and the photographic plate. In the first step of this 2-step process, a negative is generated by splitting light into two beams: one beam, called the reference beam, travels directly to the photographic plate, while the other beam, called the object beam, first hits the object to be photographed before the reflected light waves reach the plate. Both beams meet at the photographic plate, creating a phenomenon known as interference. The result is an unrecognizable negative, described by Leith as "a hodgepodge of specks, blobs and whorls." This is the hologram. In the second step, which is the reconstruction stage, the hologram is illuminated with a replica of the reference beam. Two images are formed: a virtual image behind the plate on one side of the illuminating beam, and a real image on the opposite side of the illuminating beam in front of the hologram that forms a sharp image on a screen. For the first time, holograms could now be made of arbitrary objects, not just photographic transparencies.

Eager for additional refinements, researchers called for a high-quality 3-dimensional display hologram, which had not yet been achieved (though the

information to create the objects in 3D was present in the existing holograms). Emmett and Juris went to work making improvements on their technique, which would require use of the newly available laser to get the desired coherence of light. They presented their work at the Spring 1964 meeting of the Optical Society of America in Washington, DC. As recalled by Stephen Benton in the book, *The Art and Science of Holography: A Tribute to Emmett Leith and Yuri Denisyuk* (ed. H. John Caulfield), "Leith and Upatnieks gave a short oral paper on their 3D holograms, and invited the attendees to view a hologram in the hotel suite used by the Spectra-Physics company, who made most of the early holography-capable lasers. A line of optical scientists and engineers wound down the hallways of the hotel as they patiently waited to see the 3D images that were absolutely unprecedented in their realism and accuracy."

The appearance of a crystal-clear 3-dimensional train completely transfixed the optical community, and led to press releases all over the world. Emmett and the hologram were featured in *Life Magazine*, and there were articles in *Scientific American* about the work.

These holograms had all of the usual properties of actual objects, including parallax. In fact, it was possible to peer behind obscuring structures to see what was hidden behind, just as if one were viewing the actual objects. Interestingly, the holograms were created such that by having even just a portion of the whole, the complete picture could still be generated.

This train, created April 1964, is one of the earliest three-dimensional holographic images.

Holography Becomes Practical

The startlingly realistic clarity of the three-dimensional holograms gave holography an appeal that reached outside the domain of the specialists, and called worldwide attention to this formerly esoteric subject. Whereas interest in holography had dwindled to just a few by 1960, by 1970, hundreds of worldwide research groups had turned their attention to coherent optics and holography. Improved techniques, new holographic materials and new application areas were explored by researchers around the world. The field quickly became multidisciplinary as applications in non-destructive testing of materials, medical imaging, display and entertainment, holographic optical elements, and optical data storage, drew in researchers from areas outside the traditional optics arena.

As affirmed by Gabor himself in his Nobel Prize lecture, the success of Leith and Upatnieks "was due not only to the laser, but to the long theoretical preparation of Emmett Leith, which started in 1955. This was unknown to me and to the world, because Leith, with his collaborators Cutrona, Palermo, Porcello, and Vivian applied his ideas first to the problem of the "side-looking radar" which at that time was classified… This was in fact two-dimensional holography with electro-magnetic waves... Their results were brilliant."

Leith received numerous awards for his work, including the National Medal of Science in 1979, awarded by President Carter. Leith and Upatnieks were the first recipients of the R.W. Wood Prize, both were awarded the Inventor of the Year Award – presented by the U.S. Secretary of Commerce, and they received the ASME (American Society of Mechanical Engineers) Holley Medal. Leith was a member of the National Academy of Engineering, and was awarded the Frederick Ives Medal of the Optical Society of America, the IEEE Morris N. Liebmann Award, and The International Society for Optical Engineering (SPIE) Gold Medal. He was a fellow of the IEEE and Optical Society of America.

Leith earned more than 14 patents, including the first patent on holography, owned jointly with Upatnieks. This patent, filed April 23, 1964, was called, "Wavefront Reconstruction Using a Coherent Reference Beam."

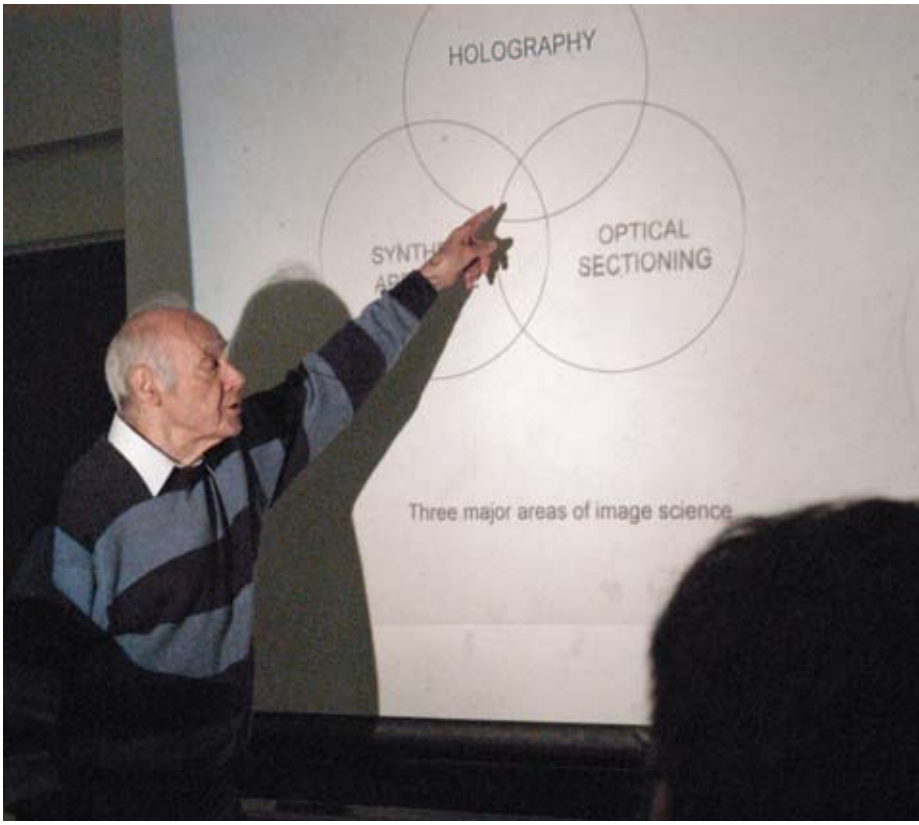
Expanding Uses for Imaging

The unifying principle between SAR and holography was coherent optics. Leith was a leader in the development of applications of coherent optics, and continued to work in areas having to do with imaging throughout his life. He maintained long-standing research relationships and friendships with several individuals who relied on his vast knowledge of the field to inform the progress of their research projects.

Dr. David Dilworth (MSE, EE and PhD, EE in '83 and '89), Director, Advanced Imaging Systems, of Argon ST, Inc., [formerly Daedalus Enterprises, Inc.], started working with Emmett as a PhD student in 1987, and through last December maintained weekly lab meetings with him. Their research focused on coherent optics, always with the goal of creating better images, particularly in the area of biomedical imaging. Dilworth and Leith own a patent that is related to the early detection of breast cancer.

This process of imaging through highly scattering media, especially biological tissue, is known as photon migration, and has grown into an entire area of optics. Leith worked in this area since the early days in the late 1980's. Using holographic methods, Leith stated that his goal was to "allow the seemingly impossible to happen – ideally, rendering biological tissue that was once impossible to see through to be as transparent as window glass. With such a technique, we could look into living tissue and discern anomalies such as malignant tumors. This ultimate goal is quite visionary; nonetheless, what has been achieved is encouraging." A method potentially useful for detecting these and other anomalies, such as an increased blood supply to areas that might become cancerous later, was found to be effective up to a thickness of a few millimeters.

Emmett also worked with Dr. Brian Athey, Associate Professor of Psychiatry, Director, Michigan Center for Biological Information, and Director of the U-M Visible Human Project, on a variety of projects since the early 1990's. In The Visible Human Project, Athey's goal was to float a 3-dimensional image in front of a viewer, so that one could view it without any 3D glasses, and to replace anatomical with virtual dissections. "We are starting to use it in experimental classroom settings, and also for virtual surgery," said Athey, who expects this to be in widespread use in 10-20 years.



Joy of Teaching and Love of Light

Emmett had a passion for optics that could perhaps only be matched by his love for teaching. He was instrumental in creating an optics program in the department during the 1960s, and took great joy in teaching the students. His graduate students often took part in Leith's preparations. Marian Shi, a graduate student of Leith's who is now a professor at Saginaw Valley State University, stated, "The students in his lectures could almost hear the air crackle in his excitement, spreading his love of optics and reveling in the joy of scientific learning. Every Friday he spent hours preparing demonstrations that visually illustrated some of the more difficult concepts that he covered in class. I saw first hand what a thrill it can be to teach optics."

"The students in his lectures could almost hear the air crackle in his excitement."

