Summer 2013

# METRICS

MECHANICAL ENGINEERING

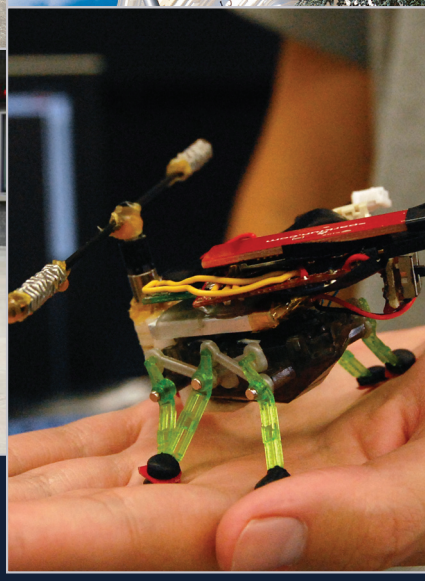
A. JAMES CLARK SCHOOL *of* ENGINEERING

A NEWSLETTER FOR ALUMNI AND FRIENDS OF THE DEPARTMENT OF MECHANICAL ENGINEERING AT THE A. JAMES CLARK SCHOOL OF ENGINEERING, UNIVERSITY OF MARYLAND.

2012-2013

# Annual Report





IN THIS ISSUE:



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# chair's MESSAGE

BALAKUMAR BALACHANDRAN

## Dear Friends:

Our department has a long tradition of successfully preparing many of the region's, the nation's and the world's mechanical engineers, dating back to 1898 when the university awarded its first bachelor's degree in mechanical engineering. More than half-a-century later, the first master's degree was awarded in the 1950s, and the first doctoral degree in mechanical engineering was awarded in 1964.

## Department Gains and Visibility

Today, the Department is 958 undergraduates strong and boasts a graduate student enrollment of 315 students, of which two-thirds are doctoral students. Every year, on average, some 200 bachelor's degrees and 30 doctoral degrees are awarded by the department. Forty-six tenured and tenure-track faculty members provide students with a high-quality academic experience. Together, students and faculty collaborate with government and industry partners on a variety of leading-edge research projects that are making a difference in the world.

For instance, many of the world's leading automobile manufacturers have turned to our Center for Advanced Life Cycle Engineering (CALCE) to improve systems reliability. And our Center for Environmental Energy Engineering (CEEE) is developing low-cost, energy-efficient heating and cooling systems for homes and businesses. The Center for Risk and Reliability (CRR) has been at the forefront of research in risk analysis and reliability science and engineering, and in 2014, CRR and CALCE will help the department celebrate 25 years of reliability engineering at the university.

Within the last two years, we have made great strides in a number of areas. The department has received base budget support to foster its Southern Maryland Program in partnership with the Naval Air Warfare Center Aircraft Division (NAWCAD) at Patuxent River. We now can expand opportunities for more students to study mechanical engineering in Southern Maryland and prepare them to meet the workforce needs in the area.

## Faculty and Staff Notables

We are pleased to announce that Professors Amr Baz, Mohammad Modarres, Reinhard Radermacher and I have been named *Minta Martin Professors,* in recognition of significant scholarly contributions to our respective areas of research. Other faculty honors: C.D. "Dan" Mote Jr., past president and *Regents Professor* and *Glenn L. Martin Institute Professor* of the University of Maryland has been nominated to be president of the National Academy of Engineering (NAE), and Ali Mosleh, *Nicole Jurie Kim Professor,* has been elected into the NAE. Professor Kenneth Kiger received the 2012 *Regents Faculty Award for Teaching,* and Professor Donald DeVoe received the 2013 *Regents Faculty Award for Research.* Recently, Professor Shapour Azarm has been named the editor- in-chief of the *ASME Journal of Mechanical Design,* and *George E. Dieter Professor* Michael Pecht has been named the editor-in-chief of the new *IEEE Open Access Journal.* In addition, our departmental staff has been strengthened through the hiring of Cornelia Kennedy as the director of external relations and Lisa Schuetz as the director of operations.

The department has never been in a better position to provide students with an exceptional engineering education and to make significant contributions to the field. We welcome our alumni and friends to reconnect with us and join our efforts to educate the next generation of multidisciplinary engineers. Contact Cornelia Kennedy at ckennedy@umd.edu to learn more about the countless number of ways through which you can give back and help us make a difference in the world.

We look forward to hearing from you.

B. Balachandran

Balakumar Balachandran
Minta Martin Professor and Chair



ON THE COVER:
Clockwise: The 2012 Formula SAE team poses with its revamped vehicle, Administration Building, Carlos Casarez holds a robot he designed, Manolo Zuñiga, President and CEO of BPZ Energy.

# Mechanical Engineering Drives Innovation Across the Scientific Spectrum

## Researchers Lead Pioneering Discoveries in Robotics, Smart Systems, Alternate Energy and Healthcare

*The discipline of mechanical engineering continues to evolve, and today researchers in the Clark School's Department of Mechanical Engineering are pioneering the latest advancements in such fields as robotics, smart systems, alternate energy and healthcare. To drive innovation in these areas, mechanical engineering faculty members increasingly are forging partnerships across disciplines, centers and even universities.*

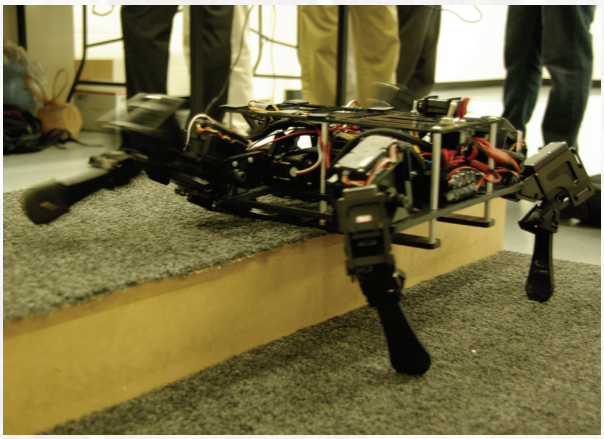
### Robotics to the Rescue

"Robots are mechanical structures with actuators and sensors that can work in automated or tele-operation mode," describes Professor of Mechanical Engineering Satyandra K. Gupta, founding director of the Maryland Robotics Center. "As tasks grow in complexity, robots to perform those tasks are increasingly more sophisticated in nature, which means greater opportunities for building connections and collaborations across the Clark School."

Gupta is currently on an inter-governmental personnel act (IPA) assignment, serving as program director in the Robust Intelligence Cluster of the Division of Information and Intelligent Systems at the National Science Foundation. With Physics Professor Wolfgang Losert, director of the Partnership for Cancer Technology, and Amitabh Varshnay, director of the University of Maryland Institute for Advanced Computer Studies, Gupta received funding to build an autonomous, image-guided optical tweezers robot that views and manipulates cells with greater speed and accuracy than human operators. The robot uses highly focused cones of laser light to trap and move micro-scale particles in a fluid medium. The silica micro-spheres act as rapidly reconfigurable grippers that, under laser control, gently enclose and move biological cells, permitting precise positioning of target cells and exclusion of unwanted material. With minimal training, operators of the tweezers robot will gain a powerful new tool to study cellular function and properties.

