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E@M

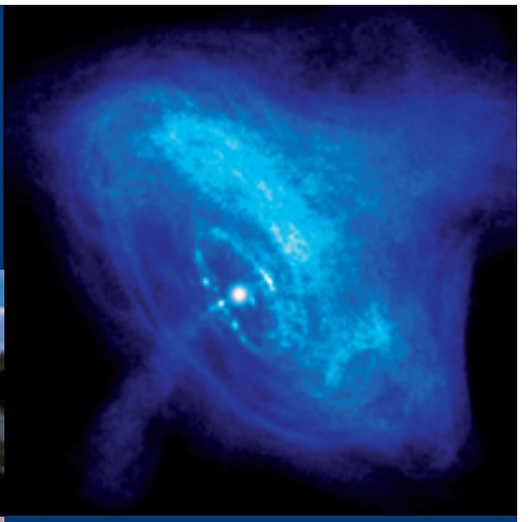
ENGINEERING @ MARYLAND

OPENING DOORS FOR FEMALE ENGINEERING STUDENTS

Clark School Takes Pioneering Role

INSIDE

A. JAMES CLARK SCHOOL OF ENGINEERING ▪ University of Maryland



STORIES

DEPARTMENTS

Publisher
A. James Clark School
of Engineering

Nariman Farvardin
Dean

Nelson Marban
Acting Assistant Dean

Editorial Staff
Nancy Grund
Editor

Paul Adams
Contributing Writer

Kristine Henry
Contributing Writer

Design Staff
John T. Consoli
Creative Director

Jason Quick
Contributing Designer

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Letters to the editor and alumni notes are welcome. Please send them to *Engineering @ Maryland* Editor, 1137 Glenn L. Martin Hall, University of Maryland, College Park, MD 20742. Information can be sent by fax to 301.314.9867 or by e-mail to ngmarban@umd.edu

Dear Alumni and Friends:

THE PRACTICE OF ENGINEERING often reminds us of a basic insight, one that is applicable not only in solving specific engineering challenges, but in many areas of life: To obtain useful answers, we must first ask useful questions. Take, for example, the question often posed by U.S. corporations and government agencies: "Where will we find the engineers the nation needs?" I submit that this is not a sufficiently useful question. It is better to ask, and it is indeed the special responsibility of engineers in academia to ask, "How will we make the engineers we need?"

The distinction is an important one. If we think the problem lies in finding engineers, we will likely come up with short-term answers, such as: "We will find the engineers we need by looking to other countries and importing their engineering professionals or outsourcing our work to them." Both of these solutions are used today, successfully and with little controversy, by U.S. employers, but they are short-sighted solutions. At some point, engineers in other countries will find it more advantageous to compete against us rather than to work for us, or politics will erect barriers to cross-border trade. At that point, importing and outsourcing will no longer be profitable or even possible.

If we see the problem as how to make more engineers, we will devise more useful answers that will serve us better in the long term. One answer is to increase the number of people who seriously consider engineering as a likely profession. As you will see in this issue of *E@M*, the Clark School of Engineering is a leader in this area. We encourage individuals to enter the field who, because of limited information and support or social and cultural constraints, would otherwise never be given the opportunity to explore what engineers do, never realize they could build satisfying careers in engineering and never take the steps to prepare for an engineering education.

Women are a primary example. For 30 years, at the instigation of pioneering female faculty members, the school has developed and supported a variety of programs, collectively known today as Women in Engineering. Together, the Women in Engineering programs increase awareness of engineering among middle and high school girls, and support undergraduate women through mentoring networks and research opportunities. One such program, Research Internships in Science and Engineering (RISE), arranges mentored research projects for undergraduate women, exposing students to the academic research experience and establishing lasting partnerships between students and female faculty members—role models for their engineering careers.

Another current program, Teachers Integrating Mathematics and Engineering (TIME), seeks to find potential engineering school candidates within low-income communities. For example, in selected Prince George's County middle and high schools, TIME creates a higher awareness of engineering and math among administrators, counselors, and math and science teachers, helps those schools develop stronger math curricula and raises students' interest in these fields. Success in Prince George's County may lead to the creation of a national TIME program.

As alumni and friends of the Clark School, you can play a vital role in extending the school's reach in these efforts—improving society's awareness of engineering, encouraging students to explore the field, helping to make the engineers we need. What ideas do you have on this topic? We welcome your input and participation.

Nariman Farvardin, *Professor and Dean*

Educating Teachers About Engineering

GE Foundation Supports Math Excellence Initiative

Through a program funded by the General Electric Foundation, Clark School faculty in collaboration with the College of Education are working with teachers in four of the neediest schools in Prince George's County, Md., to develop a stronger mathematics curriculum and to raise student interest in engineering careers.

The Teachers Integrating Mathematics and Engineering (TIME) program kicked off in July with a one-day seminar for school administrators, guidance counselors, principals, and high school and middle school math and science teachers. Clark School Dean Nariman Farvardin, along with several department chairs and representatives from minority student programs, the Women in Engineering programs and the school's co-op and career services program, met with the group.

"There is a well-established shortage of interest among high school students in areas relating to math and technology," relates Farvardin, principal investigator for the program. "For our nation to continue to innovate and stay on the cutting edge of technology, we must take steps to encourage this interest."

Farvardin's presentation underscored the interaction between engineering and society and highlighted some of the most significant engineering contributions in the last century. "It is not just that engineers have made our lives simpler or more convenient but they have basically changed the way we live," notes Farvardin.

Following the seminar, a two-week program for high school and middle school math and science teachers introduced engineering-related subjects that teachers could take back to their classrooms this fall to inspire students to learn mathematics and make the connection between engineering and technology. Civil, mechanical and electrical engineering faculty taught the program, which included an engineering primer and hands-on activities designed to raise interest in such areas as surveying and geographical positioning systems, wind and solar energy, and the structural design of bridges and forces.

"Many high school students are not even aware of the career choices open to them in engineering unless a relative is an engineer," shares Richard McCuen, professor of civil and environmental engineering and program director. "We are working with teachers and guidance counselors to make students more aware of engineering as a career option."

Farvardin is optimistic about expanding the program, extending it throughout the region and establishing it as a successful model for other universities to replicate. ■

Academy of Scholars Builds Engineering Community

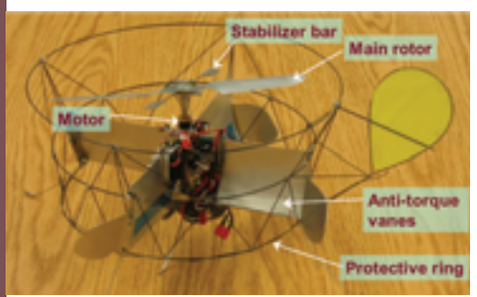
This fall, a select group of Clark School freshmen will be the first participants in Inventis: The Academy of Engineering Scholars, an exciting new program that features one-on-one mentoring from distinguished faculty, special academic and professional development programs, and research and teaching opportunities tailored to students' interests. "Inventis is the latest in a series of innovative programs offered through the Clark School that combines academic development with building an affiliated community of talented students," says Clark School Dean Nariman Farvardin.

Inventis students are matched with a mentor, selected from among the Clark School's distinguished university professors, recognized scholar-teachers, and recipients of the school's outstanding teaching or research award. During their freshman and sophomore years, mentors join students in a number of informal and formal events to share knowledge and to strengthen students' sense of belonging within the school.

Students also attend a series of workshops, seminars and field trips. As both freshmen and sophomores, Inventis students register for one-credit seminar courses taught by the dean. The spring seminar will cover such topics as the importance of team dynamics; technology entrepreneurship; ethics; and technology management issues. As Inventis students further define their career paths, they may choose to participate in research projects as undergraduate research fellows working closely with faculty or to become undergraduate teaching fellows assisting faculty members with first- or second-year level classes.

"This program gives students the flexibility to delve deeper into either research or teaching, depending on where their interests lie," says Jane Fines, director of special programs for the Clark School. "It will be an excellent tool for recruiting outstanding students and ensuring they remain throughout their careers at the Clark School." ■

Major Awards Recognize Clark School Expertise



Micro hovering air vehicle with 27-centimeter diameter rotor and anti-torque vanes

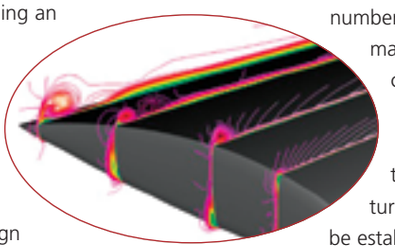
MURI Award for Micro Hovering Air Vehicles

Clark School faculty have obtained a Multidisciplinary University Research Initiative (MURI) award of more than $5.25 million over five years from the Army Research Office. The research on "Micro Hovering Air Vehicles: Revolutionary Concepts and Navigational Advancements" will accelerate the development of the next generation of micro hovering air vehicles (MAVs) that will be equipped with biologically inspired navigation, guidance and collision avoidance algorithms to support Department of Defense applications. Clark School expertise will be particularly important in designing and developing efficient micro hovering air vehicles and image processing.

The MURI is a collaborative effort among the University of Maryland, the Australian National University and North Carolina A & T University. Industrial partners, Centeye Inc. and Athens Technologies, have agreed to collaborate as commercialization partners at no cost to the program. The principal investigator for the project is Inderjit Chopra, the Alfred Gessow Professor, and participating aerospace engineering faculty members are Ella Atkins, James Baeder, Chris Cadou, Roberto Celi, Alison Flatau, J. Gordon Leishman, Darryll Pines, Frederic Schmitz, Ben Shapiro and Norman Wereley along with mechanical engineering faculty members S.K. Gupta and Elisabeth Smela and electrical and computer engineering faculty members Rama Chellappa and Reza Ghodssi.

DARPA Grant for Quiet Helicopters

The Clark School is leading an effort along with Stanford University to develop a next-generation, physics-based Hyrbrid Unsteady Simulation for Helicopters (HUSH) design capability to enable the development of quiet helicopters. The two-year, $3.25 million grant from the Defense Advanced Research Projects Agency (DARPA) builds on the expertise of the Alfred Gessow Rotorcraft Center in rotorcraft aeromechanics, computational fluid dynamics and noise prediction. James Baeder, professor of aerospace engineering, is principal investigator for the project.