His devotion to his students was expressed this past year when he underwent emergency surgery, yet the very next day asked to have his students' exams brought to him to grade. He didn't want the students to receive incompletes on their report cards.

Dick Zeck, who was a student, colleague, and friend of his for nearly 40 years, recalled that Leith refused to stay longer than 2 days at conferences because he wanted to return to his students. He also echoed the statements of many others pres-

ent at Leith's retirement reception when he said, "I am aware of no person or opportunity that ever compromised his integrity or professionalism. I learned much about proper thought and behavior by my association with him."

Former student Jin Chang, now COE and president of General Scientific Corporation (parent company, Surgitel) in Ann Arbor, said that "Emmett really taught me how to live my life." Chang now tries to help others, as Emmett helped him as a poor graduate student.

Rod Alferness, a student of Emmett's who is currently Senior Vice President for Research at Bell Labs, has done pioneering research in the area of wavelength switched optical networks. He invented devices that form the basis for many of today's wavelength division multiplexing (WDM) optical networking systems, and holds more than 35 patents. He said that by working with Emmett, he learned, "It's about ideas. It's about coming up with great, true ideas. I learned the joy of inventing and innovation, which has been valuable throughout my career." Alferness echoed many other student comments in their appreciation for Emmett's excitement and amazement at what he was able to do with light. "Emmett was always appreciative of the exciting phenomenon of light. He took a fundamental understanding of light and from it invented ways to use light as, for example, a computer to process complex radar signals to produce spectacular surface images and, much more easily appreciated by the public, invented practical holography that allows three-dimensional images to be stored on film and recreated. His ideas and the things that he made possible from them were very powerful."

Prof. Duncan Steel, Robert J. Hiller Professor of Engineering and Director of the Optics Laboratory at U-M, credits Leith with making Michigan the home of innovation in optics, which has since established new frontiers in the ultra-fast science and high-power laser areas.

Farewell to a Friend

Emmett loved his work, and he happily brought his accumulated knowledge to bear on any topic being discussed. He also brought the fruits of his gardening to many of these discussions. His students and colleagues recall fondly the delicious tomatoes and fruit he would bring to the weekly group meetings. He may have been the only Michigander to grow an orange tree in his backyard, which he kept alive for many years through the winter by building a unique greenhouse around it – a house that he expanded each year as the tree continued to grow.

Emmett was a remarkably unassuming gentleman, who was known for his quiet ways, sense of humor, cheerfulness, and by the select few who could truly appreciate it, his brilliant mind. His students and colleagues were privileged to have caught a glimpse into aspects of both his personality and intellect. For some, it changed the course of their lives. In solving the problem of practical holography, he changed the future of imaging technology, and affected millions of lives.

The Electrical Engineering and Computer Science department expresses heartfelt condolences to June Leith, Emmett's wife of 49 years, to his daughters, Pam Wilder and Kim Leith, and to all of his family and friends. We remember him fondly, and salute his remarkable legacy.

"It's about ideas. It's about coming up with great, true ideas."

Emmett was known for his pervasive yet subtle humor. One of his favorite memories was the time he and his graduate students produced coherent radiation on tap, an event captured on film.

Coherent Radiation on Tap

Prof. Leith contemplates the valves recently installed in the laboratory.

A trickle of He-Ne radiation amazes Prof. Leith.

With both valves open, an astonished Prof. Leith sees the full output of the He-Ne and Argon ion lasers on tap.

Kang Shin: Making things work in real time

Kang G. Shin, Kevin & Nancy O'Connor Professor of Computer Science

Prof. Kang G. Shin, Kevin & Nancy O'Connor Professor of Computer Science, is founding director of the Real-Time Computing Laboratory. Shin was a pioneer in the field of real-time control and computing, and remains at the top of his field. From his early work with robots and aircraft, to more recent work in wireless networks, he has made fundamental research contributions, and seen them impact industry practices.

Computing systems that work in real time are those that must respond within a specific timeframe to an active process. Real-time systems are often used as embedded systems to control a wide variety of operations that relate to personal safety, such as automobiles, airplanes, ships, high-speed trains, power generation and distribution, and medical devices. For example, space flight computers must respond to changing conditions to keep a rocket ship headed in the right direction. In automobiles with a real-time embedded system, changing driving conditions and lighting situations will cause brakes to adjust and lights to come on to keep passengers safe.

Throughout his career, Kang has led highly successful research programs in a variety of related areas, including: real-time systems, fault-tolerant computing, networking and manufacturing automation, automotive manufacturing, in-vehicle control and computing, embedded systems, avionics, and internet services and applications. His significant work in fault-tolerance allows mission-critical systems to continue to perform in a timely fashion despite equipment failures. He is continuing to forge new trails, particularly in the areas of computer networks, and Quality-of-Service issues in wireless networks.

Establishing the field through Robots and Airplanes

Computer science was a fledgling field when Kang was working on his PhD thesis in control theory. By the time he graduated from Cornell, it had taken hold of his imagination. At his first position at Rensselaer Polytechnic Institute (RPI), he combined his background in control with his new interest in the computer, and established the Robotics and Automation Lab. His work in robotics culminated in his being able to solve a long-standing minimum-time robot path-planning problem. The published research resulted in an outstanding paper award from the *IEEE Transactions on Automatic Control* in 1987.

Prof. Shin became interested in aircraft control systems at a time when few others considered this important. He was concerned about a worst-case scenario, when all operating computers, including backup computers, were rendered useless, perhaps through a bolt of lightning. He determined at what point the airplane would become unstable from the resulting delay in information being returned to the feedback controller, and presented a paper based on his work at the first real-time systems symposium in 1980. However, at this time he was not able to interest funding agencies in this work.

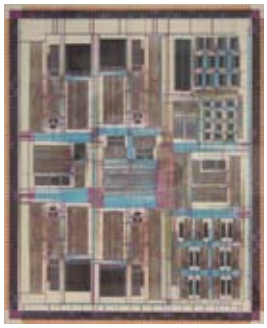
A break came when he met Billy Dove at NASA Langley, who was looking to make air flight more reliable. At that time, individuals were approaching the solution from either a hardware or a software perspective. Kang added the missing piece with his interest in control performance. His early work with C. M. Krishna attracted the interest of NASA and led to a relationship that lasted 14 years. Kang states, "during these years I was able to build a foundation for real-time computing – it was real-time control that combined timeliness with reliability."

HARTS at the Center

Kang moved from RPI to Michigan in 1982, in search of a more diverse University environment. Michigan also offered the best environment to continue his studies in robotics and real-time computing. During the 1980s, he and his colleagues at other institutions helped establish the field of real-time systems by "selling" this field of research to the Office of Naval Research, which subsequently established a research initiative to fund research in the field. Said Shin, "It was small, about $5M, but it had an important impact on developing human resources, and solving important problems."

Kang's research program began to grow, along with the number of his students, which typically rests at about 20 active students. He was inspired to tackle a large system-building project, which he called HARTS, for Hexagonal Architecture for Real-Time Systems.

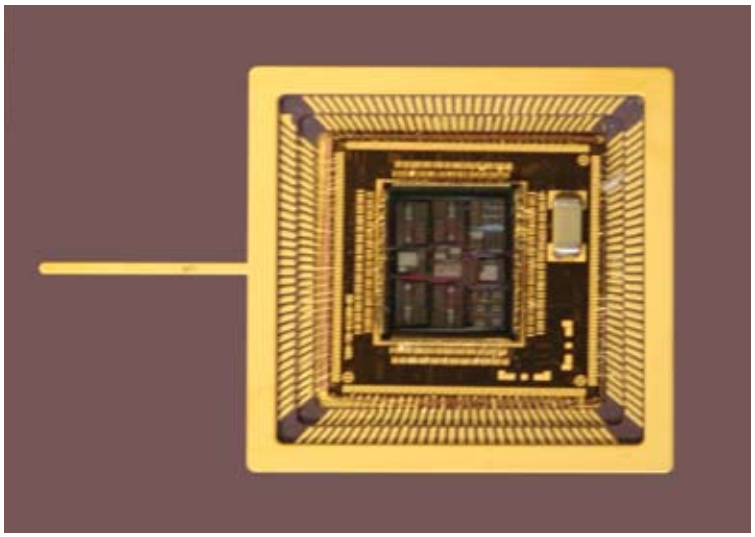
The goal of this project was to build a distributed reliable real-time system, starting from hardware, all the way through application software. The project began with chip design, fabrication and testing, and construction of a communication processor board. The next stage involved building a multiprocessor system and creating an operating system for it, followed by a network protocol, and finally, applications. It was a massive undertaking, and while Shin said in retrospect it was too ambitious, it proved to be excellent training for the more than 10 PhD students who worked on the project in various stages.



HARTS chip layout

HARTS was the common ancestor of all of Kang's current projects. Once completed, however, he knew he had to focus on either the hardware or the software, not both. He chose to concentrate primarily on software.