Last summer, Gupta, his graduate student Tom Brewer, and his postdoctoral researcher Krishna Kaipa, took second place among 100 papers for their work on a quadrupled robot with on-board sensing and parameterized gait for stair climbing at the 15th International Conference on Climbing and Walking Robots and the Support Technologies for Mobile Machines (CLAWAR 2012).

Other faculty members are making their mark in the robotics field. In research sponsored by the Defense Advanced Research Program Agency, Sarah Bergbreiter, assistant professor of mechanical engineering and Institute for Systems Research (ISR), is developing mechanisms to enable millimeter-sized sensing robots to jump to new locations when placed in natural or man-made environments. Jumping can be an efficient way for robots to move around obstacles and even latch onto and jump off moving animals, vehicles or other robots. Bergbreiter has demonstrated a new micro-fabrication process that incorporates soft elastomers with traditional silicon. This new fabrication process can be used to create flexible joints for small running robots and new actuation technologies at small scales. In addition, Bergbreiter's robotics project was selected for funding by NASA to support the agency's future missions in space as well as the country's Robotics Initiative.



SATYANDRA K. GUPTA'S STAIR-CLIMBING ROBOT AT THE 2012 MARYLAND ROBOTICS DAY.

In research funded by the National Science Foundation (NSF), Nikhil Chopra, associate professor of mechanical engineering and ISR, is laying the groundwork for network-robot interactions by enhancing robotic capabilities to coordinate complex tasks. To rescue victims in damaged areas, robots in many cases need to work together, using grippers, to manipulate and lift fallen concrete, girders or other heavy objects. He also is designing time synchronization algorithms for wireless sensors to effectively exploit additional sensing provided by the wireless sensor network.

### Benefits of Smart Sensors

They tell us if a refrigerator is too cold, if a bridge can safely handle traffic or if a manufacturing line is correctly assembling products. With embedded microprocessors and wireless communication links, smart sensors can record data, control systems operations and communicate over a network – with the capacity to make even more dramatic contributions to the information revolution.

Mechanical Engineering Associate Professor Miao Yu has been involved in developing sensors for a range of engineering applications, including optical sensors and micro- and nanoscale smart sensor systems. In a recent recognition of her work, Yu was among 100 engineers under the age of 45 invited to attend the National Academy of Engineering's 2012 U.S. Frontiers of Engineering Symposium in Michigan.

*(continued on page 4)*

## Mechanical Engineering Drives Innovation *(continued from page 3)*

Her team recently completed a project through a large-scale collaboration between the University of Maryland and the U.S. Army Research Laboratory (ARL). Yu and a group of four graduate students developed an innovative microphone array system through the partnership, which also involved the university's School of Public Policy's Center for Public Policy and Private Enterprise; the Maryland Technology Enterprise Institute Program; and Brian Darmody, special assistant vice chancellor for technology and development.

According to the team, their objective was to "develop an ultra-miniaturized fiber optic microphone array system, including a miniature microphone array and a smart sensor interrogation subsystem." The system delivers performance comparable to high-end microphone systems, but with fewer materials and fabrication costs. The ARL highlights the system's uses in a wide range of fields, noting that "the microphone system can be used commercially in electronic, medical, law enforcement, security and medical devices, such as cell phones, computers, hearing aids, magnetic resonance images (MRIs) and acoustic area monitoring systems." The array system also has benefits for the military, allowing soldiers to "lighten their load with smaller and lighter battlefield communication devices." A business plan for the project is on the drawing board and several companies have indicated interest in the project.

Yu was a finalist in the physical science category for the 2011 University of Maryland Invention of the Year Award, presented annually by the University of Maryland Office of Technology Commercialization (OTC) to honor outstanding inventions and inventors. The "Fly Ear-Inspired Miniature Acoustic Sensor System" by Yu and Haijun Liu, a postdoctoral researcher at the University of Maryland, mimics the fly's highly accurate directional hearing. The sensor can be tailored to work at any chosen frequency to achieve maximum directional sensitivity with performance comparable to a conventional directional microphone 20 times larger in size.



### Achieving Energy Sustainability

As the cost of fuel continues to rise and the nation's power grids become ever more vulnerable, as evidenced by the aftermath of Hurricane Sandy, mechanical engineers are well positioned to make significant contributions to the creation of a new energy infrastructure, with alternate energy systems at the core.

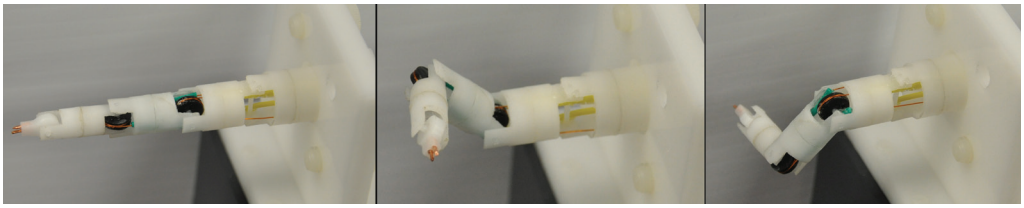
FORMER CEEE STUDENT CHRIS HORVARTH, M.S. 2013, INSTALLING DUCTWORK FOR AN EXPERIMENTAL HVAC SYSTEM IN THE CEEE ENERGY LAB.

On campus, researchers are working to extract as much usable energy as possible from conventional electric power generators. An experimental combined heating and power system on campus in the Chesapeake Building provides an ideal testing site to perfect techniques to improve energy efficiencies. Waste heat from a natural gas-fired turbine within the building can be used to heat or cool the same structure or to make electricity, according to Minta Martin Professor Reinhard Radermacher, director of the Center for Environmental Energy (CEEE), who is an internationally recognized expert in energy conversion systems, particularly integrated cooling, heating and power (CHP) systems, heat pumps, air conditioners and refrigeration systems.

Radermacher's award-winning research focuses on enabling energy sustainability by maximizing energy savings and the use of renewable resources. His team's research has led to energy savings of 50 percent or more for air-conditioning and refrigeration applications, and significant savings for cooling, heating and power systems ranging from building to carbon sequestration applications.

A member of the Clark School's Innovation Hall of Fame, Radermacher and Omar Abdelaziz, Ph.D. '09 and researcher at Oak Ridge National Laboratory were finalists in the physical sciences category of the university's 2012 Office of Technology Commercialization Invention of the Year Awards with their project, *High-Density Thermal Storage Based HVAC System*—a hybrid thermal storage system that integrates a proprietary hot/cold storage system and vapor compressor heat pump system. This innovative technology provides optimal hybrid electric/thermal storage capability, resulting in a revolutionary, cost-effective, high-density, thermal storage-based HVAC system.