Computer simulation of a helicopter tip vortex

Center for Energetic Concepts Development for Manufacturing

The Clark School and the Naval Surface Weapons Center (NSWC) in Indian Head have signed a new $10 million, five-year cooperative activity contract in support of the Center for Energetic Concepts Development (CECD). The center, directed by Mechanical Engineering Professor Davinder K. Anand and established in 1998 as a cooperative research activity between the two institutions, is engaged in a number of activities including lean manufacturing, data mining, combustion systems, functionally graded materials and safety. Under the new contract, a world-class manufacturing center in energetics will be established and a master's of engineering program in energetics will be designed specifically for NSWC. ■

Keck Foundation Funds Lab for Revolutionary Nanoscale Research

The university has received a major award from the W.M. Keck Foundation of Los Angeles to establish a revolutionary laboratory with unprecedented capabilities for rapid exploration of advanced complex smart materials and memory devices, as well as systematic investigation of their physical mechanisms. The Keck Laboratory for Combinatorial Nanosynthesis and Multiscale Characterization brings together Clark School and College of Computer, Mathematical and Physical Sciences (CMPS) expertise in materials research, particularly in complex multifunctional oxide materials, combinatorial materials science, surface nanostructures and integrated materials processing. Researchers will build on these areas of strength to gain new insights into the behavior of materials at the nanoscale.

The laboratory will be located in the new Jeong H. Kim Engineering Building, scheduled to open in early 2005. The state-of-the-art laboratories and equipment will enable researchers to establish clear correlations and deep understanding of how the architecture of materials at the nanoscale determines the properties and performance of complex material systems.

The lab was conceived by professors Ichiro Takeuchi, Gary W. Rubloff, and Ellen Williams. A distinguished university professor in physics and the Institute for Physical Science and Technology (IPST), Williams is founding director of the National Science Foundation Materials Research Science and Engineering Center (MRSEC) at Maryland, a leader in the synthesis and characterization of complex material systems, the development of surface nanostructure probes and in understanding the underlying physical mechanisms of materials and surfaces at the nanoscale. An associate professor in materials science and engineering and the Center for Superconductivity Research, Ichiro Takeuchi is a pioneer in combinatorial materials science and multifunctional materials. Gary Rubloff, a professor in the department of material science and engineering and the Institute for Systems Research (ISR), is a leader in ultraclean, integrated processing and characterization of electronic materials.

The W.M. Keck Foundation, one of the nation's largest philanthropic organizations, was established in 1954 by the late William Myron Keck, founder of The Superior Oil Co. The foundation primarily funds medical research and science and engineering projects. ■

NSF Early Career Award Winners

This spring, five assistant professors were recognized for their research with the prestigious National Science Foundation Early Career Award. Winners pictured, front from left, are Srinivasa Raghavan, Ben Shapiro and Timothy Horiuchi. Back from left, Ella Atkins, Elias Balaras and Michel Cukier, assistant professor in mechanical engineering, who received the award last year. A description of this year's award-winning work is listed below:

PHOTO BY JOHN T. CONSOLI

ELLA ATKINS, aerospace engineering, for her work on state-dependent resource management for integrated task and motion plans. Her project investigates knowledge representation and inference mechanisms for end-to-end plan construction domains, such as spacecraft flight, where resource consumption depends both on computational processes and physical characteristics of each vehicle and its environment.

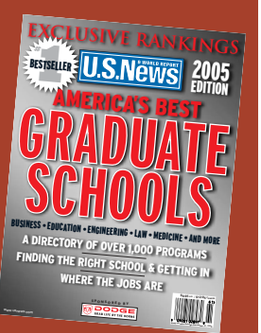
ELIAS BALARAS, mechanical engineering, for his work on large-eddy simulation of turbulent flows with dynamically moving boundaries. Balaras will be developing new adaptive numerical techniques that enable highly accurate large-scale simulations of complex biological flows, with potential applications in cardiovascular medicine and biomimetics.

TIMOTHY HORIUCHI, electrical and computer engineering and Institute for Systems Research (ISR), for his work on adaptive neuromorphic VLSI (very large scale integration) for improving accuracy and precision: modeling attention for bat echolocation. The main goals of his research are to expand the use of adaptive circuits and non-volatile analog memories to increase computational precision and accuracy at the system level using bats as natural system models. The research intends to raise awareness about how acoustic cues that surround humans can be used for sensing in engineered devices.

SRINIVASA R. RAGHAVAN, chemical engineering, for his work on self-assembled light-sensitive fluids with tunable rheological properties. The goal of his research is to use light to switch back and forth from a Jello-like, or highly viscous, fluid to a thin, runny fluid that resembles water. The technology could be used in building microvalves or micropumps in MEMS devices.

BEN SHAPIRO, aerospace engineering and ISR, for his work on feedback control of microfluidic packets and the bioparticles within them. His research concentrates on modeling, design and control of miniaturized devices with a focus on microfluidic systems. Applications include lab-on-a-chip systems, cancer screening and biochem sensing. ■

Clark School Scores High in U.S. News Rankings



The most recent issue of "America's Best Graduate Schools," published by *U. S. News & World Report*, ranks the A. James Clark School of Engineering and its graduate programs among the very best in the nation. The Clark School is ranked 16th overall and 10th among public universities.

Under engineering specialties, six of the Clark School's programs have been ranked among the top 25: aerospace engineering is ranked ninth (fifth among public universities); electrical engineering is 14th (eighth among public universities); computer engineering is 16th (ninth among public universities); civil engineering is 22nd (15th among public universities); materials engineering is 23rd (13th among public universities); and mechanical engineering is 24th (15th among public universities).

"These achievements are a testimony to the quality of the Clark School faculty, staff and students and a reflection of our collective commitment to excellence. We have established our leadership in engineering education by recruiting outstanding faculty members, launching new research, strengthening well-established research programs and developing outstanding academic experiences for our students," states Engineering School Dean Nariman Farvardin. "We will continue to build one of the very best engineering programs in the world." ■

Professional Recognition

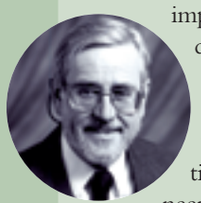
National Academy of Engineering Selects Faculty


KIM

Three members of the university faculty have achieved the highest professional honor accorded to an engineer in this country—election into the National Academy of Engineering (NAE). Newly elected members include Jeong Kim, professor of the practice in electrical and computer engineering and in mechanical engineering; Gerald E. Galloway, research professor in civil and environmental engineering; and Gilbert (Pete) Stewart, professor of computer science.


GALLOWAY

The NAE lauded Kim for his contributions to national defense and security through improved battlefield communication; Galloway for his distinguished leadership in the management of sustainable water resources and education in environmental engineering; and Stewart for his development of numerical algorithms and software widely used in engineering computation.


STEWART

AHMET AYDILEK, assistant professor in civil and environmental engineering, received the 2004 American Society of Civil Engineers (ASCE) Outstanding Engineering Educator Award. Earlier this year, he received the Outstanding Achievement Award from the Industrial Fabrics Association International (IFAI) in the geosynthetics projects category for his work on a national Environmental Protection Superfund site, for which he received an Engineering Achievement Award from ASCE last year.

INDERJIT CHOPRA, the Alfred Gessow Professor of Engineering, received the Smart Structures and Materials 2004 Lifetime Achievement Award from the International Society of Optical Engineering (SPIE), recognizing him as a visionary research leader, educator and contributor to the professional community. He was also invited to give the keynote lecture at the 44th Israel Conference on Aerospace Sciences in Tel Aviv.

JAMES DUNCAN, professor of mechanical engineering, was selected as the 2004–2005 University Distinguished Scholar-Teacher. The Scholar-Teacher program honors faculty who have demonstrated outstanding scholarly achievement along with equally outstanding accomplishments as teachers. He was also elected to the executive committee of the American Physical Society Division of Fluid Dynamics.

ASHWANI K. GUPTA, professor of mechanical engineering, was awarded the James N. Landis Medal from the American Society of Mechanical Engineers. His award recognizes his work in developing and implementing revolutionary high-temperature air combustion technology that has resulted in significant energy savings, reduced pollution and improved product quality for a range of applications using waste and fossil fuels.

MARK LEWIS, professor of aerospace engineering, has been inducted as an AIAA (American Institute of Aeronautics and Astronautics) Fellow and also was selected to assume the post of chief science officer of the U.S. Air Force over the next two years. As part of an inter-governmental exchange position, he will be on leave from his teaching responsibilities in the aerospace department and will be working in the Pentagon.

HANI MAHMASSANI, the Charles A. Irish Sr. Chair in Civil Engineering and director of the Maryland Transportation Initiative, was selected by the Urban Transportation Division of the American Society of Civil Engineers as the recipient of the 2004 Frank M. Masters Transportation Engineering Award. Mahmassani received this award for his outstanding contributions in advancing transportation engineering and planning through his internationally recognized research efforts and his commitment to teaching and mentoring future transportation leaders.

JAMES WALLACE, professor of mechanical engineering and director of the Gemstone Program, received the 2004 University System of Maryland Regents' Faculty Award for Excellence in Teaching. The award recognizes Wallace's dedication to improving the quality of a Clark School education through excellence in classroom instruction, innovation in curricular development, dedication to mentoring and leadership in campus-wide academic programs. He also was elected to the executive committee of the American Physical Society Division of Fluid Dynamics.

Becker Named One of Nation's Most Promising Scientists


PHOTO BY JOHN T. CONSOLI

JENNIFER BECKER, assistant professor in biological resources engineering, was among a select group of the nation's most promising young scientists honored with the 2002 Presidential Early Career Award for Scientists and Engineers (PECASE). The award is the nation's highest honor for professionals at the outset of their independent research careers.

Becker was named as one of 20 of the nation's most promising young scientists and engineers by President George W. Bush for her work on how certain types of microbial interactions occur in chlorinated solvents such as tetrachloroethene and trichloroethene, considered the most common contaminants of groundwater. Her research may contribute to new tools to help predict effectiveness of bioaugmentation strategies. In addition, Becker's education program includes a diverse, hands-on learning experience for precollege students and mentoring activities for student summer research projects.