Fabricated chip, with HARTS chip at the center



Solving Problems in Information Technology

Prof. Shin's recent work resides in the general area of information technology, which is the art and science of creating the technology necessary for information delivery and processing. Though he narrowed his field to software, his interests continue to be very broad within the field, encompassing embedded real-time systems, computer networking, Quality-of-Service issues, and computation and networking security.

In the area of embedded real-time systems, he developed a real-time operating system for devices such as cell phones, PDAs, smart machines, and automotive electronics components. The project, called EMERALDS (Extensible Microkernel for Embedded, ReAL-time, Distributed Systems), has been tested by Ford Motor Company and the Hitachi Automotive Research Division in Japan. Shin received a copyright for the EMERALDS software in 1996. Work is continuing in the area of energy conservation, allowing battery-backed mobile systems (e.g., laptops and cell phones) to use batteries more efficiently.

Shin is also investigating Quality-of-Service (QoS) issues in computer networking. QoS calls into play timeliness, fault tolerance, security and fairness. QoS mechanisms are designed to ensure adequate performance in a data communications system. Shin developed a method for providing QoS guarantees in Internet applications that require reliability and service, such as Internet phones, video, remote medical services, and distance learning. His protocol guarantees a sufficiently high level of end-to-end network level performance over wide-area networks such as the Internet.

Mobile and wireless networks have attracted Shin's interest, in particular QoS issues related to multi-hop wireless mesh networks (WMNs). These WMNs are promising technologies that provide high-capacity wireless networks over large areas, such as a campus, an apartment complex, or a city. Since this technology does not require the use of cables, it is easily deployed. The principal challenge lies in maintaining the quality of the wireless link. Having made significant progress in this area, Shin plans to extend QoS-aware wireless networks to support emerging communication technologies such as cognitive radio.

As part of his work with high-end web and multimedia servers, Shin and his former students developed a novel network congestion control method, called BLUE, for the Internet. BLUE reduces traffic

loss by an order of magnitude over the best existing solution, known as Random Early Drop, or RED. The paper which describes this work, "Blue: Active Queue Management Algorithms," received the 2003 IEEE Communications Society William R. Bennett Prize.

One of Shin's newest, and most rapidly expanding areas of research is computation and networking security. He is investigating three broad areas within this topic: sensor networks, attack containment or service-oriented quarantine, and mobile worms. In the first area, he has a project called LiSP: Lightweight Security Protocols for Wireless Sensor Networks, which aims to achieve a fundamental advancement of secure networking technology that meets the requirements of both high-level security and energy-efficiency. The sensor devices are designed to be low-cost, networked, and highly energy-efficient, for use in military & homeland security and other applications.

The second area involves the detection and containment of malicious code, or worm, attacks, where a computer network interruption leads to a loss of connectivity or functionality on an individual computer. The goal is to contain the attack without sacrificing many of the other services that are present in the network. He is also attempting to develop an agent-based simulation to model a virus spreading on both wireless and wired networks.

The third area in security is the detection and prevention of mobile worms. These worms can attack cell phones and PDAs, among other devices. Shin is currently talking to a company about being an industrial partner for the project.

Working in the area of network security, Abhijit Bose joined the group with a PhD in Mechanical Engineering and helps lead the efforts in network security. "Kang is one of the hardest working people I've ever met," said Bose. "He has 15-20 projects going on at the same time." This activity has spawned more than 630 technical papers and book chapters. Shin works with a steady cadre of graduate students, who become leaders in their own right upon graduation.

Educating the Next Generation

Kang's care in training his students has led to a generation of excellent scholars in academia and industry. Tarek Abdelzaher (PhD, CSE '99), a faculty member at the University of Illinois at Urbana-Champaign, said, "I am now well aware of the difficulty of the job Professor Shin was able to undertake so perfectly and effortlessly, advising not only me but close to twenty other students, all of whom later embarked on high-profile career paths. He cultivates in his students not only strong technical skills but also the independence and motivation to continuously better themselves professionally."

Dilip Kandlur (MS, CSE '87; PhD, CSE '91) leads the Storage Systems Group at the IBM Almaden Research Center. He worked on the project BLUE with Prof. Shin, sharing the 2003 William R. Bennett Award. He is an expert in QoS and performance for networks and network servers, and has hired many of Shin's students as summer interns and full-time employees to IBM. Kandlur said, "I continue to be amazed at the breadth and depth of Prof. Shin's research interests and accomplishments."

"I continue to be amazed at the breadth and depth of Prof. Shin's research interests and accomplishments."

Shin co-authored the book *Real-Time Systems* (McGraw Hill, 1997) with former student C. M. Krishna, to support a new course he developed in real-time systems (EECS 571). Krishna is a professor at the University of Massachusetts, who appreciated the manner in which Prof. Shin guided his students through their research, encouraging creativity while providing the guidance needed to succeed. "Thanks to the education I received at his hands, I had no difficulty in making the transition from being a graduate student to a faculty member," said Prof. Krishna.

Jennifer Rexford, a professor at Princeton University who is featured in the Alumni News section of this newsletter as the recipient of the College of Engineering Recent Graduate Award, said, "I was drawn to Kang's group by the opportunity to pursue cutting-edge research at the boundary of theory and practice. Working with Kang, I knew I would be able to conduct thesis research that spanned hardware, software, and mathematical modeling."

Shin's research has led to several important best paper awards, and a variety of prestigious awards within the University. He is a fellow of both IEEE and ACM, and a member of the Koren Academy of Engineering. He has recently been honored with the 2006 HOAM Prize in Engineering.

Prof. Shin has graduated 54 PhD students. "I still remember each and every PhD student I've ever supervised. That's something I cherish more than papers or awards," emphasizes Shin. "The field of computer science moves so quickly, most people don't even cite papers if they are more than five years old. But the students I work with, and the faculty I collaborate with, these relationships will last forever."

ENIAC FINDS A PERMANENT HOME

Original ENIAC in 1946. The entire room of equipment comprised the ENIAC.

Emeritus professor Arthur Burks visited the newly occupied Computer Science and Engineering Building recently to view the new home for the portion of the ENIAC (Electronic Numerical Integrator and Computer) that he brought to the University of Michigan in 1964. This is one of two remaining collections of parts from the world's first general-purpose electronic computer, the computer that launched the modern computer revolution. The other collection resides at the Smithsonian Institution. The specific parts were especially selected and assembled to capture the core function of the ENIAC, namely, the computation of artillery firing tables for the U.S. Army. Prof. Burks, one of the principal designers of the ENIAC, met with graduate students and faculty - who are today designing ever faster, more efficient computers.

Burks conducted the first public demonstrations of the ENIAC during its unveiling at the University of Pennsylvania in February 1946. Army Ordnance officers present were astounded to see that the ENIAC could calculate a 30-second shell trajectory in 20 seconds, 16 seconds of which were taken to punch out the results on cards. Previous methods took about 12 hours for an individual with the desk calculator (at that time, called a human computer), or 15 minutes for an analog differential analyzer. The ENIAC moved to Aberdeen Proving Ground later that year to assist the army in their ballistics calculations. It came to be used for other scientific uses, such as weather prediction, atomic-energy calculations, thermal ignition, and wind-tunnel design. Changing the setup of the computer to solve a different type of problem required hours or even days of adjustments - but even then, the ENIAC was a tremendous time-saver over previous methods of computation. Burks worked on all of the ENIAC's units, but his most important contribution was as designer of the Master Programmer.

Alice and Arthur Burks stand in front of the ENIAC, showing some of the original 18,000 vacuum tubes.

This portion of the ENIAC that Professor Burks brought to Michigan is displayed in the entrance to the new Computer Science and Engineering Building.

The spiral staircase is a favorite feature of the spectacular new CSE building.

Prof. Burks joined the U-M faculty in the fall of 1964. The parts of the ENIAC that he brought to Michigan later that year were four of the computer's original 40 panels: one from the Master Programmer, two from Accumulators, and one from the High-Speed Multiplier. The task of cleaning the ENIAC was accomplished by driving it through a carwash (including resistors, capacitors, wiring, and neon bulbs), followed by sandblasting away rust, and finished with enameling and baking – after which all modules still worked!

The completed ENIAC was 80 feet long, shaped in a U along three walls of a room. It was 8 feet tall, used 18,000 vacuum tubes, and weighed 50 tons. Transistors, invented in 1947, gradually replaced vacuum tubes; they were smaller, faster, and more reliable than their predecessors. Integrated circuits would provide the next major leap in design technology in the 60s and 70s. The ENIAC, as the first programmable electronic computer, launched the modern computer revolution.

Today, students learn how to fabricate their own integrated circuits in the Michigan Nanofabrication Facility (MNF), housed in the EECS Building.

FACULTY HONORS AND AWARDS

Departmental Awards

2005 EECS Outstanding Achievement Award

Michael Flynn
H. V. Jagadish
Greg Wakefield

Student Society Award

HKN Professor of the Year

Peter Chen

College of Engineering Awards

Education Excellence Award

Dennis Sylvester

Service Excellence Award

John Laird
Fred Terry

Outstanding Research Scientist Award

John Nees

Michigan Emerging Industry Pioneer Award

Kensall D. Wise, "In Recognition of Outstanding Leadership to the MEMS, MicroSystems, and Nano Technology Community."