Their collaboration continues with a $1.5 million award as part of the Department of Energy's efforts to help homeowners and businesses save money by saving energy. CEEE will be carrying out the research on miniaturized air-to-refrigerant heat exchangers for the project with the Oak Ridge National Laboratory in Knoxville, Tenn. The team, including Professor Yunho Hwang, director of CEEE's Alternative Cooling Technologies and Application Consortium and Assistant Research Scientist Vikrant Aute, director of CEEE's Integrated Systems Optimization Consortium (ISOC), will design and build prototypes of the exchangers based on previously developed parallel parameterized computational fluid dynamics (PPCFD) and approximation assisted optimization (AAO) technologies. "The new heat exchangers are expected to reach up to 10 killowatts capacity with at least 20 percent less volume and less material compared to traditional designs, which makes air conditioning and refrigeration systems for home use much more energy efficient and affordable," says Aute. Radermacher notes, "It is rewarding to see fundamental research previously supported by the Office of Naval Research move closer to commercialization. These prototypes, developed jointly with Professor Azarm, are proving to be powerful and effective design tools for the expedient exploration of new heat exchangers and other fluid flow geometries."



CABLE-DRIVEN MINIMALLY INVASIVE NEUROSURGICAL INTRACRANIAL ROBOT (MINIR).

Funded by industry and led by Aute, the ISOC focuses on the development of advanced simulation and optimization tools and algorithms for air conditioning and refrigeration applications. "Striking the right balance between engineering time and computer time, these tools allow engineers to rapidly explore new heat exchanger designs with minimal engineering time and to focus on design creativity and innovation for which computers are not suitable." Aute anticipates the tools will enable engineers to design the next generation of thermal systems and components optimized for cost, performance, emissions and environmental impact.

Radermacher and Yunho Hwang received funding for their research on solar cooling and photovoltaic cells in dense array as part of a collaboration between the ISR and Italy's Autonomous Province of Trento. The partnership provides financial backing for research in the fields of bioengineering, biomedical devices, biomicrosystems, renewable energy and storage, nonmaterials and microsystems. In recognition of his distinguished international career, Radermacher has received the university's Distinguished International Service Award. He has garnered sponsorships from companies throughout Asia, Europe and South America, resulting in $24 million in research support, 11 patents, and more than 300 peer-reviewed and conference publications. He is a guest professor at Shanghai Jiao Tong University and has conducted joint research projects with the Petroleum Institute in Abu Dhabi and United Arab Emirates, which has a long-term cooperative agreement with the university. Additionally, Radermacher led an international exchange program for the Clark School for more than two decades, which has made the Department of Mechanical Engineering one of the leading sponsors of interns on campus.

*CEEE faculty provide research sponsors with world-class innovations and top-notch continuing education opportunities. To learn more about faculty CEEE webinars developed for research sponsors, visit www.ceee.umd.edu/events. For a list of journal articles about the center's current and previous work, visit www.ceee.umd.edu/publications.*

## Addressing Critical Healthcare Needs

With engineering tools and expertise in hand, mechanical engineers are becoming critical players in solving some of today's most pressing healthcare issues. "Mechanical engineers have a huge role to play because they can design the devices to meet the needs that have been identified by healthcare professionals," says Maryland Robotics Center-affiliated Professor of Mechanical Engineering Jaydev Desai, who directs the Robotics, Automation, and Medical Systems (RAMS) Laboratory within the department.

Desai is currently working with Yu Chen, assistant professor of bioengineering, on optical coherence tomography (OCT), a device that can be used potentially for diagnosis in their research. In addition, Desai and his colleagues from the University of Maryland, Baltimore have won a $2 million grant from the National Institutes of Health (NIH) to continue developing a small robot that could one day aid neurosurgeons in removing difficult-to-reach brain tumors, one of the most feared complications of cancer. A Minimally Invasive Neurosurgical Intracranial Robot (MINIR) prototype has been developed, and its feasibility already has been demonstrated in part through research funded by a previous NIH grant.

A fully MRI-compatible MINIR could one day enable neurosurgeons to reach difficult tumors and greatly improve outcomes for patients. Furthermore, image-guided robotic surgery avoids the complications associated with brain shifts associated with conventional tumor resections, as the target tumor may move during surgery but will always remain within sight through the exquisite contrast available from real-time MRI. The latest grant will enable the teams to develop MINIR-II, a fully MRI-compatible robot and demonstrate its safety and effectiveness.

Desai and David J. Foran, M.D., director of the Center for Biomedical Imaging and Informatics at The Cancer Institute of New Jersey (CINJ), are leading a cross-disciplinary team of researchers in a five-year, $1.6 million project to develop new approaches and technologies that will add to the body of knowledge on the underlying mechanisms associated with disease onset and progression in breast cancer. The research team will focus on the design, development and evaluation of computational and imaging tools to improve detection and tracking of the mechanical and morphological changes that occur during the progression of breast cancer. Desai's research will examine the variations in the mechanical characteristics of the tissue samples through computational approaches based on experimentally observed atomic force microscopy (AFM) data.

They also will investigate the use of an array of micro-force sensors developed using micro-electro-mechanical systems (MEMS) technology to increase the sampling throughput for various regions of interest. The researchers will develop and evaluate a reliable means for performing automated characterization of specimens providing physicians and investigators with a new evaluation tool that will be tested at multiple consortium sites.

The NIH also has funded Desai's work on a tele-operated robotic haptic feedback system for biopsy (Bx) and radiofrequency ablation (RFA) of breast tumors. The system potentially will enable a patient to undergo a biopsy and treatment during the same medical appointment. Currently, there is no such tele-operated robotic system with haptic feedback capability available for breast biopsy and radiofrequency ablation of breast tumor under continuous MRI.

## Honors and Awards

Distinguished University Professor **Avram Bar-Cohen**, former chair of the Department of Mechanical Engineering, has been elected to the Institute of Electrical and Electronics Engineers Components, Packaging and Manufacturing Technology Society's Board of Governors.

Assistant Professor **Sarah Bergbreiter's** robotics project was selected for funding by NASA to support the agency's future missions in space. Bergbreiter's project, "Active Skins for Simplified Tactile Feedback in Robotics," was among eight projects selected nationwide.

Professor Emeritus **James Dally** received the **Daniel C. Drucker Medal** for his contributions to mechanical engineering through his research, teaching and publishing company College House Enterprises, LLC, which exclusively publishes engineering textbooks.

For the previous two years a Department of Mechanical Engineering professor has been invited to the National Academy of Engineering's U.S. Frontiers of Engineering Symposium. **Jaydev Desai**, professor and director of the Robotics, Automation and Medical Systems Laboratory, attended the symposium in 2011 and Associate Professor **Miao Yu** attended in 2012. The conference brings outstanding young engineers from U.S. companies, universities and government labs to discuss cutting-edge research across a variety of engineering fields.

Professor **Kenneth Kiger** received the **2012 Regents Faculty Award for Teaching** from the University System of Maryland (USM) Board of Regents. The award was established in 1995 and is one of the highest honors presented to USM faculty by the Board of Regents.

**Ali Mosleh**, Nicole J. Kim Professor of Mechanical Engineering and director of the University of Maryland's Center for Risk and Reliability, was the closing plenary lecturer at the Eleventh International Conference on Probabilistic Safety and Management in Helsinki, Finland in June 2012. His speech, "Delivering on the Promise: PRA, Real Decisions and Real Events," examined the effectiveness and performance of probabilistic risk assessments.