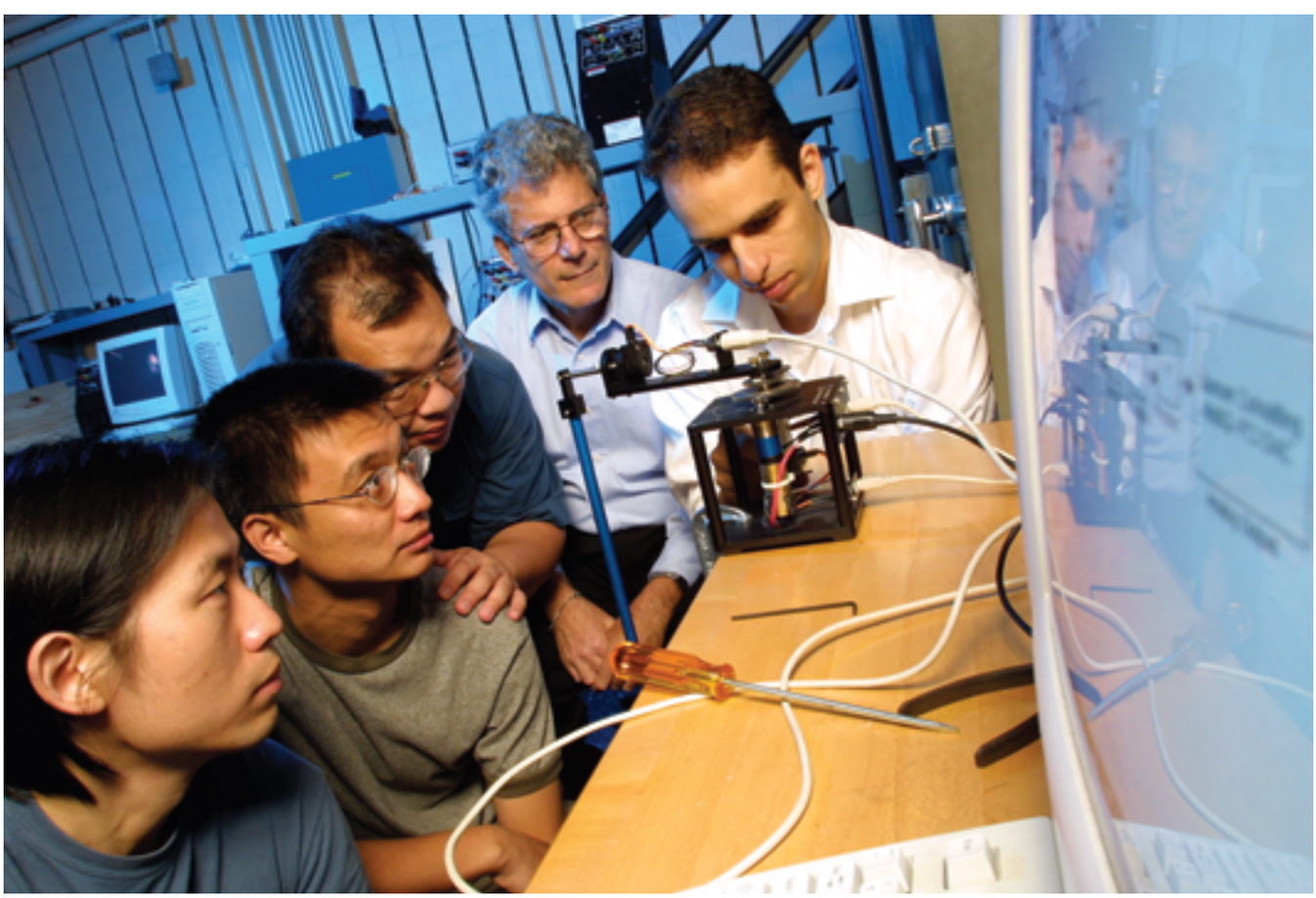
To build a computer that can mimic brain functions, a professor in the Department of Electrical and Computer Engineering (ECE) uses biology and neuroscience to look at how bats process information using sound waves. To help the government infiltrate communication among enemy forces, an ECE professor employs nanotechnology to crack computer codes in the blink of an eye. To allow a group of unmanned fighter planes to fly in unison and respond to each other and their surroundings, an ECE professor utilizes information technology to design advanced control systems.

Electrical and Com

Crossing Disciplines to

By Kristine Henry

Photography by John T. Consoli



puter Engineering: Create Novel Solutions

"These three areas—bio-neuroscience, nanotechnology and information technology—are areas of great significance for both society and for the future of the department," says Steve Marcus, professor and chair of the ECE department. "The most exciting and interesting problems are at the boundaries of our various disciplines."

To that end, ECE faculty and students are pooling resources and expertise across disciplines to tackle electrical and computer engineering's most complex problems, many of which have practical applications—from an entirely new infrastructure for sending and receiving our cell phone messages to embedded controls in the cars we drive.

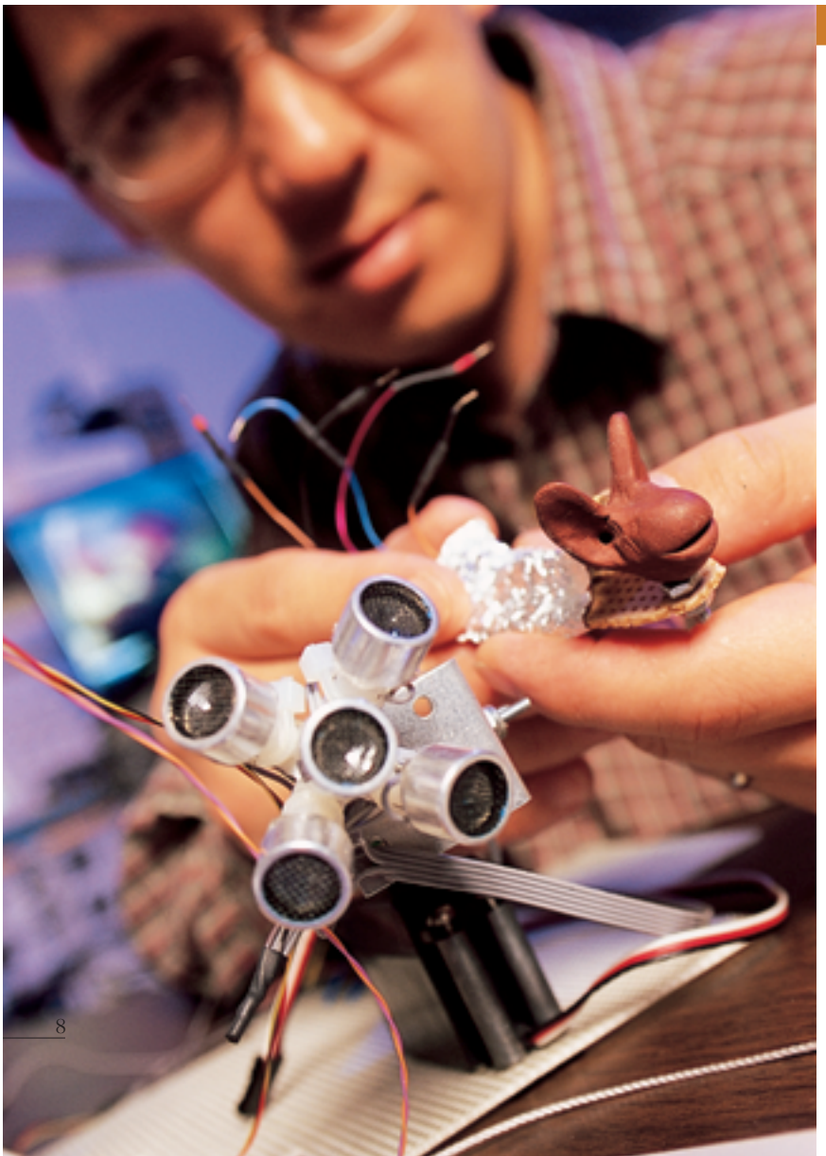
The Mind-Brain Connection

Timothy K. Horiuchi co-directs the Computational Sensorimotor Systems Lab, where he is working on VLSI (very large scale integration) circuits that mimic the brain's computational functions by using similar types of data representation and circuit architectures. "Today's digital computers can easily handle computations like high precision mathematics, database and spreadsheet management, and graphical display, but what our brains help us do extremely well is see, hear, process speech and learn," shares Horiuchi, an assistant professor in ECE and the Institute for Systems Research (ISR), who recently received a highly competitive Early Career Award from the National Science Foundation (NSF).

"Our brains can generalize a particular lesson that we have learned and constantly adapt to our environment," he explains. "These are things we simply have not figured out how to do well in contemporary computers." The goal of Horiuchi's research, which is funded by the U.S. Air Force and the National Institute of Mental Health among others, is to imitate specific auditory circuits in the brains of echolating bats that they use to perceive the three-dimensional world as they fly through the night in search of insect prey.

Shihab Shamma, ECE professor and director of ISR's Neural Systems Laboratory, is also looking to the brain and its processing capabilities in his search for innovations in computer system development. "We are trying to learn the principles underlying auditory processing and apply them as we attempt to develop robots, computers, machines and interfaces that respond to sound the way humans do," he describes. His work, supported primarily by the National Institutes of Health, could have unlimited applications in the areas of defense and security, including auditory tools to search for hostages and headphones to protect soldiers' ears and allow them to better perceive the direction of sounds. Shamma's research also will be critical in the development of "smarter" hearing aids. "Ideally, hearing aids could act like miniature brains and compensate—the way lenses in glasses do—for deformities in the ear," he adds.

Cross-disciplinary research is also vital to investigations into creating more energy-efficient computer chips. Pamela Abshire is studying the photoreceptors of the blowfly to better understand the physical basis of that efficiency in terms of how signals are transformed and transferred between different parts of the nervous system and how they can be corrupted. "Blowflies get energy from food and use that energy to find more food, evade predators and find mates in amazing and efficient ways," says



Timothy Horiuchi holds a tiny prototype bat head next to a bat-inspired sonar device.

Abshire, an assistant professor in ECE and ISR. To perform such high-level tasks, they must perform many low-level tasks such as detecting light. Findings have shown they are very close to operating at the fundamental physical limits of detection performance, she adds. Abshire's research focuses on understanding how "little" energy can be used in microelectronics and in biology to solve important communication and computation tasks—work that could eventually help eliminate the need for batteries in many kinds of electronic devices.

At the Smallest Scale

ECE researchers are working on an array of projects at the very smallest scale to create and refine microdevices that can vastly improve information technology efficiencies. Reza Ghodssi, assistant professor of ECE and director of the MEMS (Micro-Electrical-Mechanical Systems) Sensors and Actuators Lab, develops three-dimensional capabilities on computer chips using batch technology.

"One of my research group's primary activities is MEMS-based gray scale technology, which is a very powerful microfabrication technique for making three-dimensional, silicon structures of any shape or angle or height at the microscale through batch fabrication," details Ghoddsi, whose group is developing the next generation of power MEMS devices such as micromotors and microgenerators that use ball bearings for their support, which are less sensitive and easier to control than sliding friction or air bearings.

Chia-Hung Yang, a professor in ECE, is looking to conquer the inherent problems that arise from shrinking systems down to such small sizes—specifically ways that currents can be manipulated in transistors on the nanoscale. "We have created a transistor with a 25-nanometer channel length and we have a patent for this effort," Yang says, noting that high-end computers generally operate with channel lengths of more than 100 nanometers.

He is also working on spintronics—using the quantum mechanical property of the spinning electron to perform quantum computations. While it can take a year for today's computers to crack a 10-character code, Yang believes quantum computers could crack the same code within minutes.