National Honors and Awards

2006 IEEE Edison Medal

FAWWAZ ULABY, "for pioneering research in microwave and radar remote sensing technology and their environmental and industrial applications." Ulaby, the R. Jamison and Betty Williams Professor, is a member of the Radiation Laboratory. His current research interests include development of: millimeter-wave imaging radar systems; terrain classifiers using ERS-1/J-ERS-1 orbiting radars; SIR-C radar classification and biomass mapping algorithms; and bistatic scattering models.

Institute of Electrical and Electronics Engineers (IEEE) Fellow

JEFFREY FESSLER, "for his contributions to theory and practice of image reconstruction." Fessler is a member of the Systems Laboratory. His research interests include medical imaging, tomography, nonparametric estimation, and inverse problems, with current projects in PET, SPECT, X-ray CT, MRI, microscopy, radiation therapy, and biomedical signal detection.

AMIR MORTAZAWI, "for contributions to quasi-optical and circuit based power generation techniques." Mortazawi is a member of the Radiation Laboratory. His research interests include RF and microwave circuits, specifically: microwave and millimeter-wave power amplifiers, spatial power combining and thin film ferroelectric based frequency agile circuits.

Association for Computing Machinery (ACM) Fellow

MICHAEL WELLMAN, "for contributions to market-based and decentralized computation." Wellman is a member of the Artificial Intelligence Laboratory. His recent research has focused on computational market mechanisms for distributed decision making and electronic commerce.

American Physical Society (APS) Fellow

THEODORE B. NORRIS, "for contributions to ultrafast lasers and their application to semiconductor physics and optoelectronics." Norris is interim director of the Center for Ultrafast Optical Science. His research interests include the application of femtosecond optical techniques to the physics of semiconductor structures, the development of new ultrafast optical and electronic probes with high spatial resolution for applications to semiconductor nanostructures and biological imaging, and the development of new laser sources for applications in femtosecond spectroscopy and the generation of THz radiation.

American Institute for Medical and Biological Engineering (AIMBE) Fellow

KHALIL NAJAFI is Deputy Director of the NSF Center for Wireless Integrated MicroSystems (WIMS), and Director of the NSF National Nanotechnology Infrastructure Network (NNIN). His research interests lie in the areas of solid-state integrated sensors and circuits, analog and mixed-mode integrated circuit design and fabrication, fabrication technologies for silicon microactuators and three-dimensional micromechanical systems, integrated implantable sensors for biomedical applications, packaging techniques for protection of integrated circuits and sensors for long-term implantation in biological environments, miniature implantable wireless microtelemetry systems, and design of microinstrumentation systems for sensing environmental parameters.

NSF CAREER Award

Lee Markosian, for his proposal, "3D Sketchpad," in the NSF Graphics and Visualization Program.

Association for Computing Machinery/Special Interest Group on Design Automation Technical Leadership Award

Igor L. Markov

Best Paper Awards

(EECS Faculty names in bold, EECS Student names in italics)

Samuel T. King, George W. Dunlap, and **Peter M. Chen,** "Debugging operating systems with time-traveling virtual machines," Proceedings of the 2005 Annual USENIX Technical Conference.

S. Krishnaswamy, G. F. Viamontes, **I. L. Markov,** and **J. P. Hayes**, "Accurate reliablity evaluation and enhancement via probabilistic transfer matrices," 2005 Proceedings Design Automation and Test in Europe (DATE).

Sami Yehia, *Nathan Clark*, **Scott Mahlke**, and Krisztian Flautner, "Exploring the design space of LUT-based transparent accelerators," 2005 International Conference on Compilers, Architecture, and Synthesis for Embedded Systems (CASES).

Jeffrey Cox, Thomas Bartold, and **Edmund Durfee**, "A distributed framework for solving the multiagen plan coordination problem," The Fourth International Conference on Autonomous Agents and MultiAgent Systems (AAMAS05).

Clark T.-C. Nguyen and J. Kitching, "Towards chip-scale atomic clocks," 2005 IEEE International Solid-State Circuits Conference.

Betty Cummings Retires After 40 Years

Betty Cummings, Solid-State Electronics Laboratory (SSEL) Senior Research Administrator, retires April 2006 after 40 years of dedicated and outstanding service to the University and the Department.

Betty joined the University in 1996, as secretary to the Assistant Director of the Electron Physics Laboratory (later changed to SSEL). When Prof. George Haddad became lab director, she worked for him, beginning a long-standing partnership. Betty continued to work for Prof. Haddad when he became Chair of the department, at which time her own responsibilities greatly expanded to earn her the title of administrative manager for the department. She agreed to manage the SSEL when Prof. Haddad left the Chair's office the first time in 1986.

Betty saw the annual research funding grow in the SSEL from $815K in 1966, to $11.5M at the present time, and has been responsible for managing this growth since 1987, a formidable task she accomplished with precision and much care. She knew all of the students, and even kept photos of each in case they were to return to the department, so they could be welcomed as remembered friends.

The Department, and especially the faculty of the SSEL, are grateful for her many years of devoted service, and wish her much happiness in her retirement.

RESEARCH EXPERIENCE FOR UNDERGRADUATE STUDENTS

Undergraduate EECS students experience the thrill, hard work, and occasional setbacks involved in conducting research through a variety of opportunities on campus. They may participate in a summer Research Experience for Undergraduates (REU) through the EECS Department, or take advantage of one of the special programs offered by the Center for Wireless Integrated Microsystems (WIMS), or they may participate in the University-wide program, Undergraduate Research Opportunity for Undergraduates (UROP). Some students continue working with faculty after participating in one of these programs, or become involved in a faculty member's research after distinguishing themselves through their coursework. Here are some of our students and their projects.

Lawrence McAfee worked with Prof. Kensell Wise and graduate student Jianbai Wang on the project, "A Tip Sensor and Its Noise Analysis in a Contact Sensing System for Cochlear Prosthesis." As a participant in the WIMS Undergraduate Research Program, Lawrence worked closely with Wang to develop a system based on the program LabVIEW

for providing feedback information during testing of a cochlear electrode array while being inserted into the cochlea. Lawrence plans to attend graduate school in electrical engineering after graduating this term.

Four undergraduate students, **Anshuman Bhuyan, Brandon Gregory, Howard Lei,** and **Seow Yuen Yee**, worked with Prof. Yogesh Gianchandani on the project, "Pulse and DC Electropolishing of Stainless Steel for Stents and other Devices," as participants in the WIMS Undergraduate Research Program. Stainless steel stents have important biomedical applications for cardiac patients. Gregory presented the research at the IEEE Sensors 2005 international conference last November, followed by presentations by Bhuyan and Yee as part of the WIMS seminar series. Yee (see photo) attended the

conference, and said, "I was very impressed with the research from other universities and countries. I am proud to be a Michigan student." She is a junior studying electrical engineering, with a minor in physics. Anshuman Bhuyan will graduate this year, and plans to pursue graduate studies in electrical engineering. Lei graduated last term with his degree in electrical engineering. Gregory graduated last term, and is currently a graduate student in Circuits & Microsystems in the EECS Department.

David Madigan worked with Prof. Satinder Baveja and his research group to develop algorithms and software to allow a Sony AIBO robotic dog to do two new tasks. First, with the help of infrared sensors and touch pads on the feet of the dog, and the use of heuristic algorithms and software code, the dog was able to navigate a cluttered environment. Second, the robotic dog was placed in a specially built, artificial, maze-like environment in which the dog had to find a ball placed in another room and

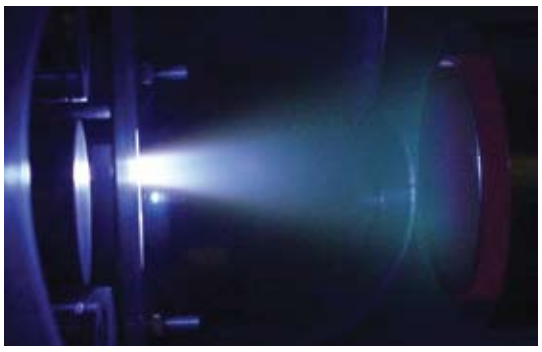
Prof. Satinder Singh, Vishal Soni, David Madigan, Nicholas Gorski

then push it into a target room. Madigan plans to graduate this year with a degree in computer science. Speaking of the project, Madigan said, "I made friends and have kept in touch with the people I worked with on the project. It was a great experience."

Jason Miller worked with Prof. Michael Wellman and his research group as they prepared for the 2005 Trading Agent Competition, Supply Chain Management game (TAC/SCM). Wellman said that Miller played a crucial role on the "Deep Maize" team, which placed fourth in the finals. Jason developed a module for predicting product prices, based on historical data, using a machine learning approach. He employed sophisticated and state-of-the-art methods, and according to Wellman, produced a prediction module that was likely the better or equal of any other TAC/SCM entrant. Jason is continuing to work with Wellman's research group (funded by an NSF grant) on analyzing and improving the methods he developed during the summer REU project.