University System of Maryland Regents Professor, Glenn L. Martin Institute Professor of Engineering **C.D. (Dan) Mote, Jr.** received the **2011 ASME Medal**, the highest honor bestowed by the American Society of Mechanical Engineers. Mote, former University of Maryland president, received the award for creating a theory of the dynamics of flexible moving structures as well as his leadership roles at the University of Maryland and the University of California, Berkeley. He is the new president of the National Academy of Engineering (NAE).

Assistant Professor **Santiago Solares** won the U.S. Department of Energy's Early Career Award for his research project "Trimodal Tapping Mode Atomic Force Microscopy: Simultaneous 4D Mapping of Conservative and Dissipative Probe-Sample Interactions of Energy-Relevant Materials." He is the first faculty member in the department to receive the award, which is in its third year.

## Promotions/Tenure

Professor **Don DeVoe** was promoted to senior editor of the *Journal of Microelectromechanical Systems*, a bimonthly journal sponsored by IEEE and ASME. In this position, DeVoe will occasionally pre-screen and determine which papers appear in the journal.

**Kenneth Kiger** was promoted to full professor in 2012 and director of undergraduate studies. He has taught in the department since 1995, one week after receiving his Ph.D. from the University of California, San Diego.

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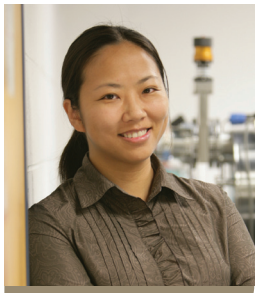
AVRAM BAR-COHEN

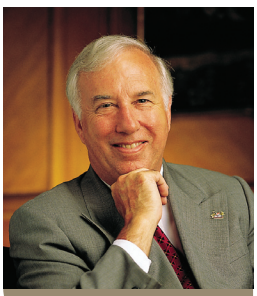

SARAH BERGBREITER


JAYDEV DESAI


MIAO YU


KENNETH KIGER


ALI MOSLEH


C.D. (DAN) MOTE


SANTIAGO SOLARES


DON DeVOE


TENG LI

## Promotions/Tenure *(continued)*


ELISABETH SMELA

**Nikhil Chopra** was promoted to associate professor in April 2013. He has taught in the department since 2007.

**Javdev Desai** was promoted to professor in July 2013. He has taught in the department since October 2006.

Associate Professors **Teng Li** and **Santiago Solares** received tenure in August 2012. Both Li and Solares have worked for the department for six years. They collaborated with a research team in a study on "Electromechanical Properties of Graphene Drumheads" that appeared in the June 2012 issue of *Science* magazine.

**Elisabeth Smela** is the first female faculty member in the department to become a full professor. She was promoted in July 2011. Her primary research focuses on artificial muscles, polymer microelectromechanical systems (MEMS) and bioMEMS.


JIM WALLACE

**Miao Yu** has been promoted to associate professor with tenure in August 2011. Yu's research focuses on micro-scale and nano-scale sensors, optical systems, biology-inspired systems, and sensor mechanics and material behavior at multiple spatial scales.

## Retirements

**Peggy Brumfield**, executive director of administrative affairs, retired on September 30, 2012. She worked for the Clark School for 25 years and in the department for 11 years. Brumfield will miss the camaraderie among her colleagues and the entire university community. Brumfield plans to travel, starting with trips to Australia and New Zealand.

Professor and former Gemstone Program Director **Jim Wallace** has retired after 37 years with the Clark School. He served as Gemstone Program Director for 11 years and will continue to support the department as a professor emeritus directing the Burgers Program, which brings together fluid dynamics faculty members through symposia and faculty exchanges.

# New Faculty Join Department

## Pertmer Teaches Senior Capstone Design Course


GARY PERTMER

Associate Professor **Gary A. Pertmer** has transferred to the Department of Mechanical Engineering faculty. Pertmer taught ENME 472, the department's capstone design course, for the first time in fall 2012. In the course, students work in teams to design a product and present their prototypes at Design Day at the end of the semester. As a former Design Day judge, Pertmer appreciates the wide variety of projects that students design to reflect their specific interests, from a water bottle with a straw sipper that does not freeze in cold weather to a shirt that helps improve posture. Pertmer joined what is now the Department of Materials Science and Engineering in 1978. From 2000 to 2010, he was the associate dean of undergraduate student affairs in the Clark School. Pertmer has been part of the Keystone Program since 2008 and continues to teach Mechanics I as a Keystone professor.


MONIFA VAUGHN-COOKE

## Vaughn-Cooke Adds Human Factors to Capstone Design Course

Assistant Professor **Monifa Vaughn-Cooke** has co-teaght ENME 472 Integrated Product and Process Development, the department's capstone design course with Associate Professor Gary A. Pertmer. She joined the department shortly after earning her Ph.D. in industrial engineering from The Pennsylvania State University.

*(continued on page 9)*

## About the Keystone Program

The Keystone Program was established in 2006 to change the way the A. James Clark School of Engineering approaches introductory engineering courses. Faculty members in departments throughout the school are selected based on their passion and commitment for teaching, specifically those courses that all students are required to complete: ENES 100 Introduction to Engineering Design, ENES 102 and 220 (Mechanics I and II) and ENES 221 Dynamics. The Keystone Professors receive three-year renewable contracts that provide them with greater flexibility and help ensure both faculty and student success.

"I am constantly impressed by the qualities and abilities of incoming students," says Keystone Professor Gary Pertmer, who values the opportunity to serve as a Keystone professor. "It is fun to watch students get excited about the field and to understand how they can begin applying engineering principles to their lives."

Since the program's inception, retention rates of first-, second- and third-year students have increased by 9, 12 and 8 percent, respectively. Four-year and five-year graduation rates also have improved, increasing by 6 and 15 percent, respectively.

# Four ME Faculty Named Minta Martin Professors

*Last fall, four mechanical engineering faculty members were named Minta Martin Professors, full professors who have made significant scholarly contributions in their area of research. We asked the department's new Minta Martin Professors how they felt about receiving this honor.*

BALAKUMAR BALACHANDRAN

## Balakumar Balachandran, Ph.D., *Department Chair*

Describe some of your accomplishments that you feel characterize a Minta Martin professor.
"My accomplishments include a wide range of fundamental and applied contributions in the broad arena of applied mechanics. These contributions have been in the form of discovery of nonlinear phenomena, design and engineering of response schemes and inventions."

What does being a Minta Martin professor mean to you?
"Being a Minta Martin Professor means being recognized for my scholarly accomplishments and also having opportunities to pursue novel research avenues."

Minta Martin encouraged her son Glenn L. Martin to pursue his interests in aviation that led to his success. As a Minta Martin professor, how do you encourage your students to turn their ideas into reality?
"I encourage my students by providing them opportunities to innovate and discover in the research labs that I direct."

AMR BAZ

## Amr Baz, Ph.D., *Director of Smart Materials and Structures Research Center*

Describe some of your accomplishments that you feel characterize a Minta Martin professor.
"I am devoted to establishing innovative research in vibration and noise control using smart materials. An integral part of my research philosophy is to involve undergraduate and high school students with my graduate students in order to nurture them and prepare them for graduate school."