Romel D. Gomez, an associate professor in ECE, who is exploring the quantum effects in magnetic systems also likes "to exploit the novel effects that manifest themselves when ordinary things are shrunk to nanoscale." Gomez's group has invented a new way to build an MRAM (magnetic random access memory) device using quantum concepts. The technique uses only a single magnetic layer and relies on "spin-polarized" current through film to record data, which is markedly different from the conventional approach in which several layers of magnetic and non-magnetic films are stacked to implement the recording process.

"The demands on fabrication become less stringent, which, in principle, allow us to put these memory chips on practically anything, including flexible substrates such as polymers," relates Gomez. The technique expands available storage space for memory, since the memory can be placed on any type of plastic from car dashboards to clothing.

Testing New Technologies

The economic and market fluctuations of the last decade may have taken their toll on the information technology industry, but they have not stopped ECE faculty from pursuing new ideas and research.

K.J. Ray Liu, professor of ECE and director of the Communications and Signal Processing Laboratory, whose work encompasses broad aspects of wireless communications and networking, information security, signal processing and bioinformatics, has achieved significant breakthroughs in the design of coding schemes for multiple-input multiple-output (MIMO)

wireless communication systems. Liu's team was the first to achieve full diversity—the degree of freedom available that can be leveraged to improve transmission performance—for space frequency codes. They later developed the first full-rate, full-diversity, space-time-frequency code with the highest possible diversity in all space, time and frequency domains. "This discovery can help us devise powerful coding schemes that maximize performance for wireless communications," offers Liu.

Liu also is working with Assistant Professors Min Wu, Wade Trappe and Z. Jane Wang to pioneer the development of efficient and effective digital fingerprints for multimedia content that can withstand collusion attacks and support the secure sharing of information. Wu explains, "For every copy of a multimedia document, we can create a unique identifier. If that copy is duplicated, we can easily trace it to the point of origin and identify those members of a group who are leaking the information." Hollywood filmmakers are particularly interested in the technology to prevent illegal film distribution.

A pioneer in the study of wireless communication networks, Anthony Ephremides, the Cynthia H. Kim Professor of Information Technology with a joint appointment in ISR, is looking to improve access, speed and reliability of ad-hoc wireless networks. Ephremides and his colleagues, John Baras, Lockheed Martin Chair in Systems Engineering and director of ISR's Center for Satellite and Hybrid Communication Networks, and ECE Assistant Professors Richard La and Sennur Ulukus have received an NSF grant to study these networks in a new way. Previously the layers of the network responsible for transmission, linking and routing of signals have been studied separately. "It became clear that layers are interrelated and we should study them jointly," Ephremides offers. "So far, we have developed concrete examples of improvements in network design when you do cross layering." For example, he adds, energy consumption—something that is particularly important in battery-operated wireless devices—can be improved when the system is studied in a holistic manner. "This is one of the hottest topics in the wireless communication field," says Ephremides.

Information sharing among systems is critical to advancements in the area of controls. Individual control systems, such as cruise control, have become extremely advanced, but P.S. Krishnaprasad, professor of ECE and ISR, is looking at control systems in multiple devices that act in unison. "A frontier problem is to devise control systems that work together, such as unmanned surface vehicles or robots doing a cooperative task like moving furniture. Getting systems to do things cooperatively and to realize the benefits of their collective strengths is a challenge," he explains.

Krishnaprasad recently received a major grant from the U.S. Army to study modeling, analysis, design and control of communicating networked systems of fixed and mobile sensors and actuators. For example, sensors could include microphones distributed over a geographic area to provide safety information to the robot receivers.

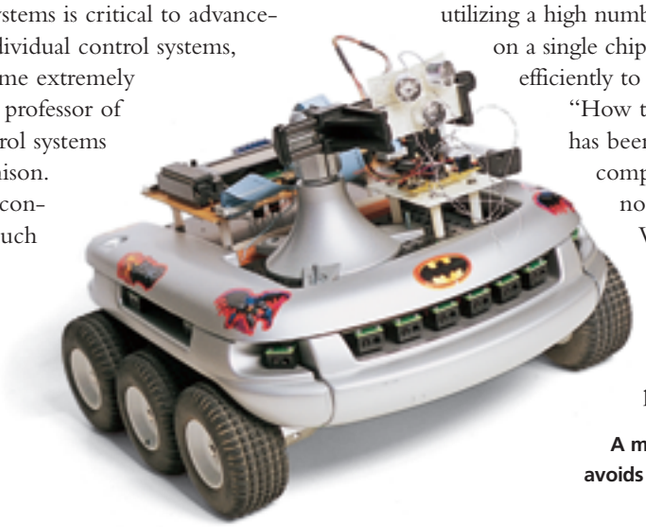
Automatic controls are also integral parts of our lives from basic float valves in every toilet to anti-lock braking systems. Through their research, William Levine, professor of ECE, along with Dimitris Hristu-Varsakelis, professor of mechanical engineering, are helping students "see" control problems from new perspectives. With computers quickly replacing analog devices as controllers, doors are opening for an array of new applications, shares Levine. In the interdisciplinary Controls Lab in the new Jeong H. Kim Building, scheduled to open in early 2005, a personal computer network will enable students to use computers to control experiments. "They can actually use a computer network to control an experiment across the room," details Levine. In the not-so-distant past, Levine recalls that students would have spent the entire semester writing code for a computer control system, while today's code-writing tools enable students to focus on the actions of the controller and design their own control systems.

Levine is currently working on three projects with students: engine controls for automobiles; optimal controls for hybrid systems, including a computer control for a "real" system such as a robot; and a project with the University of Maryland Dental School on the biomechanics of the tongue. "We are using the available quantitative information on how the tongue works to develop a computer and mathematical model that may help us understand how the brain controls tongue muscles," explains Levine, whose work could aid patients, such as stroke victims, with speech difficulties.

Improving Efficiency and Speed

For many applications, easier-to-program and faster computers are critical. Uzi Vishkin, professor of ECE and the Institute for Advanced Computer Studies, is working on parallel computing—utilizing a high number of transistors as multiprocessors on a single chip and organizing them to function efficiently to shorten processing time.

"How to think algorithmically in parallel has been a fundamental question that computer systems architectures have not adequately answered," says Vishkin. The computational Parallel Random Access Model (PRAM) was developed over the last two decades to address the question, but it has not been possible to build parallel machines



A mobile robot, based on bat sonar, avoids collisions in complex environments.

that adequately support it using multichip multiprocessors. As technological advancements enable increasing amounts of hardware to be placed on a single chip, Vishkin hopes to address that problem and commercialize his technology one day through his own company, XMTT Inc., started through the Maryland Technology Development Corporation. Potential applications include drug development, high-end computer games and graphics and computer-aided design.

Just as researchers develop faster, smaller and more efficient computers, ECE Professor Bruce Jacob is countering the problems that come with these advances through his work in circuit integrity. "If you run circuits at higher speeds and lower power levels using very small devices, which are all increasing trends in information technology, it becomes really easy to upset the correct function of the circuit," notes Jacob, whose research group has prototyped an architecture that improves a microprocessor's ability to tolerate electromagnetic interference. "We are building test chips and running experiments to develop analytical models for thermal behavior and signal integrity," Jacob states. Researchers then use those models to design chips to minimize or avoid problems, such as overheating or crosstalk.

The university has long been recognized as one of the nation's leading graduate programs in chaos and non-linear dynamics and many of those theories are now being applied to the area of electromagnetic interference through the research of Edward Ott, distinguished university professor in ECE, physics and the Institute for Research in Electronics and Applied Physics, and Thomas Antonsen, a professor of ECE and physics.

"In our increasingly wireless world, 'shielding,' or preventing electromagnetic interference, is gaining in importance," relates Antonsen. Together, the researchers are developing statistical models to help them determine the probability that a particular device will fail to function properly when high-power microwaves are directed at it and what steps can be taken to prevent that interference and to design more resistant devices. "It is virtually impossible to calculate the response of a complicated system excited by microwaves. If you think of microwaves in terms of beams, the orbits or trajectories of the beams are chaotic," shares Antonsen. Ott offers the example of computer chips or circuits in a military vehicle that could be disrupted by shining high-power microwaves at them and how it takes only the smallest change to upset a device.

Ott is also looking at one of the biggest problems in weather forecasting today as he constructs a computer code for a model or dynamical system for all of the physical processes in the atmosphere. Using a new technique based on the Kalman filter methodology, Ott is attempting to circumvent the problem posed by the prohibitively large matrices that would need to be handled if one attempted to apply a standard Kalman filter to the entire atmosphere.

His colleague, Antonsen, in collaboration with ECE Professor Howard Milchberg, is studying how intense laser pulses interact with matter—research that was not even feasible in a small laboratory just a decade ago. By developing theories of how laser pulses react to gas, plasma or clusters of liquid, Antonsen may uncover clues to the development of smaller versions of particle accelerators with potential applications to medical treatment as well as to high energy particle physics research.

A Recognized Leader

The strength and breadth of research opportunities within ECE are two primary reasons, ECE Department Chair Steve Marcus believes, that *U.S. News & World Report* ranks Maryland's graduate program in electrical engineering 14th in the nation (eighth among public universities) and its graduate program in computer engineering 16th nationally (ninth among public universities).

In fact, research opportunities are extended to both undergraduate and graduate students. Undergraduates work in the department's research labs, collaborate with faculty on independent research projects and participate in a number of summer research programs, the most visible of which is MERIT (Maryland Engineering Research Internship Teams). The highly competitive MERIT program provides undergraduates with the opportunity to work side by side with the most experienced faculty members on cutting-edge research and to present research findings at the culmination of this eight-week program.

"Getting involved in research helps students define their interests and goals," shares Steve Norton, associate director of undergraduate studies in ECE, who notes that about one-third of the electrical and computer engineering students have actively participated in research by the time they graduate. "Research projects help students network and are excellent preparation for graduate school."

For students preparing to graduate, the senior-level Capstone Design Course combines lectures with viable research. For example, in the multimedia capstone course, taught by ECE faculty including Ray Liu and Min Wu, who developed the course, seniors learn the fundamentals of video, audio, image and speech technologies then set out to devise their own multimedia tool such as a pocket personal computer language tutor developed by a student team this spring.

No matter how sophisticated the field becomes, Marcus stresses the importance of providing students with a solid foundation in the fundamentals that will allow them to pursue careers in any number of new directions. Currently, the ECE undergraduate curriculum is undergoing an extensive review to ensure the department is responding to changing technological times and the needs of the market. Marcus is enthusiastic about what the future holds for ECE. "It is an exciting time to be in this department and in the Clark School in terms of research programs and the quality and excellence of our faculty and students," he shares.