Scott Boehmer worked with Prof. Kang Shin and Dr. Abhijit Bose on a summer REU research project examining the problem of topological worms spreading over wireless networks on a variety of devices, including mobile phones, PDAs, and laptop computers. In order to gather information on the behavior of such worms, they designed an agent-based simulation that incorporated different mobility and propagation models. Scott performed much of the C++ and MatLab programming for the simulation and contributed to the overall design. Boehmer said he appreciated the opportunity to do self-directed design, and was happy to be invited to continue work on the project. "I have learned a great deal about network security, worm propagation, and wireless networking," said Boehmer, who plans to graduate this year with a degree in computer science and is currently interviewing with several companies.

Vinay Alexander worked with Prof. Jamie Phillips on the project, "Pulsed Laser Deposition of Oxide Thin Films for Integrated Optics and Thin Film Capacitors." "The summer research program provided valuable hands on experience in the field of solid-state electronics and optics," said Alexander. "I learned about the integration of oxide thin films for integrated optics and the working principle behind optical modulators." The photo shows the



process of Pulsed Laser Deposition , where a target containing a specific material is blasted with a laser onto a substrate under different growth conditions (temperature, oxygen pressure etc). Alexander graduated this past December 2005 with a degree in electrical engineering, and is currently working on a project with Prof. Mohammed Islam in the Optical Science Laboratory. He plans to attend graduate school in electrical engineering.

Patrick Macnamara worked with Professors Stéphane Lafortune and Demosthenis Teneketzis on the project, "Correlation and Classification of Internet Traffic Anomalies." He developed a program in C++ to extract information from raw Cisco NetFlow files, and analyzed the performance of a hierarchical approach to monitor and classify a large number of alerts generated by anomaly-based intrusion detection systems at spatially distributed sites on the Internet. "I learned much about the Internet and network security through this REU," said Macnamara, who plans to graduate this semester with a degree in computer engineering, and then pursue a graduate degree in economics.

Left: Julia Lipman, Leyla Nazhandali, Michael Moffitt, Prof. John Hayes.
Ed Nightingale not available for photo

2005 CSE Honors Competition

The 2nd Annual Computer Science & Engineering (CSE) Honors Competition was held November 11, 2005. Four graduate student finalists, representing different research areas in CSE, presented papers before a panel of judges, faculty, and fellow students. The finalists were selected by faculty in their respective areas, and approved by the CSE graduate committee, chaired by Prof. John Hayes.

With their winning papers, Julia Lipman represented Theory, Leyla Nazhandali - Hardware, Michael Moffitt - Artificial Intelligence, and Ed Nightingale - Software. The overall winner was Leyla Nazhandali, for her paper, "Architectural Optimization for Performance- and Energy-constrained Sensor Processors."

Google sponsored the competition, and was represented by three U-M alumni: Marius Eriksen (BSE CE, '04), Eric Pollmann (BSE CE, '97), and Clay Wood (BSE CE, '02 and MSE CE, '03). Eriksen assisted in the judging, and said, "The papers were extremely strong. Overall, this was much better than any conference I have been to in recent times, both in terms of innovation and impact of work. It was very difficult to select one winner." Nazhandali was awarded $1,000, Moffitt took 2nd place and $500, and Lipman and Nightingale received honorable mentions and $250.

U-M Team Wins the 2005 CADathlon

Matthew Guthaus and Jarrod Roy took first place in the 2005 ACM SIGDA programming contest, CADathlon, held at ICCAD in San Jose, CA, November 6, 2005. Their team name was named "Underdogs," perhaps a bit deceptive since Matthew Guthaus was a member of the winning team in the 2003 CADathlon, and Jarrod Roy was a member of the winning team in the 2004 CADathlon.

Guthaus is a PhD candidate in electrical engineering. His dissertation topic is design automation of robust clock networks using parametric statistical STA. Other research interests include physical design automation, low-power architecture for embedded systems, and algorithm specific microprocessors. Jarrod is a Ph.D. candidate in Computer Science & Engineering. His research interests include VLSI physical design as well as SAT and QBF solving.

Team Members: Jarrod Roy Matthew Guthaus
Advisors: Igor Markov Richard Brown, Dennis Sylvester

HKN Receives Outstanding Chapter Award

The Beta Epsilon chapter of Eta Kappa Nu, U-M's student chapter of the national Electrical and Computer Engineering Honor Society, is a recipient of the Outstanding Chapter Award for 2004-05. The plaque was awarded at the ECEDHA (Electrical and Computer Engineering Department Heads Association) Annual Meeting, March 2006. Shown below are the officers for the Winter 2006 term.

Left: Shaun Cox (Treasurer), Jon Cable (Activities Chair), Nan Li (Projects Chair), Eric Wucherer (Vice President), Alex Rutkowski (Bridge Correspondent), Andrew Myrick (President), Steve Stergar (Corresponding Secretary), Matthew Pizzimenti (Newsletter Chair), Kevin Borders (Recording Secretary)

STUDENT HONORS AND AWARDS

College of Engineering Awards

Distinguished Achievement Awards
Undergraduate Students
Patrick Macnamara, CE
Dinkar Jain, CS
Song Chua, EE
Graduate Students
Hai Huang, CSE
DaHan Liao, EE
Doron Blatt, EE-Systems

Marian Sarah Parker Award
Nupur Srivastava, EE undergraduate
Ruba Borno, EE graduate student

Mildred and Steele Bailey Prize
Chee Keong Tee, EE undergraduate

Charles Barth Jr. Distinguished Class Prize
Jacky Lo, CE Undergraduate

Undergraduate Distinguished Leadership
Cody Hartwig, CS/CE

Tau Beta Pi Award
Jack Li, EE undergraduate

EECS Department Awards

Senior Outstanding Achievement Award
Cody Hartwig, CE
Robert Gaunt, CS
Albert Chen, EE

Undergraduate Outstanding Research Award
Daniela Marquez, EE
Tee Chee Keong, EE

Undergraduate Outstanding Service Award
Jack Li, EE
Nupur Srivastava, EE

Graduate Student Instructor Award
Ganesh Dasika, CSE
Marcial Lapp, CSE *
Anthony Nicholson, CSE
Scott Wright, EE

**Lapp was an undergraduate student majoring in computer science and German when he received this award.*

Student Paper Awards

(Student names are in bold, faculty advisor names are in italics)

Bill Gates Says There will be Jobs!!!

Bill Gates visited campus October 12, 2005 to deliver an important message to students interested in the field of computer science – there will be many jobs in the field for the foreseeable future. In fact, the creation of jobs is expected to outpace the number of trained individuals available to fill them, ensuring excellent salaries.

Gates first met with a small group of computer science and engineering faculty during his visit. He wanted them to spread the message to students that computer science careers involve a significant amount of personal interaction; they are not jobs of cubicle isolation. In fact, Mr. Gates stated that for coders and software developers, 60% of the job is people skills, and for program managers, the percentage rises to about 80%.

With a background of loud pulsating rock, prospective students from around the state, current undergraduate students, and some fortunate graduate students, faculty, and staff, sat in anticipation of what Gates might say at the lecture.

"This is an amazing field," said Gates in his talk. "This is the field that is revolutionizing the world more than any other. I was excited to find out that Microsoft hires about 30 people a year from The University of Michigan, and a lot of our top people come from here. So let me thank you for that."

Kevin Buell, "Electromagnetic MetaMaterial Insulator to Eliminate Substrate Surface Waves," 2005 IEEE International Antennas and Propagation Symposium (AP-S). Buell received first prize among the Best Paper Awards for his paper. He graduated with a PhD in Electrical Engineering, December 2005.

Christine K. Eun, R. Gharpurey, and *Yogesh B. Gianchandani*, "Broadband Wireless Sensing of Radioactive Chemicals Utilizing Inherent RF Transmissions from Pulse Discharges," 2005 IEEE Conference on Sensors. Eun is a graduate student in EE.

DaHan Liao and *Kamal Sarabandi*, "Modeling and Simulation of Near-Earth Propagation in Presence of a Truncated Vegetation Layer," 2006 International Union of Radio Science, National Radio Science meeting (USNC/URSI). Liao is a graduate student in EE.

Dan Ruan, J. Balter, M. Roberson, *Jeff Fessler*, and M. Kessler, "Non-rigid Registration using Regularization that Accommodates Local Tissue Rigidity," Young Investigators' Symposium of the Great Lakes Chapter of the AAPM (American Association of Physicists in Medicine). Ruan is a graduate student in EE:Systems.

Alumni Society President's Message

Recruiting for class of '25

Some of the most successful and interesting people have come through the halls of Michigan's department of Electrical Engineering and Computer Science. It's not possible to name them all in such a small space but a few you may or may not know include Larry Page (co-founded Google), Tony Fadell (masterminded the iPod), Kevin O'Connor (founded DoubleClick), Claude Shannon (considered the Father of Information Theory), and Bill Joy (co-founded Sun Microsystems, created Java). Many of our award-winning alumni tell us that their experiences at Michigan prepared them well for success. It's also certain they brought a wealth of potential and aptitude with them when they walked through the door. But why did they walk through this door? Why did they choose to attend Michigan?