"I actively seek out collaborations within the department, across the different departments, with different U.S. and international universities and with government laboratories. This collaboration brings strength and high quality to the multidisciplinary research activities that I am trying always to push forward."

What does being a Minta Martin professor mean to you?
"Dedication to high quality teaching does not hinder my research activities. On the contrary, I think teaching has helped me conduct better research and my research accomplishments were continuous feedback to improve my teaching."

Minta Martin encouraged her son Glenn L. Martin to pursue his interests in aviation that led to his success. As a Minta Martin professor, how do you encourage your students to turn their ideas into reality?
"In all my classes and with all my graduate students, I emphasize dedication, hard work, believing in one's abilities, having an inside fire to excel and distinguish oneself from others, fighting for one's ideas and never be in a comfort zone that leads to stagnation. In all my classes, I reinforce the words and experiences of the greatest scientists who made an impact to reinforce the belief that nothing is impossible and nothing is more satisfying than seeing an idea put to work, especially when others have discouraged us from pursuing it."

MOHAMMAD MODARRES

## Mohammad Modarres, Ph.D., *Director of Nuclear Engineering Program*

Describe some of your accomplishments that you feel characterize a Minta Martin professor.
"My accomplishments in research include my international recognition as a leading expert in probabilistic risk assessment, my recent work in safety analysis of the newly developed small modular reactors (SMRs) and my contributions to probabilistic physics of failure and probabilistic fracture mechanic-based reliability assessment."

"I proposed the reliability engineering curriculum in the mechanical engineering department in the mid-1980's and developed and offered its curriculum as a subspecialty within the Nuclear Engineering Program. A few years later, along with the Professor Emeritus Marvin Roush, we pursued and established a stand-alone graduate program in Reliability Engineering. Today, this program is a worldwide leader in this discipline, and its 300 or so alumni are making tremendous impacts in this field."

What does being a Minta Martin professor mean to you?
"My last name in Persian (my mother tongue) and Arabic means "educator." From childhood I loved to teach and conduct research. So I selected this profession because of this passion, not necessarily to follow the principal profession of my ancestors nor to be honored. The honor of becoming a Minta Martin Professor, however, holds me to far higher standards in both research and education at all times."

Minta Martin encouraged her son Glenn L. Martin to pursue his interests in aviation that led to his success. As a Minta Martin professor, how do you encourage your students to turn their ideas into reality?
"I encourage my students to form teams and integrate their skills and knowledge. I emphasize the value that I place on creative ideas and continually encourage them to execute their ideas and their passions into practical, real-world plans."

*(continued on page 9)*

## Minta Martin Professors *(continued from page 8)*


REINHARD RADERMACHER

### Reinhard Radermacher, Ph.D., *Director, Center for Environmental Energy Engineering*

Describe some of your accomplishments that you feel characterize a Minta Martin professor.

"Through consistent collaboration with many colleagues, the Center for Environmental Energy Engineering (CEEE) developed a strong industry-funded research program in energy efficiency and sustainable energy conversion. Students see almost immediately the impact of their work on how air-conditioning and heat pumping systems are designed, improved and employed. We are also developing software for the design of such systems, and we see this software succeed and being employed more and more by industry."

What does being a Minta Martin professor mean to you?

"This honor is confirmation that what we do in terms of research actually matters to society as a whole and that it is recognized as such."

Minta Martin encouraged her son Glenn L. Martin to pursue his interests in aviation that led to his success. As a Minta Martin professor, how do you encourage your students to turn their ideas into reality?

"We encourage students to focus on developing their own ideas. I teach a seminar in Problem Solving and Creativity for Engineers. We urge our students to follow their ideas, as part of their thesis research and explore the impact and feasibility of their ideas which more often than not leads to new insights or ways of doing things. This is very motivating and rewarding to see evolve!"

## New Faculty Join Department *(continued from page 8)*

Vaughn-Cooke's research focus is on applying human reliability tools to system and product design and she is bringing that perspective to the course. She is seeking to improve undergraduates' applied human factor design knowledge to allow them to integrate physical ergonomics and cognitive human factors considerations early in the capstone design process.

In spring 2013, Vaughn-Cooke taught ENRE 645 Human Reliability Analysis, a graduate course that examines different methods of solving practical human reliability problems. She also has proposed a new course to the mechanical engineering curriculum for fall 2013 called Risk and Reliability in Healthcare. Through the course, students will learn reliability and safety assessment methods and tools to sharpen their ability to make critical decisions in healthcare. A key component of the course would be an industry project in conjunction with a local healthcare facility, where students would work on a process or product design issue. Healthcare professionals would serve as project advisors and provide real-world experience to students to supplement course lectures.

## Hahn Focuses on Control Systems


JIN-OH HAHN

Assistant Professor **Jin-Oh Hahn** has joined the Department of Mechanical Engineering from the University of Alberta, where he worked as an assistant professor for two years. Two of the students he advised while at the University of Alberta, **Nima Fazeli** and **Ramin Bighamian**, have joined Hahn and are now studying at the Clark School.

Hahn co-taught ENME462 Vibrations, Controls and Optimization II, with Assistant Professor **Nikhil Chopra** in fall 2012. Hahn's research focuses on condition monitoring of dynamic systems based on control systems approaches and its applications to health monitoring, disease diagnostics and treatment in bio-systems and healthcare.

Fazeli, who enrolled in a graduate program in January 2012, was selected as a Best Student Paper Finalist and competed for a Best Student Paper Award at the 2012 ASME Dynamic Systems and Control Conference in Ft. Lauderdale, Fla.

## Larsson Brings Expertise in Fluid Mechanics


JOHAN LARSSON

Assistant Professor **Johan Larsson** joined the department from the Center for Turbulence Research at Stanford University, where he was a postdoctoral fellow and a research staff member. Larsson earned his Ph.D. from the University of Waterloo in Ontario, Canada, in 2006.

Prior to graduate studies, Larsson worked as an engineer at the Volvo Car Corporation in his native Sweden. His research interests include fluid mechanics, turbulence, combustion and computational science, with a special focus on developing physical and mathematical methods that can predict the behavior of complex but applied problems in fluid mechanics. He is currently developing predictive methods to analyze supersonic combustion ramjet (scramjet) engines, which are used for flight at between five and ten times the speed of sound. Larsson taught ENME392 Statistical Methods for Product and Process Development in spring 2013.

# Carlos Casarez: Making a Difference


CARLOS CASAREZ

Mechanical engineering student **Carlos Casarez**, B.S. '13, knew he wanted to be an engineer since junior year of high school. But when he saw firsthand the exciting mechanical engineering projects his brother, Christopher Casarez, B.S. '10, was involved with, including a hovercraft project in ENES100 Introduction to Engineering Design and a bridge project in ENES102 Mechanics I, Casarez was convinced engineering was for him.