Kristine Henry is a Baltimore-based writer who has written for a number of newspapers, including The Baltimore Sun, The Dallas Morning News *and* The Minneapolis Star Tribune.

Opening Doors for Female Engineering Students

Clark School Takes Pioneering Role

By Paul AdamsSBy Paul Adams

They have split the atom and sent a man to the moon, but for decades scientists and engineers have failed to find an answer to a relatively simple question that has confounded academics for more than a half a century.

Why do so few women pursue careers in engineering?

Step into any medical or law school classroom and you will find female undergraduates in virtually every other seat. But women have yet to achieve gender parity in the field of engineering. Less than 20 percent of undergraduate students in engineering schools today are female, and an even smaller percentage of women hold engineering jobs in the private sector, according to recent studies funded by the National Science Foundation (NSF).

A Career of Firsts

Professor Kawthar Zaki's career in electrical engineering has been one of groundbreaking firsts. She was the first of her siblings to become an engineer; the first woman to earn her doctorate in electrical engineering from the University of California, Berkeley; and, in 1976, the first woman to earn tenure in the Department of Electrical and Computer Engineering at the Clark School.

Zaki paved the way for future female faculty members by distinguishing herself as a top expert in microwave engineering. Her research has enhanced many civilian and military communications and radar systems and her work on wireless communications technology and microwave filters has helped private companies like K&L Microwave in Salisbury, Md. She also has developed computer-aided design systems to enhance product development and created automated techniques for microwave filter tuning and diagnosis, which have significantly improved manufacturing production rates and boosted cost savings.

Her career has taken her far from her homeland of Cairo, Egypt, where Zaki's father initially disapproved of her plans to study engineering at the university in Cairo.

"I kept fighting and fighting and my parents would say, 'the woman's place is in the home,'" she recalls. "Finally, I got accepted at the university and my father said, 'Okay, you can study engineering.'"

Zaki's student days did not prepare her for the challenges of attaining tenure at the University of Maryland in the mid-1970s. "These days, things have completely changed," she says, referring to the Clark School's Women in Engineering programs and other initiatives designed to encourage women engineers. "Women who are entering the field now are really encouraged and supported and that makes a big difference."■

That disparity has long been a concern for the A. James Clark School of Engineering. Answering a national call to bring balance to the classroom and the laboratory, the Clark School began offering programs to support women in engineering more than three decades ago to ensure that women excel in the field.

Formalized in 1995 through funding by the Alfred P. Sloan Foundation, the programs identify potential female students during their middle and high school careers and help to recruit and retain women engineering students at all levels.

The initiatives date back to the 1970s and the work of Marilyn Berman Pollans, who launched Women in Engineering (WIE) on the heels of the women's movement and built it into a national model. Berman Pollans, who retired as associate dean of the Clark School in 1996, marvels at how far women have come since WIE enrolled its first female undergraduates in the summer of 1975. "It was groundbreaking in those days because women were expected to stay home and bake cookies," she recalls. "They were not expected to go to graduate school."

To change those attitudes, the Clark School has developed a full menu of outreach programs to introduce teenage girls to the world of science, while providing undergraduates with the support networks and research opportunities they need to succeed in a predominantly male environment.

"We had to find ways to encourage women in science and engineering to stay in those fields and consider graduate school or even become academics," explains Paige Smith, who recently earned her doctorate in industrial engineering from Virginia Polytechnic Institute and currently heads the WIE programs. Smith's own interest in the topic was sparked while still a student. "In my first classes, I looked around the room and realized I was one of a few," she shares. It was not until she held a graduate assistantship in the Office of Minority Engineering Programs at Virginia Tech that she realized the significance of her own experiences and how those feelings can shape female students' academic pursuits.

Raising Student Interest

Research shows that young women typically lose interest in science and engineering around their middle school years, even though they are just as competent as young men, Smith notes. Through WIE, Smith runs a variety of programs to attract women to the field, such as the Keys to Empowering Youth program for middle school girls. Once a semester, some 40 Maryland and Washington, D.C., students attend a one-day workshop to learn the impact of engineering on everyday life. Students meet female professionals, often Clark School graduates, and work on team-based, hands-on projects such as constructing model roller coasters to learn about potential and kinetic energy.

Other programs include Stepping Stones to Your Future, inaugurated in summer 2004 to bring middle school students to the Clark School for a week of intensive applied learning experiences, and Exploring Engineering, a program targeted to academically talented young women in high school who spend a week in residence at the university, learning about engineering majors and rolling up their sleeves to participate in experiments. Their campus stays help students become familiar with college life and meet other women in the field, Smith adds. A key component of the week is an engineering team design challenge using LEGO Mindstorms to create robots and learn visual programming skills.

The needs of current Clark School female students are also addressed as undergraduates join female faculty members and pursue research directions of their own through the Research Fellows Program. Funded by the Maryland Space Grant Consortium, the program has resulted in a number of award-winning

projects. In the spring, Sadie Michael, B.S. in aerospace engineering '03, presented her research on the design, fabrication and testing of a prototype closed-section collapsible boom with potential space shuttle applications at a regional conference of the American Institute of Aeronautics and Astronautics and at the international conference of the Society for the Advancement of Material and Process Engineering.

Building Support Networks

Mentoring is yet another component of the Women in Engineering initiative. MentorNet (http.www.mentornet.net) connects female students and graduates with professional women throughout the region and the world via the Internet. A second mentoring program links first-year students with upper-level female students within their major. Both are part of the school's efforts to build support networks for aspiring women engineers, Smith asserts.

"There is a whole pool of women who are talented, but for whatever reasons have chosen other careers," says Linda Schmidt, associate professor of mechanical engineering at the Clark School. "We need the most talented individuals, both male and female, working on all of the world's problems, or we will not find the best solutions."

Schmidt is one of three women on the faculty in the Clark School's Department of Mechanical Engineering and the first woman in the history of the 45-member department to earn tenure. Linda Schmidt joined Smith and Janet Schmidt, director of interdisciplinary research for the university's College of Education, as co-principal investigators of an NSF grant to develop an academic program to attract more women to the field. Their efforts led to the creation of the Research Internships in Science and Engineering (RISE) program (see sidebar, p.15).

A study commissioned in 2002 by the NSF validates the Clark School's approach. Research conducted over the last three years found that female engineering students are more likely to complete degrees when they have a strong

A Commitment to Female Faculty

Attracting outstanding female faculty members is another objective of the Clark School. As part of the school's strategic plan, Dean Nariman Farvardin is committed to increasing the number of female tenure-track faculty. Last year, along with the College of Computer, Mathematical and Physical Sciences (CMPS), the school received a grant from the Henry Luce Foundation, which it will use to hire an outstanding female faculty member in the electrical and computer engineering department. Funded through the Clare Boothe Luce Program, the award recognizes the university's and the school's longstanding commitment to increasing the number of women on its faculty. ■

Modernizing the Military

When the Department of Defense (DoD) needed a leader to bring its civil service pay and personnel system into the modern age, it did not go looking for an expert in human resources. It tapped one of the military's most experienced senior female engineers.

Mary E. Lacey, B.S. in mechanical engineering '78, was selected in May 2004 by Secretary of the Navy Gordon England, B.S. in electrical engineering '61, to head the new National Security Personnel System (NSPS) Program Executive Office. Lacey, already a senior federal government official since her appointment to the Senior Executive Service in 1996, reports directly to England, who was appointed to oversee the NSPS by Secretary of Defense Donald Rumsfeld. Lacey and her staff are charged with crafting a new personnel system for the DoD's 746,000 civil service employees, a project considered critical to the Pentagon's broader efforts to modernize the nation's armed forces.

"The system we have now was designed for a work force of the 1920s," explains Lacey, who equates designing a personnel system to that of a complex weapons system or Navy ship.

Lacey's appointment is the culmination of an engineering career that began in 1973, when she went to work as a federal junior fellow in the U.S. Navy to pay for her education. After graduation, she rose through the ranks rapidly, eventually becoming technical director of the Naval Surface Warfare Center, which designs the ships and weapons systems that power the U.S. fleet. In that role, Lacey was responsible for a $4 billion annual budget and roughly 17,000 employees.

Over the years, Lacey has remained close to the university, creating partnerships with the Clark School to research the chemistry of propellants and explosives, and serving on the school's Board of Visitors. She also has mentored hundreds of female engineering students.

Lacey believes female engineers have made significant progress over the years, in part, because technological advances play to their strengths. "The things we engineer have become more complicated and interdependent," she explains. "Women are very comfortable dealing in complexity and they are more inclined to team and build consensus as opposed to always tackling things through confrontation. As our systems grow, that collaboration is even more critical." ■

An Advocate on Campus

In 1969, Sandra Greer entered the work world only to find few opportunities for women in science. That did not deter Greer, now a professor of chemistry and biochemistry and of chemical engineering and a world-renowned researcher in the thermodynamics of fluids and phase transitions and the study of polymer solutions. This year, she was honored by the American Chemical Society with its Francis P. Garvan-John M. Olin Medal, given annually to a distinguished female chemist.

Greer left high school in 11th grade to pursue a bachelor's degree in physical chemistry at Furman University in Greenville, S.C. She later earned her master's and doctoral degrees in chemical physics from the University of Chicago. "An academic career at that time was closed to me," she remembers. "Nobody hired women. In all my training, I never had a female professor because there were not any on the faculty."

Greer was fortunate to find work as a scientist at the National Institute of Standards and Technology, where she stayed until landing a position with Maryland in 1978. In 1988, she became an advocate for women on campus by chairing the university committee that led to the creation of the Classroom Climate Project and the Curriculum Transformation Project. Both initiatives helped to make classrooms more hospitable to women and changed course curriculum to highlight the contributions of women in research and academia.

More recently, she has served on the board of the Committee for the Advancement of Women in the Chemical Sciences and has helped develop workshops for women chemists and chemical engineers. "The career prospects for women have gotten enormously better over time," Greer shares. Today, she notes, women are closer to gender parity in the field of chemistry and their representation in engineering is increasing as well. ■

social support network at school and within the field. Developing that support is one of the primary goals of the WIE programs, which are as critical today as ever, affirms Berman Pollans. "Women bring a different perspective to the workplace in terms of creativity levels, problem-solving skills and multitasking abilities," she notes. "The engineering profession stands to benefit tremendously if we can reach parity in the field."

Smith notes the importance of identifying ways to create a more nurturing environment for female engineering students and faculty. "The key is reaching potential female engineers early in their decision process and giving them the tools and self confidence they need to succeed," she says.

The proof of the Clark School's success is in the numbers. While female students made up only two percent of the student body 30 years ago, today the Clark School is drawing ever closer to surpassing national averages and achieving its strategic goal of female students comprising one-fourth of its undergraduate enrollment.