Michigan is certainly a fantastic university that attracts top notch undergraduates, but think of all the things high school students have on their mind when selecting their choice for college. This can include:

- Which school has the best academic program
- Which school has the right student body size
- Which school is close enough to home (or far enough away from home!)
- Which school has the right 'culture'
- Which school is affordable

By some measures Michigan is clearly on top. By others, it depends on the student.

Seeing all these criteria, you may be reminded about your own decision to attend Michigan. Was it an easy choice? Did the difficulty only increase when you received acceptances to multiple schools? In the book *The Paradox of Choice* by Barry Schwartz, it's shown that decision stress only increases when we have more options – because if we don't make the right choice we have only ourselves to blame. So what it comes down to is making the right choice for each student.

When you were making your decision, did you get a call from a person representing the University or College? Did you get a 'warm fuzzy' feeling that this place was just right?

One unmistakable reason why Michigan is great (and by consequence the college and our department) is that it attracts the best people. In fact, it's our ability to recruit students that matters most, and recruit is the operative word here. Would our University's sports teams have such a draw on top players if those athletes didn't receive a visit from the coach? You may be surprised how that little but crucial touch can make the difference in a player's decision.

Well, as good as our sports teams are, our academics are even better – and we're recruiting just as earnestly in that department. Now, although 'Coach Munson', our department chair, may make personal calls on top candidates, he needs help from his staff to cover all worthwhile recruits. And, in case you haven't noticed, we don't draw 100,000+ paying fans, or have commercial sponsors, so the term 'staff' is quickly stretched to include volunteers, like, well, like you!

The College of Engineering, and our beloved department, has an official, well-organized volunteer recruiting program. They know what needs to be done and when, and are happy to accept your volunteered time. They can tell you exactly what you can do and when you need to do it. You merely make two or three phone calls to those top high school candidates who have been admitted, but have not yet accepted – those candidates who are on the fence.

Your mission, and I encourage you to accept it, is to make yourself available to a few students, answer their questions, let them know what Michigan meant to you. You can help them make the right decision for their needs.

To become a recruiter for the College of Engineering (remember, high school students apply to the college, not the department), please contact:

Sharon Burch
Director of the Office of Recruitment and Admissions
University of Michigan College of Engineering
(734) 647-7101
sharbu@umich.edu

If you become a volunteer recruiter it may surprise you that you never end up speaking directly to your recruit – they have very busy lives. Nevertheless, simply leaving the message that Michigan cares enough to call them may tip the balance in their decision.

Finally, if you think we might already have enough recruiters, consider this: it means much more to a student to hear from a local alumni than it does to hear from someone far away. This means we need recruiters all over the country and around the globe. You may be just the person we need to reach out to that next gifted student at Michigan, and to continue the tradition that keeps Michigan world class.

Stay true and go blue!

Steve Schwartz, President
EECS Dept. Alumni Society
stevschw@umich.edu

2005 COLLEGE OF ENGINEERING ALUMNI SOCIETY MERIT AWARDS

Electrical and Computer Engineering

Ron Gibala (Interim Dean, CoE), Fred Leonberger, Dave Munson (Chair, EECS) *Photograph by Dwight Cendrowski*

Fred Leonberger, (BSE EE '69; also SM and PhD degrees from Massachusetts Institute of Technology in electrical engineering), founder and principal, EOvation Technologies LLC

Fred Leonberger founded the technology advisory firm EOvation Technologies in 2003, after retiring from JDS Uniphase (JDSU) as Senior Vice President and Chief Technology Officer. At JDSU, he was responsible for strategic technology, and his focal areas spanned product development, strategic planning, OEM customer requirements, and assessment of worldwide market trends and technical advances. He previously served as co-founder and general manager of UTP, a supplier of optical modulators, and in a variety of management and staff positions at MIT Lincoln Laboratory and United Technologies Research Center. He has worked in the area of photonics throughout his career, and his work in integrated optical devices, which focused on high-speed analog and digital modulation, has long been recognized as significantly advancing the field.

Dr. Leonberger recently received the IEEE Photonics Award, sponsored by the IEEE Lasers and Electro-Optics Society for, "technical leadership, commercialization and practical deployment of photonic component technologies for optical communications." He is a recipient of the IEEE Quantum Electronics Award and Millenium Medal, and the United Technologies Corporation George Meade Award. He has served as President of the IEEE Lasers and Electro-Optics Society. He is a fellow of IEEE and OSA (Optical Society of America), and a member of the National Academy of Engineering. He currently serves on the Board of Directors of RF MicroDevices, Inc. and Alphion.

After his recent visit to Ann Arbor during alumni weekend, Leonberger said, "I have a lot of great memories of my undergraduate years at Michigan. I met my wife Jan at Michigan, and we have been married for 35 years." By the time Dr. Leonberger graduated, he was convinced he wanted to work in semiconductors and microelectronics. "I am very grateful to have had the opportunity to attend Michigan, major in EE, and find my career path."

Computer Science and Engineering

Ron Gibala (Interim Dean, CoE), John Sanguinetti, Dave Munson (Chair, EECS) *Photograph by Dwight Cendrowski*

John Sanguinetti, (BS Applied Math '70, PhD, Computer and Communication Science '77), co-founder and chief technology officer, Forte Design Systems

John Sanguinetti has been a pioneer in the field of computer science, particularly in the areas of computer architecture, performance analysis, and design verification. Upon receiving his PhD from U-M in 1977, he began working for a succession of computer manufacturers as a performance analyst, computer architect, and design verification engineer. After working for DEC, Amdahl, ELXSI, Ardent, and NeXT, he founded Chronologic Simulation in 1991 and was President until 1995. He was the principal architect of VCS, the Verilog Compiled Simulator, which greatly contributed to a resurgence in the use of Verilog in the design community. VCS is still the leading simulator for electronic design. Dr. Sanguinetti served on the Open Verilog International Board of Directors from 1992 to 1995, and was a major contributor to the working group, which drafted the specification for the IEEE 1364 Verilog standard.

In 1998, Sanguinetti co-founded CynApps, now Forte Design Systems, to produce high-level synthesis technology for electronic design. He is currently the Chief Technology Officer of the company. Dr. Sanguinetti has been active as an angel investor in the Electronic Design Automation community, and serves on the Board of Directors of several Electronic Design Automation companies. In addition, he is on the Board of Directors of the Myeloma Research Fund as well as the Peninsula Symphony, where he has served as principal trombone for 20 years. John plays trombone in the U-M Homecoming Band when he is in town.

John reflected on his days at Michigan, and his plunge into the world of Silicon Valley:

"A dominant theme of my experience at U-M was the pursuit of excellence. I first encountered this in the Marching Band under Dr. Revelli, and then at the Computing Center. Embracing this attitude changes one's life. I had to stretch myself to keep up in that environment. There were symbols of excellence throughout the university then, as there still are. Bo Schembechler was one of the more visible ones. Dr. Revelli was another. Michigan football represented the pursuit of excellence, and you could measure it on the scoreboard. The Marching Band did, too, and you could hear it on the field. Leaders and Best is not just an empty slogan.

When I moved to Silicon Valley in 1982, it was a hotbed of entrepreneurship. Those who started companies and got rich were celebrated and admired for creating products and businesses, and measured by the IPO numbers. In a very real sense, the stock listings were the scoreboard. I had the self-confidence that I could fit in to that world, though it took me a long time to come up with an idea that was good enough for me to take the plunge. In the end, self-confidence, ambition, and the intellectual foundation to make a reasonable judgment about what to do and how to do it will allow you to make an impact on the world. I got all those things at Michigan."

2005 College of Engineering Alumni Society Recent Engineering Graduate Award

Jennifer Rexford, Ron Gibala (Interim Dean)
Photograph by Dwight Cendrowski

Jennifer Rexford (MSE, PhD, CSE '93, '96) received the 2005 Alumni Society Recent Engineering Graduate Award for her remarkable record of groundbreaking research and intellectual achievement in the relatively short period of time in which she has been working in the field of data networks. She joined the Computer Science Department at Princeton University as a professor in 2005, following more than 8 years at AT&T Labs-Research as Technology Leader in the IP Network Management and Performance department.

Rexford is a leading thinker in the field of data networks. Her research focuses on Internet routing, network measurement and network management. She aims to make data networks easier to design, understand and manage. She is recognized for her pioneering work on Internet traffic engineering and Border Gateway Protocol (BGP) analysis and configuration. Rexford co-authored the book *Web Protocols and Practice*, an all-in-one reference text about the core technologies underlying the web, including a detailed evolution and explanation of its building blocks. She holds six patents.

In 2004, Technology Review magazine named Prof. Rexford to its annual TR-100 list of top innovators under the age of 35. That same year, the Association for Computing Machinery recognized her with the Grace Murray Hopper Award as the outstanding young computer professional of the year for her work on assuring stable and efficient Internet routing.