Casarez pursued research projects with his faculty advisor, Mechanical Engineering Assistant Professor **Sarah Bergbreiter**. His first project with Bergbreiter, "Improving the Efficiency of Elastomer Spring Jumping Millirobots," was motivated by a microelectromechanical systems (MEMS) fabrication process developed by Bergbreiter and graduate student Aaron Gerratt that integrates soft elastomers with rigid silicon features on a single etched wafer. Casarez conducted this project as part of the **Louis Stokes Alliance for Minority Participation Undergraduate Research Program** and won first place for a poster presentation of this research at the **2012 Emerging Researchers National Conference in STEM** in Atlanta.

In spring 2012, Casarez was selected for the **Goldwater Scholarship**, a prestigious national award given to a select number of college students who intend to pursue careers in science, mathematics or engineering. Casarez was among 282 students nationwide to win the award, which "validates that my efforts in my courses and research are taking me towards a career in robotics research and development," says Casarez, who will start a combined masters and doctorate mechanical engineering program at the University of California, Berkeley this fall.

Casarez's latest project, "Using an Inertial Tail for Rapid Turns on a Miniature-Legged Robot," draws on his research interests in bio-inspired robotics, working with a fully integrated robotic system and implementing a robust control algorithm. The work, which analyzes the effectiveness of using the swing of a tail to steer a small walking robot, was accepted for publication in the proceedings of the **2013 IEEE International Conference on Robotics and Automation**. Casarez presented his research at the May conference.



# Zhao Zhang Combines Goals Inside and Outside the Classroom

In August 2007, **Zhao Zhang** left his native China for the United States to earn his Ph.D. in mechanical engineering at the Clark School. A large Chinese student population on the College Park campus, the university's proximity to Washington and an **A. James Clark Fellowship** all factored into his decision to attend the Clark School, but his research interests ultimately helped him make the final decision.

While applying to the Clark School, Zhang became intrigued with Associate Professor **Teng Li's** research in flexible macroelectronics and nanomechanics of thin films. The Clark School offered the perfect combination of strong research and opportunities outside the classroom, and Zhang soon began his studies in mechanical engineering.

Zhang worked with Li to study graphene, a new material that holds promise in revolutionizing thinking about the size, shape, and speed of electronic devices. However, issues with controlling the properties of graphene have prevented it from being widely used. Zhang's research focused on using extrinsic regulation to fine-tune graphene properties that would enable creation of reliable graphene electronics. That research culminated in a dissertation that was one of three honored in spring 2012 with the second annual **University of Maryland Distinguished Dissertation Award**, which recognizes an unusually significant contribution to a particular field. Zhang was selected by the university as the sole nominee for the **2012 Council of Graduate Schools/ProQuest Distinguished Dissertation Awards**, considered to be the nation's most prestigious honor for doctoral dissertations.


ZHAO ZHANG

Since graduating from the Clark School in December 2011, Zhang has returned to China and is working as a research analyst in an investment advisory firm focused on China's machinery sector. The knowledge and global perspective he acquired as a student at the Clark School helped Zhang improve critical-thinking and problem-solving skills that are essential to his current position. Zhang's advice to graduate students: Read research papers and talk to professionals outside your field to gain the different perspectives so vital to successful research.

# John Miller, M.S. '74, Retires as Director of the U.S. Army Research Lab

## Clark School Education Provided Solid Foundation to Lead $1 Billion Operation

**John Miller**, M.S. '74, mechanical engineering; B.S. '69, aerospace engineering, has retired as director of the U.S. Army Research Lab (ARL), the Army's central laboratory that conducts a variety of basic and applied research for developing innovative tools that provide the latest technologies to soldiers. Research conducted at the lab ranges from ballistic protection systems to safeguard soldiers from improvised explosive devices (IEDs) to building micro-sized systems that soldiers can use to determine potential threats in the area.

As a graduate student, Miller worked with Professor Emeritus **Jackson Yang.** With Yang's guidance, Miller studied structural dynamics and stress wave propagation in dissimilar media areas. Miller says his graduate work provided the foundation that guided his later work solving similar problems for the Army.

In the innovative laboratory environment at ARL, Miller enjoyed a career of lifelong learning with engineering colleagues, many who were recent graduates from the Clark School. "The Clark School should be proud. The school does an amazing job of nurturing the next generation of engineers," says Miller, who was motivated throughout his career by the opportunity to make a difference for U.S. soldiers defending our country.

JOHN MILLER, M.S. '74, RECEIVED A GIFT FROM DEPARTMENT CHAIR BALAKUMAR BALACHANDRAN IN HONOR OF HIS RETIREMENT FROM THE U.S. ARMY RESEARCH LAB.

Miller has served on the ME Visiting Committee for four years, providing him with a platform for increasing awareness among faculty members and students about the specific research challenges and future directions in Army laboratories. Since retiring from ARL, Miller has taken a part-time position as special assistant to the director of Army research and engineering command at Aberdeen Proving Ground north of Baltimore, Md.

ME faculty and the ARL have collaborated on a number of research projects as part of an initiative to explore new ideas in science. Associate Professor Miao Yu's research efforts along with four graduate students to develop an ultra-miniature fiber-optic microphone array system was part of an agreement between the university's School of Public Policy's Center for Public Policy and Private Enterprise and ARL(see related story, p. 4). Professors Michael Zachariah and Hugh Bruck also have completed research projects as part of a $10 million, five-year agreement between the Center for Energetic Concepts Development (CECD) and ARL.



# Alex Mehr Follows His Dreams


ENTREPRENEUR ALEX MEHR SHARES HIS SUCCESS STORY WITH CLARK SCHOOL STUDENTS.

**Alex Mehr,** M.S., '03, Ph.D. 03, knew he wanted to start his own business even as a graduate student at the Clark School. With his roommate, **Shayan Zadeh**, Mehr launched Synthesoft, a software company that was based on his Ph.D. thesis. Synthesoft looked promising – Mehr and Zadeh even won $2,750 in start-up funding in the university's Pitch Dingman competition. However, their student visas prevented them from pursuing the business in the United States at that time.

Following graduation, Mehr worked at NASA for two years then enrolled in the Haas School of Business at the University of California, Berkeley, where he laid the groundwork for Zoosk. When Zadeh obtained a visa to work in the United States, the team reunited and devoted themselves full time to creating their start-up. Initially, Zoosk.com was a market research company called Pollection, but their venture turned toward social dating after users of Pollection's Facebook application began to use the service as a dating platform. Based on that application's success, Mehr decided to change the company's name to Zoosk and launched its social dating service in December 2007. Since then, the company has grown to more than 100 employees with net sales of more than $95 million in 2012.

Mehr recommends that anyone interested in starting a company should invest at least six months in testing the idea to determine whether entrepreneurship is the best fit for them. "The learning experience is so quick, and you learn so much in such a short span of time," Mehr said. Whether or not the business is successful, one can take the skills learned through this process and apply them to a career as an entrepreneur or at another company, he added.

# Tim Sweeney: Turning a Hobby Into a Career

TIM SWEENEY, CREATOR OF EPIC GAMES, AT THE COMPANY'S HEADQUARTERS IN CARY, N.C.