Paul Adams is a Maryland-based freelance writer who has written extensively for metropolitan and regional newspapers in Maryland and Minnesota.

A Bridge To Success

Norine M. Walker, B.S.'83, project coordination manager for the Woodrow Wilson Bridge Project in Alexandria, Va., was among the first to benefit from the Women in Engineering program. In 1976, she joined a dozen other Maryland high school girls enrolled in one of the program's first summer sessions, marking the beginning of the Clark School's efforts to raise awareness among teenage girls about the field of engineering. The experience inspired Walker to earn her bachelor of science in civil engineering and a bachelor of arts in urban studies at the university, and has led to a career as a vice president in transportation engineering, planning and design for URS Corp.

When Walker began classes, she found herself surrounded primarily by male students. "Being shy and one of the only girls in class, I found it doubly hard when I had a challenge because I had to face it myself," she recalls. Walker says she overcame those challenges by studying hard and, at times, repeating classes until she "got it right."

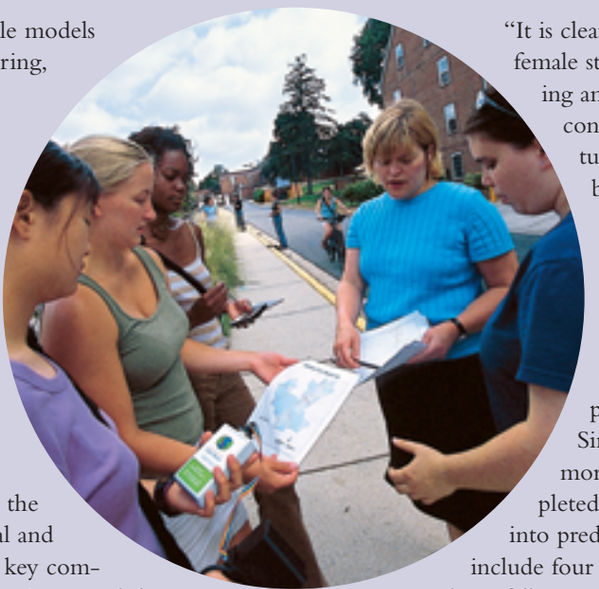
The work ethic developed at the Clark School has served her well. Walker began working for Rummel, Klepper & Kahl Engineers in Baltimore in 1983, advancing to project manager during her 11-year career with the firm. Among her high-profile projects was all of the traffic analyses related to the construction of Oriole Park at Camden Yards in Baltimore.

Walker then joined Greiner Inc., later purchased by URS Corp., one of the venture partners managing the design and construction for the $2.43 billion Woodrow Wilson Bridge Project, currently the largest construction project on the East Coast. As URS' senior professional on site, Walker coordinates with clients, construction managers, design engineers, contractors, the community, elected officials and other stakeholders, providing information and educating students and community groups about the reconstruction of the mile-long bridge and four interchanges through Maryland, Virginia and Washington, D.C.

Walker traces her success back to that summer in 1976 when she first discovered her calling. "I always wanted to do something where I could see the fruits of my labor," she recalls. "I just had a curiosity about how things worked and that summer I made my decision." It is a decision that Walker has never regretted. ■

Research Internships Attract Nation's Top Students

With so few women faculty and role models in the fields of science and engineering, female undergraduates can face a lonely beginning to their academic careers. The Research Internships in Science and Engineering (RISE) program facilitates lasting partnerships between female students and faculty, and gives students a chance to collaborate with other women in the field to conduct applied research with real-world implications.



RISE, funded with a National Science Foundation grant and co-sponsored by the Clark School and the College of Computer, Mathematical and Physical Sciences (CMPS), has two key components: the First Year Summer Experience and the RISE scholars program.

Even before they begin their freshmen year, 25 incoming female undergraduates in the Clark School and CMPS spend two weeks on campus as part of the First Year Summer Experience orientation program. Together they investigate the math, science and engineering fields and make connections with students and faculty to jumpstart their academic careers.

Nearly 75 students have participated in the program in the last three years. In addition to academic exploration, their schedules include team-building challenges such as a ropes course, professional skill development, computer resource training and volunteer efforts as well as field trips to Baltimore and Washington, D.C. Living on campus and participating in community-building activities are key to making female students aware that they are not alone in an academic field dominated by men, claims Linda Schmidt, associate professor of mechanical engineering, who co-directs the NSF grant that supports RISE along with Paige Smith, director of the Women in Engineering programs, and Janet Schmidt, director of interdisciplinary research for the university's College of Education.

Students also meet women role models, who introduce them to career opportunities in their respective disciplines. For example, first-year RISE students met with women who work at Baltimore-based toolmaker Black & Decker, NASA and the National Institute of Standards and Technology, among others.

PHOTOS BY JOHN T. CONSOLI

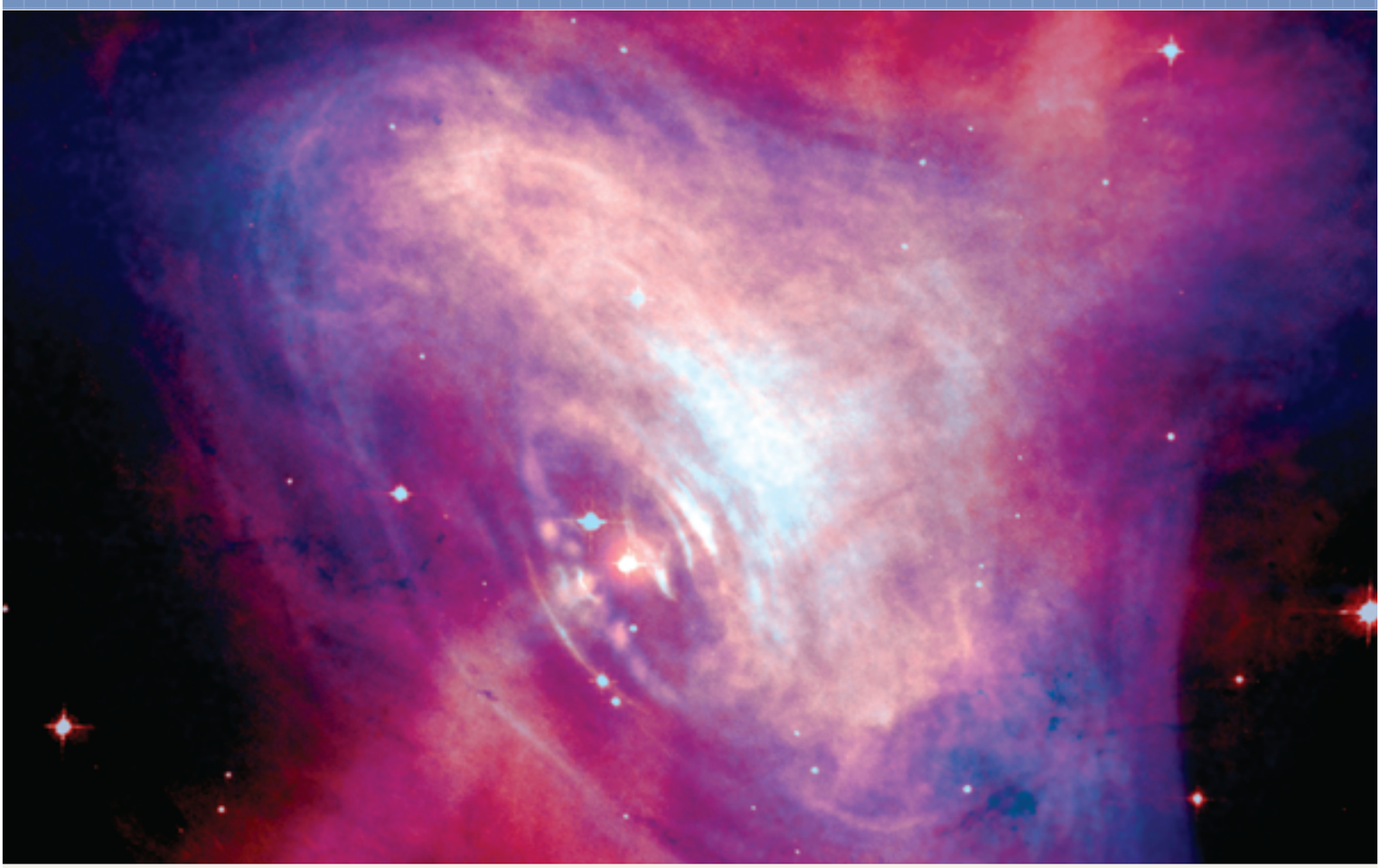
"It is clear that if we are to engage more female students in the fields of engineering and science, we must address their concerns and give them every opportunity to build their knowledge base along with their self confidence," offers Smith.

In the second part of the program, academically advanced students from top universities all over the country spend 10 weeks as RISE scholars working on paid summer research projects. Since the program's inception, more than 60 scholars have completed the internships. Interns are split into predominantly female teams, which include four RISE scholars, one senior undergraduate fellow, one graduate fellow and one faculty member. The team structures allow RISE scholars to work with women in all phases of the academic hierarchy.

This summer, projects ranged from the study of bioremediation strategies in wetlands to research on the superstring theory in particle physics. One team of students worked with Kelly J. Clifton, professor of civil and environmental engineering, to model pedestrian route choices in College Park, Md., (see photos). Eventually, the research could help civil engineers design more pedestrian-friendly sidewalks and intersections. At the end of each project, students take the stage to share research results with family members, researchers and administrators at a formal symposium. "From collecting and analyzing data to preparing research reports, these students get a real taste of what careers in research are all about," says Linda Schmidt.

The RISE program has unexpectedly affected those female graduate students serving as mentors and research supervisors. "These students gain valuable experience that many of their peers do not gain until they join the faculty," notes Smith. "Their experiences make them appreciate the importance of the advisor/student relationship and it solidifies their commitment to graduate education."

In addition to building their résumés, students learn first hand how their work can make a difference in the world, which gives them the motivation to continue in their careers. "We tell students, this is a major research institution," explains Linda Schmidt. "Students come here to do serious research. This is not just another summer job." ■



The Sky's the Limit

Celestial GPS Wins Invention of the Year Award for Clark School Researchers

An idea sparked during an interplanetary spacecraft navigation course has garnered this year's Physical Sciences Invention of the Year Award from the university's Office of Technology Commercialization for Clark School doctoral student Suneel Sheikh and Darryll Pines, professor of aerospace engineering.