Rexford is chair of the Association for Computing Machinery's Special Interest Group on Data Communications. She is also a member of the ACM Council and the Computing Research Association Board of Directors.

Credit: CoE Media and Marketing for background and summary information about the CoE award recipients.

FOCUS ON OUR ALUMNI

David Pennock, Principal Research Scientist, Yahoo! Research

DAVID PENNOCK (PhD, CSE '99), Principal Research Scientist at Yahoo! Research, was recently named to MIT Technology Review's list of 35 "top technology innovators under age 35" for 2005. Pennock is one of a growing vanguard of economically literate computer scientists who are teaming with computationally-literate economists to create the trading bazaars of the digital age. To Pennock, nearly everything is tradeable - from traditional goods (think eBay) to more ephemeral objects like user's clicks on a web page (sponsored search auctions) or speculative bits of information (financial futures, derivatives, and gambling markets).

Pennock's most notable work is in the area of information markets. He and his colleagues have examined the computational process and speed of information propagation in an information market, and the computational complexity and algorithms required for an auctioneer to simultaneously match-up opposing speculative wagers expressed as arbitrary Boolean logic formulas. Pennock has analyzed a number of real online information markets, and shown that even fake-money Internet games can have a surprising ability to predict the future success of whatever is being bartered.

Pennock's most recent invention is the dynamic parimutuel market, a new financial auction mechanism good for low-liquidity environments found in derivatives trading and information markets. The dynamic parimutuel is featured in Yahoo!'s Tech Buzz Game, a high-tech fantasy market used to gauge traders' collective wisdom about technology trends. Players try to predict what technologies will be popular with web searchers. To find out more about this game, and begin to play yourself, go to: http://buzz.research.yahoo.com.

Pennock has three patents in progress in the area of electronic commerce and the WWW, including a new financial framework for web search advertising, where impressions and clicks aren't simply sold by search engines to advertisers, but are actively traded back and forth in analogy to today's commodity futures exchanges. Pennock says that such "search futures" might "open up a whole new world of hedging and speculating." Pennock has over 50 academic publications in conferences and journals. His work has been featured by Discover Magazine, New Scientist, CNN, the New York Times, the Economist, and several other publications.

Prior to his current position at Yahoo!, Pennock worked as a research scientist at NEC Research, and in 2001 served as an adjunct professor at Pennsylvania State University. At Michigan, Pennock worked with Michael Wellman, a professor in the Artificial Intelligence Laboratory. Wellman describes Pennock as, "an extremely innovative researcher, well positioned to exert continuing technical impact on prediction markets, sponsored search, and other areas of Internet life."

Pennock is program co-chair of the 2006 ACM Conference on Electronic Commerce (EC'06), which will be held June 11-15 in Ann Arbor, MI. This conference is sponsored by the ACM Special Interest Group on Electronic Commerce (SIGecom), chaired by Prof. Wellman.

2006 ACM Conference on Electronic Commerce

June 11-15, 2006
Ann Arbor, MI

http://stiet.si.umich.edu/ec06

1940s

RUSS YOUNGDAHL (BSE EE '46) was glad to hear about the mentoring opportunity for students, and for alumni. Having recently retired for the fourth time, he has a wealth of experiences to share. At Consumer's Energy, where he spent 38 years, he started as a junior engineer and retired as Executive Vice President and board member. He then was President and board member of Long Island Lighting, retired, and opened his own consulting company back in Michigan. His fourth career was as an elected official, Township Supervisor, for eight years. He tells students:

> *"Being an engineer is an interesting job and you can make a career out of it. But I also think you'll find that you can spread that background, that knowledge, into other fields. That's why I branched into management, I've been in civic clubs, and served on several national committees that dealt with a variety of issues, including nuclear power, licensing plants, building, and operating plants. When I got out of one of my last retirements, I decided to get into local politics. These are the kinds of things engineering students can do. They can contribute to their society. It's challenging, sometimes a little frustrating, but rewarding."*

1970s

RICHARD DAVIDSON (BSE EE '70) received the 2004 American Radio Relay League (ARRL) Herb S. Brier (W9AD) Instructor of the Year Award. Davidson has taught license classes to those wanting to receive their Amateur Radio license since 1994, while being education director and ham class instructor for the North Shore Radio Club. He was active in the U-M ham radio club, W8UM, during his years as a student. He tells us, "I still have a QSL card in my collection that I saved from the times when we operated the station on the top floor of the East Engineering Building."

1980s

STEPHEN FENWICK (BSE EE '88) is a senior software engineer in the Applied Technology department of Motorola, Inc. Upon graduation from U-M, he went to Motorola, developing software in CGISS for the new generation of all-digital two-way police radios, both hand-held and mobile. He then moved to the Applied Technology department, where he has developed systems and software on several wireless products for government customers. Outside of work, Fenwick and a co-worker have been working to enhance an Internet-connected display box they developed, which won an honorable mention in a 2004 contest in Circuit Cellar magazine. On weekends, he volunteers his time at Chicago Canine Rescue helping dogs find owners to adopt them, and Vital Bridges, an organization which provides food and health counseling for people with AIDS. He received his MSEE from the Illinois Institute of Technology in 2005.

HOSSEIN JADVAR (MSE CICE '86) went on to earn a PhD in bioengineering (1988) from Michigan, an MD degree from the University of Chicago in 1993 and a MPH degree from Harvard University in 2005. He completed post-graduate medical training with an internship in internal medicine at UCSF (1993-94), a residency in diagnostic radiology and nuclear medicine at Stanford University (1994-98), and a fellowship in positron emission tomography and nuclear oncology at Harvard Medical School (1998-99). He is also currently pursuing a MBA degree (Class of 2007) in the Executive Program of the Marshall School of Business at the University of Southern California. He joined the faculty of the University of Southern California in Los An-

geles in 1999, and is a tenured Associate Professor in the Department of Radiology with a joint appointment in the Department of Biomedical Engineering. He is also a Visiting Associate in Bioengineering at California Institute of Technology in Pasadena. His research is currently supported by the NIH and is focused on the imaging evaluation of cancer. He is married and has two daughters (3.5 years and 5 month old), and lives at the foothills of Mount Wilson in the beautiful "city of roses," Pasadena, CA.

RICHARD P. (RICK) WALLACE (BSE EE '82) has been named chief executive officer (CEO) of KLA-Tencor Corporation. Wallace joined KLA-Tencor in 1988 as an applications engineer, and most recently was President and COO of the company. During his time at KLA-Tencor, Wallace has been responsible for the Wafer Inspection Group, Reticle and Photomask Inspection Division, Films and Surface Technology Division, Software and Customer Groups, and the Lithography Control Group. Wallace has been credited in a recent press release with playing an important role in KLA-Tencor's strong market and technology position. After his undergraduate degree at U-M, Wallace earned a master's degree in engineering management from Santa Clara University.

1990s

JEFF ABRAMSON (BSE CE '89, MSE CSE '91) and his wife, Nicole, welcome Trevor Douglas Abramson to their family, born January 17, 2006. Jeff is a General Manager at Intel Corporation and also owns his own business, Rainy Day Games. Trevor has an older brother Mitchell (28 months old). The family lives in Beaverton, OR.

AMIR A. AMINI (PhD EE '90). After 10 years at Washington University School of Medicine (past 5 years as Associate Professor and Director of Cardiovascular Image Analysis Lab), Amini will be moving to the University of Louisville in August 2006 where he will hold an endowed chair in bioimaging as a full professor of Electrical and Computer Engineering. He will also have a lead role at the Cardiovascular Innovations Institute directed by Laman Gray, M.D. (the heart surgeon who performed the first totally artificial heart implant in the world). Until August, he can be reached at amini@wustl.edu, URL: http://www-cv.wustl.edu

SVEN G. BILÉN (MSE EE '93; PhD EE '98) is professor of Engineering Design and Electrical Engineering, and Chief Technologist at the Center for Space Research Programs at The Pennsylvania State University. He was on campus recently as a panel member with the College of Engineering Career Path Series, where U-M students can learn from alumni how they chose their current careers.

JAMES A. D'ANTONIO (BSE, CE '99) started working for Anderson Consulting, now Accenture, upon graduation. He is currently an M2 (2nd year manager). His specialization is the IT Asset Management group within the Data Center Operations organization. He is serving in his 5th year as head coach for the University of Michigan Roller Hockey team.

MATTHEW GERLACH (MSE EE '98) worked at SandCraft Inc. (Santa Clara, CA) for close to 6 years before leaving for Nvidia Corp. (also of Santa Clara, CA). His job focuses on circuit and cad design for Nvidia's next generation graphics processors. He recently moved from the bay area back to Michigan to be closer to family and friends, and telecommutes for Nvidia out of his home. Go Blue!