At the age of 10, Epic Games Founder and Mechanical Engineering alumnus **Tim Sweeney** was well on his way to a career in computer games. His journey began with a visit to his older brother Steve, who worked at a technology company in California. Young Sweeney had the chance to program his brother's IBM personal computer, one of the first desktops sold in California. When Tim returned to his home in Potomac, Md., he began programming games on his own using his Apple II computer.

At the Clark School, Sweeney attended engineering classes during the day and at night began working on a game called ZZT that would change the course of his life. The game became such a success among his friends that he decided to start selling it as shareware. When he realized that he was earning more money selling ZZT than at any previous job, he decided to turn this hobby into a career and created a company called Potomac Computer Systems, which later became Epic Games.

Business took off and Sweeney had less time to devote to classes, finding himself a few credits short of completing his degree in mechanical engineering. He found math courses to be the most valuable for programming games like Unreal, while mechanical engineering coursework taught him that he most enjoyed building things via programming.

In nearly 20 years, Epic Games has grown from a one-man operation in Sweeney's parents' basement in Potomac, Md., to a 200-person company based in Cary, N.C., that has created popular games such as Epic Pinball and the Unreal and Gears of War series. Sweeney has shifted his role from programming to managing the direction of company as it continues to grow.

# Students Discover Career Possibilities

## Thinking Big While Exploring Options in Mechanical Engineering



Advances in technology have expanded the role of mechanical engineers. To help students navigate the growing number of career options and select a path best matched to their skills and interests, the department created ENME 201 Career Paths. Over the last five years, some 80 students have enrolled in the course each semester, which was previously taught by the department's former Director of Undergraduate Studies David Bigio.

In fall 2012, University System of Maryland Regents Professor and Glenn L. Martin Institute Professor of Engineering **C.D. (Dan) Mote, Jr.** co-taught the course with Mechanical Engineering Professor and Director of Undergraduate Studies **Kenneth Kiger**. "President Mote's wealth of experience as an engineer and educator provides a unique and valuable perspective for our students," says Kiger.

TOM CARCATERRA, B.S. '84, SHOWS CAREER PATHS STUDENTS HIS WORK DURING A CLASS PRESENTATION.

The course helps students choose an area of specialization in mechanical engineering that best matches their professional goals and interests: fluid and energy systems, mechanics and materials, electronic products and systems, or design and reliability of systems. By selecting an area of interest early in their undergraduate education, students can apply for internships, research projects and related electives that best suit their interests. The course also encourages students to think about their careers in the context of what an undergraduate degree in mechanical engineering can provide for them. Mechanical engineering practitioners in various industries and agencies serve as guest speakers, discussing the skills their companies seek in new engineers and how students can better prepare for jobs in the field and career paths at their companies. Kiger and Mote encouraged speakers to share life lessons and successes to prompt students to think beyond their traditional, and often limited, ideas of possible careers in mechanical engineering.

Students also are required to attend at least four engineering community events, including seminars, career and internship fairs and discussions hosted by engineering clubs. The department is always looking for guest speakers interested in sharing their experiences in mechanical engineering. Contact Cornelia Kennedy, director of external relations, at 301.405.1364 or ckennedy@umd.edu for more information.

*Near the close of the fall 2012 semester, representatives from more than 20 companies representing a variety of industries, including Bechtel Corporation, Siemens, and Stanley Black and Decker, attended a career fair sponsored by the department. The career fair was created to address the growing industry need for engineering professionals with a systemwide perspective. The next mechanical engineering career fair will be held Dec. 6, 2013. For more information about the fair contact Heidi Sauber at hsauber@umd.edu.*

# Terps Racing Program Gives Students a Competitive Edge

## Baja, Formula Teams Build Vehicles from the Ground Up

During his senior year in the Department of Mathematics in 2004, **Mike Cook** made a decision that changed the course of his life – he joined the Formula SAE (FSAE) program. He enjoyed the process of designing, testing and building a Formula vehicle to compete in nationwide events so much that he changed his major to mechanical engineering and spent an additional three years at the university.

"FSAE really opened my eyes to the things that I liked to do," Cook says. "When I graduated, I already knew exactly what kind of job I wanted."

That job was at the U.S. Army Aberdeen Test Center in Aberdeen, Md., testing military vehicles. But Cook has not strayed far from the program that sparked his career shift, as he continues to mentor students participating on the Formula SAE and Baja SAE teams as part of the Terps Racing program while earning a master's degree in mechanical engineering at the Clark School.

Baja SAE team members are primarily freshman and sophomore volunteers who design an off-road vehicle. Due to its complicated design, the Formula SAE team participants usually enroll in ENME408 Selected Topics in Engineering Design to gain expertise they can put to use on the Formula cars. On both teams, students must work together to design and create the vehicle themselves, learning the hands-on skills of machine fabrication and meeting deadlines to ensure the vehicle is ready for competition at the end of the academic year. Students must also work with sponsors to help purchase the required equipment to build the vehicles. Both Baja and Formula teams have winning records. In 2009, the Baja team placed first out of all U.S. teams at the SAE Carolina event and the Formula team placed fourth.

In 2012, the Formula SAE team unveiled a new generation car, but lack of time for testing prevented the new vehicle from operating at full capacity and resulted in a performance at the FSAC West Competition in Lincoln, Neb., that did not meet the team's expectations. This academic year the team devoted most of its time to testing and resolving outstanding issues. At the 2013 FSAC Michigan competition, the team tied for tenth place in design. The team was set to finish in the top 10 in the endurance competition before the vehicle experienced an engine piston durability failure in the next to last lap and was unable to finish the race.

Terps Racing faculty advisor **Greg Schultz** says that participating in the program gives students a chance to "cut their teeth" in engineering before graduation, and provides students with a competitive advantage that allows Terps Racing alumni to be more selective than their peers in potential employment opportunities.

If you or your company are interested in becoming a Terps Racing sponsor, contact Cornelia Kennedy, director of external relations, at 301.405.1364 or ckennedy@umd.edu.


TERPS RACING'S BAJA AND FORMULA SAE TEAMS COMPETE WITH TEAMS FROM ACROSS THE COUNTRY.

# ME Participates in Maryland Robotics Day

## Annual Event Jumpstarts Engineering Careers

Primary and secondary school students from throughout the state had the opportunity to view and discuss research projects designed by mechanical engineering graduate and undergraduate students at Maryland Robotics Day last fall.

Hosted by the **Maryland Robotics Center,** a research center within the Institute for Systems Research in the Clark School, the day highlighted the center's mission to advance robotics systems, underlying component technologies and applications of robotics through interdisciplinary research and educational programs based on a systems approach.

The **Simulation-Based System Design Lab**, whose Co-Director Satyandra K. Gupta is also founding director of the Maryland Robotics Center, develops, tests and implements simulation techniques for modeling, evaluating and optimizing systems to improve decision-making throughout the system development life cycle.

Research from the **Micro Robotics Lab**, led by Assistant Professor Sarah Bergbreiter, addresses networked centimeter- and millimeter-sized mobile robots that can solve issues from microrobotic locomotion to efficient actuators and novel fabrication techniques.