Sheikh and Pines have developed a novel navigation system that uses pulsed X-ray radiation from distant celestial bodies to determine spacecraft time, position, velocity and attitude. Because the system relies on X-ray radiation from natural sources, it can function autonomously and without the costly development and maintenance that a traditional global positioning system (GPS) requires.

"Traditional GPS is limited to spacecraft operating near the earth," explains Sheikh. "If future spacecraft are to travel to the moon or to Mars, they will be beyond the orbits of current GPS satellites."

The celestial sources that they intend to use are neutron stars. These stars, found to be spinning at fast rates with immense magnetic fields and referred to as pulsars, provide a stable, predictable and unique signature, relates Sheikh. Pulsars are a relatively new phenomena, discovered by astronomers in the late 1960s. Given their large distances from earth, pulsars provide good signal coverage for operations throughout the solar system and possibly the galaxy.

Sheikh had been thinking of using stars that act as "lighthouses" to develop a system that emulates GPS over a much broader range. That idea germinated as part of his final coursework toward his doctoral degree. "The pulsar signal varies over time and it provides basically what GPS does—a periodic signal that can be processed." Sheikh teamed with Pines, the course instructor, to develop the concept and to collect and analyze data.

The first investigations conducted by the two were in collaboration with the U.S. Naval Research Laboratory, which had previously collected data from the Crab Nebula and Pulsar in 1999 and 2000 (pictured above). "For their astrophysical experiments, they were collecting data to study the physics of pulsars. We were

able to use their data to support our navigation hypotheses," offers Sheikh. "In our work, we showed it is possible to determine within meters of accuracy the location of a spacecraft."

"In the optical wavelengths, there are only a few very bright pulsars, too few to be practically useful for navigation. In the radio wavelengths, antennas 25 meters and larger would be required to collect a useful signal," says Sheikh, who is now focusing on building an X-ray detection system to collect X-ray photons from pulsars. "Using X-rays, we can build a small detector, the size of a shoe box or computer monitor, to detect the pulses from pulsars. Then, we can collect enough data from several pulsars using multiple sensors attached to a spacecraft to determine the vehicle's exact location."

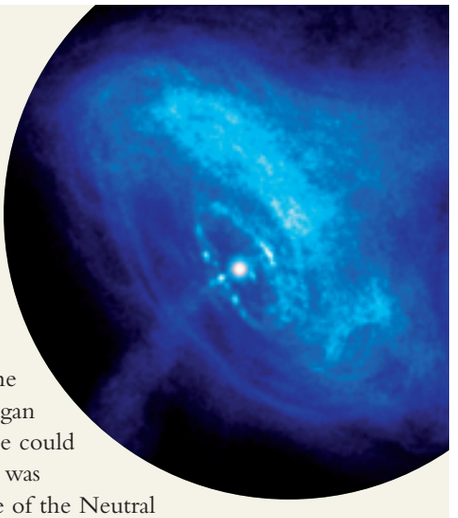
Pines, now on sabbatical from the Clark School, is pursuing similar research at the Defense Advanced Research Projects Agency (DARPA) as part of President George W. Bush's initiative on new space architecture.

An Entrepreneur at Heart

As an older student, Sheikh feels the time is right in his career to start his own research group. "Now that I am completing work on my doctoral degree, I know more about how to obtain funding, how to work with different groups of people, and how to do my own research. It is a good time in my life to begin a new chapter," claims Sheikh.

An entrepreneurial venture represents a new path for Sheikh, who received his bachelor's degree in aerospace engineering and mathematics from the University of Minnesota and his master's degree from Stanford University. He then interned at Honeywell in the early 1990s and later moved to Martin Marietta to work on guidance of their Titan IV launch vehicle system, the largest expendable rocket to launch satellites into orbit.

"In the heyday of GPS research, particularly in terms of how GPS would operate with all types of navigation and landing systems, I returned to Honeywell," recounts Sheikh. "We were looking at GPS and its ability to assist air traffic control by improving the ability to direct traffic and provide automated landings of aircraft," he adds. His work helped Honeywell secure a contract to develop a new navigation system for the Space Shuttle, still in development, and the International Space Station, now fully operational.



After spending a decade in private industry, Sheikh felt the "need to know more" and began looking at schools at which he could pursue his doctoral degree. "I was attracted to Maryland because of the Neutral Buoyancy Lab and the space robotics program," he says. "In business, it is difficult to do research on 'unique' ideas, you must pursue those ideas for which you have received funding. I was looking forward to more freedom and openness in the academic environment."

Sheikh quickly realized that even in academia you need funding to support your research. "The first few years at Maryland I spent a lot of time trying to find what I really wanted to do," he says. His various projects included a vision-based navigation system for underwater vehicles and the control of formations of satellites. Along the way, he garnered a number of fellowships: the Gustave J. Hokenson Fellowship Award from the aerospace department and the Achievement Rewards for College Scientists (ARCS) Endowment Fellowship given by the Metropolitan Washington Chapter of the ARCS Foundation Inc. for the past two academic years. The ARCS award freed Sheikh to pursue independent research and he chose his current project, which was recognized by the aerospace industry with the 2003 American Institute of Aeronautics and Astronautics (AIAA) Foundation Guidance, Navigation and Control Graduate Award.

Darryll Pines, left, and Suneel Sheikh are winners of this year's Physical Sciences of the Year Award.

"In my Ph.D. research, I enjoy the independence and the ability to make my own decisions and would like to continue to do this in a business," shares Sheikh.

Sheikh is hoping to put that entrepreneurial spirit to work for him after he receives his doctoral degree in December. In addition to research contract possibilities with the federal government, Sheikh will be touching base with his contacts in industry and looking for collaboration with academic institutions. Of course, he will be tapping into the entrepreneurial resources of the Clark School and has already contacted his former employer, Honeywell, to generate interest in his research. ■

PHOTO COURTESY OF NASA

PHOTO BY JOHN T. CONSOLI

Former Pilot Flying High with Alumni Award

Before serving in Vietnam, Norris Krone gained experience on a T-33 training jet.

If Norris Krone Jr., B.S. '55, Ph.D. '74, a highly decorated Vietnam War veteran and a recognized leader in the field of aeronautical sciences, had to relinquish all of the many awards earned during his illustrious career except one, the keeper would be his latest honor—the Distinguished Alumnus Award from the A. James Clark School of Engineering. Krone acknowledges, "The combination of my doctoral and my undergraduate degrees provided the entire foundation for everything I did in my career. I appreciate all of my awards, but to be honored as a distinguished alumnus of Maryland is breathtaking to me."

Krone began his career with a small aircraft company only miles from College Park after receiving his bachelor's degree. Months later, he entered U.S. Air Force pilot training and was assigned to the Air Defense Command as a fighter/interceptor pilot, monitoring the nation's borders. In 1962, Krone earned a master's in aeronautical engineering from the Air Force Institute of Technology and was assigned to Wright Patterson Air Force Base, where he worked as a systems engineer and chief of air frame engineering for the original B-1 aircraft.

Krone never envisioned himself as a forward air controller in combat, much less as a fighter pilot, but he soon found himself flying two and three missions a day over the fields and mountains of North Vietnam scouting for the enemy and directing the military's larger striker aircraft against the North Vietnamese and the Vietcong. "I had been out of the basic job of flying for some time," recalls Krone, already a father of four children at the time. "But I felt strongly it was my duty and obligation to serve our country." In total, Krone flew some 280 combat missions and while he had many close calls and his plane was shot at, he was never shot down. For his bravery, he was awarded the Distinguished Flying Cross Bronze Star, three Vietnamese Cross of Gallantry medals, 10 Air Medals, and the Vietnamese Medal of Honor.

When he returned from Vietnam, Krone began working at the Pentagon as a program manager responsible for the advanced development of U.S. Air Force reconnaissance systems. When the Air Force suggested Krone continue his education, he accepted the offer only if he could attend the doctoral program at Maryland. To his surprise, the Air Force agreed. Following completion of his doctoral degree, Krone served at the Air Force Systems Command Headquarters working on special programs for the four-star commander before moving to the Defense Advanced Research Projects Agency (DARPA), where he became chief of the Air Vehicle Technology Office, and founder and program manager for the X-29 experimental airplane. At DARPA, he pioneered the development of the technical principles of the forward swept wing aircraft concept, a true advancement in aerodynamics and a breakthrough in the field. "The wing was so unstable it required a computer to control it, which gave it remarkable maneuverability," notes Krone. This process was pioneered by Krone while a student at Maryland.

Today, as president and chief executive officer of the University Research Foundation (URF) and its co-founder, Krone directs all aspects of the Maryland Advanced Development Laboratory's technical, financial and program management activities. His main research efforts are now focused on improving aircraft transportation in the United States.

He also is the leader and founder of the Maryland Small Aircraft Laboratory, a NASA-sponsored alliance of 14 organizations. During his tenure at URF, he has served on two vital NASA committees: 20 years on the Aerospace Technology Advisory Committee and 16 years on the Aerospace Safety and Advisory Panel, chairing its subcommittee on aeronautics.

The Distinguished Alumnus Award is just the latest in a long list of honors for Krone. He has received the Aircraft Design Public Service Medal from NASA, one of its highest honors; the Superior Performance Award from the Office of the Secretary of Defense for his work at DARPA; and recognition by *Aviation Week* as a major contributor to the aeronautical sciences.

Krone remains committed to bringing even greater recognition to the Clark School. "It gives me great satisfaction to know that in some small way I contributed to improving our school and our university," he states. "URF is working with the dean in whatever way it can to promote the visibility of the school and contribute to a better education for our students." ■

Above left: Lisu villagers and students work together. Above: Students Amanda Gassman and David Kerske assemble lighting fixtures.

Engineers Without Borders

Engineering students are combining their interests in the field with a concern for reducing poverty and improving the quality of life in developing communities worldwide through their involvement with Engineers Without Borders (EWB). A nonprofit organization established in 2000, EWB assists these communities with engineering needs while training internationally responsible engineering students. The University of Maryland student chapter was formed in spring 2004.

In June 2004, five Clark School students, Michael Bronson, B.S. '04; Amanda Gassman, B.S. '04; David Kerske, B.S. '04; S. Xiah Kragie, B.S. '06; and Michelle Neukirchen, B.S. '05 joined chapter faculty advisor, Deborah Goodings, professor of civil engineering and co-director of engineering and public policy, on a trip to Thailand for their first project.

"In the classroom, we steep our engineering students in the theory and application of engineering equations and in technological solutions to problems, but we teach them in an environment that is, for the most part, divorced from the discussion of values and of the consequences of our engineering decisions. Engineers Without Borders makes that connection for students," affirms Goodings.

The group worked on building a health clinic to serve several villages of Lisu hill tribes in Northern Thailand near the Burmese border. Previously, villagers had to travel great distances to the nearest doctor or health center. The new center will handle some 60 visitors a day from surrounding villages and will include living quarters for a physician, an emergency room, a waiting area, a small laboratory and a pharmacy.