2000s

TIMOTHY BRANDT (BSE CE '02) stayed at U-M after graduation to take a graduate course in 'Geometric Modeling' while working on a computer animation project. That led to a short gig with CIS: Hollywood, working on visual effects for the movie 'The Core'. He then worked for Warner Bros. Animation, a small post house called 'Ring of Fire', and since May 2004 has been at Sony Pictures Image-

works. He worked as Look Development Technical Director on their first CGI feature, 'Open Season,' and will be moving into the software department to help with the new proprietary lighting / compositing tool, Katana. Using Katana, he will help the current shows (Spiderman 3 / Beowulf / Surfs Up) find a good workflow, and help write specific tools that they need. Next Fall, he will start work on the third Sony Pictures Animation film, 'Cloudy, With a Chance of Meatballs,' as a shader writer. Timothy tells us, "after being put on academic probation my sophmore year, I became very serious about school and realized all the wonderful opportunities available at The University of Michigan. I am eternally grateful for how well the University prepared me for my career. Thank You and Go Blue!"

TUCKER DEAN BERCKMANN (BSE CE '05) received a Fulbright Scholarship to work with the FORBIAS project at the Technical University of Munich (TUM), where he is studying computer systems in self-guided automobiles. Tucker has

been interested in Germany even as a youth, and spent a year in Munich at TUM during his junior year at U-M. The photo shows Tucker in front of the Rathaus (City Hall) on Marienplatz (Main Square) in Munich.

JOANNA [BORDERS] BONJOUR (BSE CS '05) married Andy Bonjour May 28, 2005. They live in Steubenville, OH. Joanna is currently doing freelance web development. They are expecting their first child.

JILL DIMOND (BSE CS '05) is working at a usability firm in Seattle working as a user interface designer (designing the look and flow of software and websites) and as a usability engineer (testing the software with actual users). She has been working with clients such as Microsoft, Amazon, and small dot com startups.

SURAJ MANSUKHANI (BSE EE '02) and **PREMA KUMAR** (BSE CE '03) tied the knot November 25, 2005 in Dearborn, MI. They both work for the Boeing Company in Houston, TX.

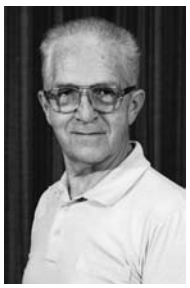
CARMELA [BARNES] YOUNG (BSE CE '03) is an embedded software engineer at Smiths Aerospace in Grand Rapids, Michigan. She tells us, "It will be 3 years in May since I've been at Smiths and I really enjoy my position! In May, 2004 I was married, and my husband, Eann, and I reside in Grand Rapids. I enjoy my field so much that I am planning to further my education by obtaining a Masters degree in Electrical and Computer Engineering with an emphasis in Computer Architecture/Embedded Systems from Michigan State University beginning this summer of 2006. I will continue to work full-time to take advantage of my company's tuition-assistance program. I'm really excited about my Master's opportunity and I am thankful to the U-M EECS Department for helping me to obtain a solid Computer Engineering foundation to do well within my career, and to God for blessing me with the opportunity to attend. I would like to extend special thanks to Prof. Martha Pollack, Prof. Toby Teorey, and Prof. Todd Austin who have been great mentors and provided excellent guidance and support of my goals and aspirations while I was at U-M and beyond.

IN MEMORIAM

SUSHILA (SUSHI) RAJALAKSHMI SUBRAMANIAN (MSE, CSE '91) passed away peacefully at her home June 21st, 2005 after a difficult struggle with cancer. After graduating from U-M, she consulted for several companies in the software systems area. She worked at U-M's CITI (Center for Information Technology Integration) between 1991-93, at the School of Information on the UARC (Upper Atmospheric Research Collaboratory) project from 1996-98, and for Professor Farnam Jahanian from 1998-99. Sushi was known for her love of art and music, and she enjoyed playing guitar. She will be greatly missed. Her husband, Daniel Kiskis, is an Assistant Research Scientist in the Real-Time Computing Lab of the EECS Department.

Memorial donations can be sent to:

The Sushila R. Subramanian Memorial Fund
c/o The University of Michigan Women in Engineering Office
1240 LEC
1221 Beal Ave.
Ann Arbor, MI 48109



LOUIS FRANK KAZDA, emeritus professor of electrical engineering, passed away peacefully in his home in Las Cruces, New Mexico, January 15, 2006. Prof. Kazda joined the faculty of the University of Michigan as an instructor in 1947, achieved the rank of full Professor in 1960, and retired in 1985.

Professor Kazda worked at U-M's Willow Run research facility, and participated in research that contributed to the department's development of a major graduate program in the control and communication systems area. He later turned his attention to energy systems, and served as Director of the Power Systems and Energy Conversion Laboratory during the period 1975 to 1980.

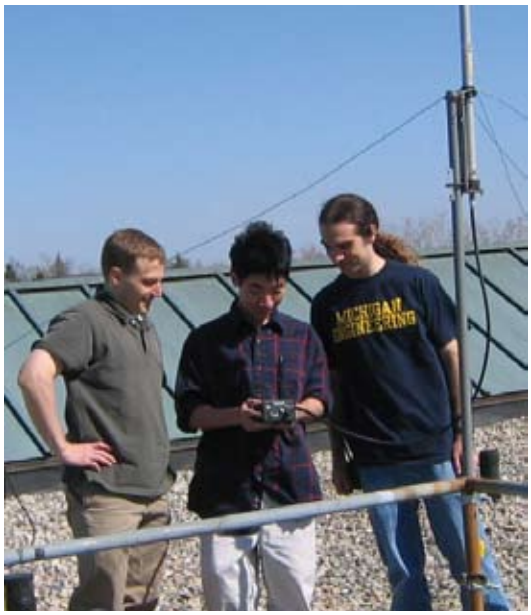
Professor Kazda graduated twenty-two Ph.D. students, published in major technical journals, and received a number of professional honors, including the IEEE Centennial Medal and Certificate in 1984 in recognition of his exceptional service to the profession. He was a Fellow of the IEEE.

Following his retirement from U-M in 1985, he and his wife, Jane, moved to Las Cruces, New Mexico, where he continued to inspire students, teaching for many years at New Mexico State University. Professor Kazda is survived by two of his daughters — Sally Stites of Norman, Oklahoma, and Joan Kazda of Las Cruces, New Mexico; and by four grandchildren and seven great-grandchildren. His wife Jane, and his third daughter, Judith Ann, both predeceased him.

The Department of Electrical Engineering and Computer Science offers its sincere condolences to the family and friends of Louis Kazda and expresses its gratitude for his many years of dedication and service to his students, colleagues and the University. He was a dedicated and thoughtful individual whose contributions will be appreciated for many years to come.

AMATEUR RADIO CLUB NEEDS ALUMNI HELP!

Founded in 1913, the University of Michigan Amateur Radio Club (UM-ARC) has been pursuing an ambitious revitalization program since the new shack was dedicated last year. Included in the station is a new Omni-VI donated by alumnus and Ten-Tec president Jack Burchfield, K4JU. A satellite station is being developed with the help of the EECS 430 class and an ARRL Education and Technology Development Grant. A donated SB-220 2 kW amplifier is also being rebuilt to power the club's signal all over the Earth. The club has been granted approval for a 40 foot HF tower to be installed on the EECS building, which will allow the tower to be above the noise generated by industrial equipment on the top floor. Valued at over $3,500, a Tennadyne T12 log periodic antenna and a Telex Tail Twister rotator have already been donated to support the "Sponsor a Foot" campaign. With the total cost of the tower estimated at $10,000 the club needs the support of alumni and amateur radio enthusiasts everywhere to meet the funding requirement and complete the club's revitalization. With the new tower, amplifier and satellite station, UM-ARC will become the envy of college radio clubs all over the Big Ten. Only with your help can UM-ARC realize its ambitious goals of establishing a fully capable amateur station to knock the socks off MSU in the next Michigan QSO party. Check out UM-ARC's website at www.umich.edu/~umarc to see how you can help, 73!



Christopher Galbraith, John Suen, and Noah Liebman on the roof of the EECS Building.

Contribute to the EECS Alumni Society Fund

Support your alumni society efforts in mentoring, networking, recruiting, scholarships, and alumni events.

Name(s)_____

❑ *Please don't publish my name*

Address _____

_____

_____

Phone _____

Enclosed is my gift of:

❑ $500 ❑$250 ❑ $100 ❑ $50 ❑ Other _____

Thank You!

❑ I have enclosed my employer's matching gift form
❑ My check is payable to the University of Michigan
❑ Charge to ❑MC ❑VISA ❑AMEX ❑Discover

Account Number _____
Signature _____
Expiration Date _____
E-mail _____

Mail To: ATTN: Catharine June
EECS Alumni Society
1301 Beal Avenue
Ann Arbor, MI 48109-2122

EID# 317930 AGG BAA06 EN04

Electrical Engineering and Computer Science

THE UNIVERSITY OF MICHIGAN

NONPROFIT ORG.
U.S. POSTAGE
PAID
ANN ARBOR, MI
PERMIT NO. 144

1301 Beal Avenue
Ann Arbor, Michigan
48109-2122

MichiganEngineering