Graduate students in Associate Professor Miao Yu's **Sensors and Actuators Lab** presented the latest research projects from the lab, including fiber optic tweezers for particle manipulations and fly ear-inspired sensors for acoustic homing and localization.

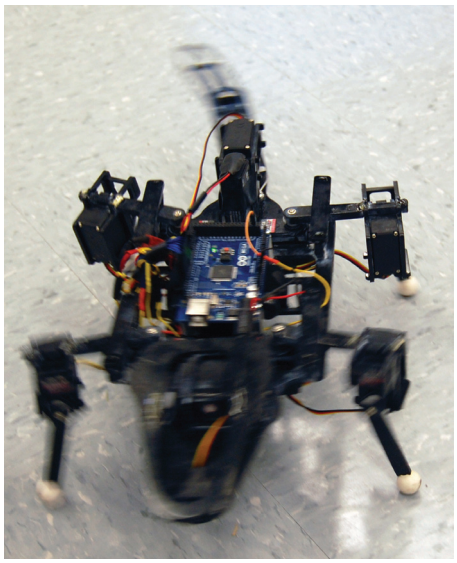
Associate Professor Nikhil Chopra leads the **Semi-Autonomous Systems Lab** in developing a comprehensive framework for semi-autonomous coordination of networked robotic systems. Robots designed in this lab not only coordinate with each other, but also with human operators who control the higher-level decision-making in the overall system.

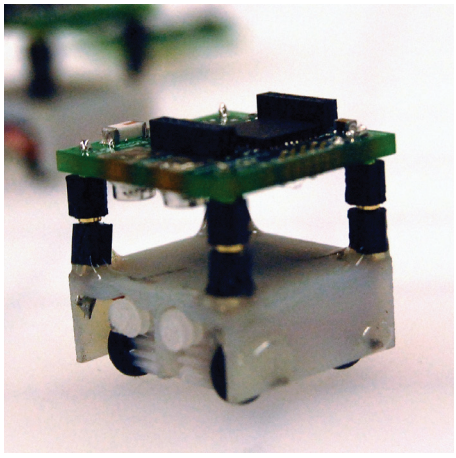
The **Laboratory for MicroTechnologies**, led by Professor Elisabeth Smela, focuses on new technologies at the micro scale that combine inorganic materials such as silicon chips and optical fibers with organic materials like polymers and cells.

The **Robotics, Automation and Medical Systems Lab,** led by Professor Jaydev Desai, focuses on research in medical robotics both at the micro-scale and the macro-scale.

The next Maryland Robotics Day will be held in late October and will be part of a week-long A. James Clark School of Engineering event.

ABOVE: FORMER GRADUATE STUDENT AARON GERRATT, PH.D. '13, SPEAKS TO PRIMARY AND SECONDARY SCHOOL STUDENTS AT MARYLAND ROBOTICS DAY.





TOP TO BOTTOM RIGHT: A DIVERSE SET OF ROBOTS WITH A VARIETY OF FUNCTIONS WERE ON DISPLAY DURING MARYLAND ROBOTICS DAY.

# Maximizing the Corporate Connection

## Lee Lushbaugh Strengthens Personal, Company Ties with the Department

LEE LUSHBAUGH

For nearly three decades, **Lee Lushbaugh**, B.S. '74, stayed connected with the University of Maryland primarily as a football and basketball fan until his daughter, Kara, entered the Clark School in 2002. "That's when I began thinking that it is time to give something back," says Lushbaugh, senior vice president and manager of Bechtel Power's Execution Unit in Frederick, Md.

One way of giving back was through his employer. "I am very proud of the way that we, as a company, have helped support the university," affirms Lushbaugh, who has spent his 38-year career at Bechtel Corporation. The University of Maryland, College Park is one of a small number of higher education institutions that Bechtel has designated as "Partnership Schools," each of which is sponsored by a senior vice president in the company. Lushbaugh helps recruit students for jobs and internships at Bechtel Power while supporting scholarships and financial aid for Clark School students.

The Clark School has been prime recruiting territory for Lushbaugh. In 2012, Bechtel Power hired 10 Maryland graduates, and employs nearly 20 students intern in the summer. Betchel Corporation employs over 300 Maryland graduates. "Our close proximity allows us to participate in many campus events, and the size of Bechtel and its global reach are big selling points for students," says Lushbaugh.

He looks forward to continuing his relationship with the department and the Clark School, serving on the visiting committee for the mechanical engineering department and on the school's board of visitors. He and his wife also have funded the **Lee and LouAnn Lushbaugh Mechanical Engineering Scholarship**, the first of which was awarded in fall 2012. "If we don't give back, the next generation will suffer," attests Lushbaugh. "The engineering profession is hurting without people willing to step up and assist today's students in continuing on their upward path."

### WE WANT TO HEAR FROM YOU, OUR ALUMNI!

METRICS is designed to keep our readers informed about the activities and accomplishments of the Department of Mechanical Engineering. We would like for you, our alumni, to keep us informed about your activities and accomplishments so that we may share them with our readers. Please send your alumni news to **ckennedy@umd.edu**, or visit our website: **www.enme.umd.edu.**

ABOVE AND BOTTOM LEFT:
MECHANICAL ENGINEERING'S SPRING 2013 GRADUATES.




METRICS is published for alumni and friends of the Department of Mechanical Engineering at the A. James Clark School of Engineering.

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Designer: P. Weickert
Faculty and Staff Photographs: J. Condi, R. Copeland, M. Eisele, T. Island, C. Kennedy, N. Macon, A. Santos

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# Celebrating 25 Years of Reliability Engineering

## Mechanical Engineering to Host Two-Day Celebration and Symposium


Celebrate the 25th anniversary of the Department of Mechanical Engineering's reliability engineering program at a symposium and reception on Tuesday, April 1 and Wednesday, April 2, 2014. The event will provide alumni with the opportunity to reconnect as they meet the industry's innovators and learn from developments in the field from distinguished guest speakers.

The reliability engineering program at the Clark School was the first of its kind to offer doctorate and full master's degrees. The program, which began with a handful of students, has grown to include nearly 120 full- and part-time students.

The symposium will kick off with four invitation-only workshops on the latest issues and challenges in reliability engineering and risk analysis led by world-renowned researchers and scientists. Topics include probabilistic physics of failure (PoF), uses of risk and performance information in regulation and oversight, and the challenges of creating a curriculum based on a non-traditional engineering discipline such as reliability engineering. The Department of Mechanical Engineering will host an alumni reunion and VIP networking reception the evening of April 1 for graduates, researchers and scientists who participated in the workshops.

The vast majority of reliability engineering alumni are leaders in their particular fields, says Professor Ali Mosleh, director of the school's Center for Risk and Reliability. "Alumni have shared with me that the knowledge and expertise they acquired and developed here gave them the foundation to tackle the majority of problems employers present them with," according to Mosleh.

The second day of the symposium will feature panel presentations of workshop outcomes and additional alumni and guest speakers. The department will also announce the results of special fundraising efforts for the program.

If you have any questions about the program or upcoming events, please contact Ali Mosleh at mosleh@umd.edu or Cornelia Kennedy at ckennedy@umd.edu.