Clark School students were assigned to provide technical and physical assistance in the construction of the simple wastewater treatment system and to assist with the electrical system, the plumbing, the interior walls, the ceiling and finishing work. Students from the Columbia University and the University of California, Los Angeles EWB chapters and members of the West Coast Professional EWB Chapter also participated in the project, which won the national chapter's 2004 EWB Collaboration Award. In addition, major contributions came from Lisu villagers, who worked with students and provided accommodations, hospitality and meaningful cultural exchanges for EWB members.

"Students learned that a critical component of working in developing countries is adaptability in design and execution to fit with local building practices, community needs and community cultural expectations," notes Goodings.

Members of the Clark School chapter have already received approval to design and build a water and sanitation project for next summer on the Pine Ridge, South Dakota Native American Reservation. A group from the chapter traveled to the reservation in July to explore project ideas and to better understand the cultural aspects of the project.

If you are interested in volunteering or supporting the Maryland chapter of Engineers Without Borders, please visit www.eng.umd/ewb or contact faculty advisor Deborah J. Goodings, 301.405.1960 or goodings@umd.edu ■

Clark School Students Garner National Scholarships

Jennifer Marie Roberts, B.S. '04, an electrical engineering and computer science double major, and Alice Turner Ryan, B.S. '04, an aerospace engineering major, both earned National Science Foundation awards of $30,000 a year plus tuition to pursue graduate education in the sciences. In addition, Roberts won a $25,000 scholarship from the Fannie & John Hertz Foundation, and Ryan received a $28,000 National Defense, Science and Engineering Scholarship.

"I like thinking about problems people have not looked at before and trying to come up with solutions," says Roberts, who plans to attend graduate school at the Massachusetts Institute of Technology and whose awards will fully support her graduate education through the doctoral level.

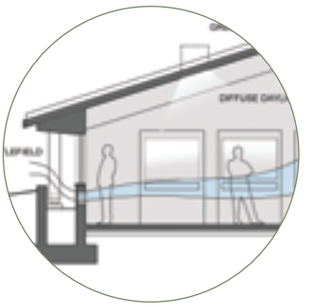
Ryan says she hopes her success in winning these national scholarships will help motivate other young women to pursue graduate study in engineering. "In my classes, there were always fewer women than men, and women are not pursuing graduate degrees nearly as much," says Ryan, who plans to attend Stanford University to study aeronautical engineering. ■

Mechanical Engineering Major Wins Excellence Scholarship

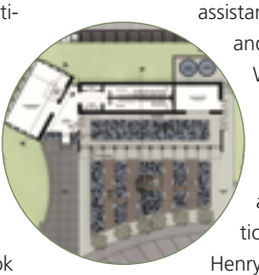
Selin Mariadhas, a junior majoring in mechanical engineering, has received the first Circle of Excellence Scholarship awarded by the Baltimore-based business and legal publication, *The Daily Record*. The award coincides with the annual naming of Maryland's Top 100 Women by the publication.

Mariadhas participates in the University Honors Program, a highly selective two-year program for the most academically gifted incoming students at the university. She founded the ENGineering Recruiters, a mentoring program for middle and high school students designed to recruit a diverse group of students to the Clark School, and she organized the program and curriculum of Exploring Engineering to help female high school students explore the field of engineering. Additionally, she coordinates the Engineering Equals Maryland Community Collaborations, a project that works with elementary schoolchildren; and is an active member of the Engineering Student Council as fundraising chair and as a representative of the Society of Women Engineers. ■

Design Teams Win Competition



Two teams that included Clark School graduate students and faculty won a design competition to create an environmentally friendly welcome center at an existing scenic overlook in Frederick County, Md. The competition, sponsored by the Office of Maryland Congressman Roscoe G. Bartlett and the Maryland Department of Transportation State Highway Administration, was created to generate innovative design concepts for the existing Goodloe Byron Scenic Overlook located along northbound Interstate-270.

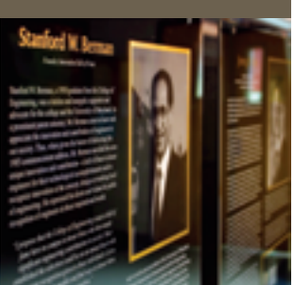


Together, the two teams were awarded $25,000 and plan to share ideas for the final design, which must rely on nontraditional energy, water supply and wastewater treatment technologies and must be self contained and self sustaining.

The winning design team included mechanical engineering graduate research assistants Ji Bian and Jonathan Winkler. Reinhard Radermacher, professor of mechanical engineering, served as faculty adviser for the competition and students worked in cooperation with Ziger/Snead Architects, Henry Adams Consulting Engineers, Catholic University and Michael Furbish. Second place winners included Jason McGill, mechanical engineering graduate research assistant, and Greg Jackson, associate professor of mechanical engineering, in conjunction with students from Catholic University and Cho, Benn and Holbeck Associates. ■

Innovation Hall of Fame Founder Honored

Stanford Berman, B.S. in mechanical engineering '50, who proposed the establishment of the Engineering Innovation Hall of Fame more than a decade ago, was honored this spring posthumously with a special exhibit. Berman funded an endowment to support ongoing exhibition expenses and he chaired the selection committee for the award for many years. A distinguished patent attorney with a broad record of service to the university, Berman was a former president of the Alumni Association International and the Engineering Alumni Chapter. ■



Kim Inducted Into Innovation Hall of Fame

Jeong H. Kim, engineering professor of the practice with a joint appointment in electrical and computer engineering and mechanical engineering, was inducted into the Clark School Innovation Hall of Fame in May. Kim has a distinguished career as an engineering entrepreneur, merging his technical expertise in communications, wireless technologies and optical networking systems and devices with outstanding business leadership.

Kim received the first Ph.D. in reliability engineering from the University of Maryland in 1991 and holds a master's degree in technical management and bachelor's degrees in both electrical engineering and computer science from Johns Hopkins University.

Following his service in the U.S. Navy, Kim joined AlliedSignal Inc. and worked at the Naval Research Laboratory on satellite systems development. Kim recognized the potential of asynchronous transfer mode (ATM) technologies, an international communications standard used to link different modes of electronic communications for high speed fiber optic networks.

In 1992, he founded a successful telecommunications company, Yurie Systems, and pioneered the development of a revolutionary ATM switch for wireless applications.

The switch was pivotal in the modernization of telecommunications for today's digital market. In 1998, Lucent Technologies acquired Yurie Systems and Kim assumed senior leadership positions as president of carrier networks and as president of the optical networking group.

Kim has received numerous awards and honors including election to the National Academy of Engineering in 2004, Ernst & Young's Emerging Entrepreneur of the Year Award and the University of Maryland Engineering Alumnus Award for his contributions to the field of engineering and service to the university. Kim and his family have been honored by the Clark School for their generosity in funding the Kim Engineering Building, set to open in early 2005. ■

ENGINEERING THE FUTURE

Forward Thinking

PHOTO BY LUISA DIPIETRO

Marilyn Berman Pollans loves the University of Maryland with a passion. While her road to the Clark School did not exactly follow a straight and narrow path, her arrival on campus marked the beginning of a wonderful relationship.

Marilyn's entry into higher education began at Brooklyn College in New York at the tender age of 15. In 1956, she earned a bachelor's of arts degree in elementary education, *cum laude*, becoming the first member of her family to graduate from college.

For many years, her career as a wife and mother sidelined any professional aspirations. "In the 1950s, women were defined by who they married and they did not aspire to much else," recalls Marilyn, who married Stanford Berman, B.S. '50, when she was 20 years old. Three children later and well into her 30s, she began to re-evaluate how she would define the rest of her life.

Enter University of Maryland, where Marilyn began pursuing a master's degree in counseling. "When I came to Maryland, I was turned on to the academic environment. It was at the height of the feminist movement and I was bitten by the women's and civil rights movement bugs," she shares. Before long, she and a colleague began offering "How to Succeed" courses for older returning women students.

As she began pursuing her doctorate in higher education, Marilyn started working as a counselor in the dean's office of the engineering school. "At the time, the school was not a particularly supportive place for women students or faculty. Even my husband questioned my decision to work here," says Marilyn, who developed and taught a special summer course for female high school students to introduce them to the engineering profession.

Receiving her Ph.D. at the age of 43 is one of her greatest accomplishments and soon after she became assistant dean, managing the undergraduate advising office.

She is especially proud of her ability to work in an all-male environment and to bring a different perspective to the table. "I recall sitting in meetings and asking questions that my male counterparts would never have considered. Men solve problems very differently," she explains. Along the way Marilyn blazed new trails with three key programs that were far ahead of their time—Women in Engineering, the Center for Minorities in Science and Engineering and international programs.

Marilyn retired from the university at age 60 to care for her ailing husband, who died in 2000. In honor of her 60th birthday and retirement, Stanford Berman established The Marilyn R. Berman Fund for Female Undergraduate Teaching Fellows and Scholarships through a bequest.

That's just one example of the family's generosity to the university. Stanford Berman established the Clark School's Innovation Hall of Fame and provided funding support for its activities. The Stanford Berman Scholarship Fund, established by Marilyn in honor of his 65th birthday, provides an annual scholarship in voice or piano in the university's music school.

Together, current husband Albert and Marilyn established an Endowment for Special Projects for the School of Music. Albert Pollans also wants to ensure that the Women in Engineering programs are funded for the future and has joined his wife in support of the Clark School.

Marilyn remains ever thankful to Maryland. "The university gave me so much, a chance to thrive and to grow. It paid for my education and gave me a career. I could not be more grateful." ■

To learn more or for confidential inquiries about other planned giving arrangements, please call or write:

Nelson Marban, Acting Assistant Dean, Clark School of Engineering, University of Maryland, College Park, Maryland 20742 ■ 301.405.8289 ■ ngmarban@umd.edu

PHOTO BY JOHN T. CONSOLI

Kim Engineering Building Nears Completion

The excitement is mounting as the completion date for the Jeong H. Kim Engineering Building grows ever closer. The building is 85 percent complete, according to Clark Construction, with final touches to the plaza and landscaping yet to come. The Clark School, university community and friends of the school will celebrate the building's official opening and tour the school's newest state-of-the-art facility on May 2, 2005. Labs and classrooms will be fully operational by February.

While generous individuals, corporations, the state of Maryland and the university have contributed significant resources to the construction and purchase of equipment for the Kim Building, additional private support is needed. For more information on how you can assist the Clark School in these efforts, visit our Web site at www.eng.ume.edu/giving or contact Nelson Marban, acting assistant dean, at 301.405.8289.

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